The Evaluation of Student's Knowledge about Climate Change Phenomenon: Gender, Demographic Region, and Student's Attitudes toward The Environment

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Abstract

This study aims to describe students' knowledge about the phenomenon of climate change based on gender and demographic region and describe the effect of environmental attitudes on the level of students' knowledge of the phenomenon of climate change in Indonesia. This research is a quantitative survey type research using a questionnaire as the main instrument in the research. The instrument used was a questionnaire about student's knowledge of climate change phenomena and students' environmental attitudes. The population in this study was 1080 students taken from various junior high schools in Indonesia. Sampling used a random sampling technique to obtain a total of 302 samples. Because of previous studies were only conducted abroad and in Indonesia many were conducted at the university and high school levels, this research focuses on the junior high school level with the consideration that students have received material about global warming. The results showed that students' knowledge of the phenomenon of climate change in Indonesia was relatively high. It is known that the knowledge level of female students is higher than male students and students who live in villages are higher than students who live in cities. In addition, the level of students' knowledge about climate change is also significantly influenced by students' attitudes towards the environment. This research provides further empirical insight into how teachers should facilitate students' knowledge of the phenomenon of climate change according to gender, demographic region, and attitudes toward the environment.

Keywords: Climate change, knowledge, phenomenon.

How to cite this article:

Djauharoh, A., Shofiyah, N. (2023). The evaluation of student's knowledge about climate change phenomenon: gender, demographic region, and student's attitudes toward the environment. *IJIS Edu: Indonesian Journal of Integrated Science Education,* 6(1), 39-47. doi: https://dx.doi.org/10.29300/ijisedu.v6i1.13692

INTRODUCTION

Climate change is a difficult issue to understand (Salampessy, 2018). The issue of climate change is also one of the biggest problems facing the world today (Alfiandy & Firman Ilahi, 2023). There are several studies stating that climate change is the most critical super evil problem facing civilization (Akaygun & Adadan, 2021; Cross & Congreve, 2021; Kurup et al., 2021). Climate change itself is a change in several climate elements consisting of temperature, pressure, wind, humidity, rain, and so on against normal conditions (Aldrian et al., 2011). The definition of climate change based on Ratag et al. (2004) is the average state of the air (weather) at a certain period shown from records of various elements that affect it. According to Setiadi (2010) the issue of climate change is one of the issues that is currently a hot topic to discuss. Climate change has been, is, and will continue to occur in the future. Cardwell (2011) says that climate change is one of the most threatening global environmental issues of this century. Global temperatures over the last century have increased by at least 0.74°C and appear to be the result of very high levels of greenhouse gases in the Earth's atmosphere which in turn causes warming or heat gain in the world's climate (Urry, 2012). In Indonesia, BMKG (Badan Meteorologi Klimatologi dan Geofisika) says that the temperature will always increase by about 0.03°C per year (Setiawan et al., 2012). So it can be expected to increase to about 0.3°C in the next 10 years.

Several studies show that people's knowledge about global climate change is relatively low and it is difficult to understand the scientific context behind the term climate change itself(Afiff, 2022; Nurhayati et al., 2020). The community has not been very familiar with climate change, but on the other hand they are aware of the impacts caused by climate change (Nurhayati et al., 2020) . In connection with the community's concern about the issue of climate change, Pongiglione (2011) said the importance of providing contextualized procedural knowledge to the community to apply concerns and knowledge into action. Similarly, research conducted by Salehi et al. (2016) shows that only a portion of the community knows information about global climate change. Based on research conducted by Nadhor Tsaqib et al. (2020) on University of Indonesia students, students from science and technology clumps have the right basic knowledge related to climate change, but some of them are not confident enough with the ability of the basic knowledge they have. While students who come from clumps outside science and technology, many of them lack information about basic knowledge related to climate change.

As explained earlier, it is known that climate conditions are already in an alarming condition because of that, people are required to be aware and careful of the symptoms caused and then be able to take preventive and handling actions. There is one of the most appropriate solutions for the prevention and handling of these conditions is through education. Previous research studies conducted by Kagawa & Selby (2012) haveshown that education is one of the main components for the younger generation to raise awareness about climate change, the risks that must be faced, and the steps in handling it. Previous researchers Tahmidaten et al. (2019) stated that in Indonesia, efforts to introduce the concept of climate change already exist in formal learning by incorporating materials on climate change in formal learning by including material about global warming at the elementary and junior high school levels. However, no research examines the significance of providing global warming material in junior high school on students' knowledge of procedural and contextual concepts of the phenomenon of climate change.

A person's knowledge of climate change could be influenced by several factors. Habtezion. S (2013) in his research said that women and rural communities are more vulnerable to the risks of climate change than men. However, research conducted by Sánchez-Cortés & Chavero (2011) found that men have higher knowledge about the phenomenon of climate change than women. Then a person's knowledge about climate change is also influenced by the region where he lives. Rad et al., (2014) found a relationship between a person's region of residence and the level of knowledge about climate change, where people who live in urban areas understand the concept of climate change better than people who live in rural areas. Because of previous studies were only conducted abroad and in Indonesia many were conducted at the university and high school levels, this research focuses on the junior high school level with the consideration that students have received material about global warming. Thus, the purposes of this study are to: (1)

Describing the level of knowledge of junior high school students about climate change, (2) Describing the level of knowledge of junior high school students about climate change based on gender and demographic regions (3) Describing the effect of students' environmental attitudes on the level of knowledge about climate change.

METHOD

Research Design

The research design used in this study is included in quantitative survey research. As described in the introduction, the main targets in this research are junior high school students. The population used in this study amounted to 1,080 students obtained from various junior high schools in Sidoarjo Regency, East Java Province, Indonesia. The sampling technique in this study used random sampling techniques. A sample of 302 students was obtained, consisting of 51.5% male students and 48.5% female students. The sample variation of demographic factors is shown in Table 1.

Table 1. Demographic Variations of the Sample

Background	Total	
	N	%
Gender		
Male	155	51,5
Female	147	48,5
Demographic Region		
Cities	181	59,9
Village	121	40,1

Research Instrument

The research instrument used in this study is a questionnaire regarding students' interpretation of the phenomenon of climate change. This questionnaire consists of two types, (1) a questionnaire about knowledge of the phenomenon of climate change consisting of 14 question items adopted and modified from (Salehi et al., 2016); and (2) a questionnaire about students' environmental attitudes consisting of 8 question items which were also adopted and modified from (Salehi et al., 2016). This questionnaire has been tested for validity and reliability using the Rasch analysis method with the help of Winstep Rasch Software. Based on the results of the Rasch analysis test, the reliability value of the item = 0.70, individual = 0.60, and alpha Cronba = 0.68. Based on Straub & Gefen (2004) the cronbach alpha score could be valid if it reaches a score of 0.60. For this reason, the researcher's questionnaire is declared reliable or worthy of testing.

Data Collection and Analysis

In this research activity, data was collected through offline and online surveys. In the offline survey, questionnaires were distributed directly to several schools in the Sidoarjo district. Then for the online survey, the questionnaire link was distributed via WhatsApp group. There are three main topics used in this research, the first is to describe the level of knowledge of junior high school students about the phenomenon of climate change. In this case, students' understanding of climate change is measured by looking at the percentage distribution of correct or incorrect answers.

Then the data analysis will be presented in the form of descriptive statistics to explain the response of each question item. The second topic, namely describing the level of students' knowledge of climate change based on gender, was tested through the Independent Sample T-test with the help of JASP software. Before conducting the T test, the questionnaire was also tested for homogeneity assumptions using the Test of Variances which in this test gets a value of P <0.05 which indicates that the test conducted has been significant.

Then on the third topic, namely describing the effect of students' environmental attitudes on the level of knowledge about climate change, the correlation was tested using Pearson Correlation with the help of JASP software. Students' attitudes towards the environment were analyzed first in the form of descriptive statistics which were then correlated with the results of students knowledge level on the first topic.

RESULT AND DISCUSSION

Junior High School Students Knowledge of Climate Change

Analysis of the level of knowledge of junior high school students about climate change is addressed in Table 2 which is presented in the form of statistical and descriptive analysis obtained from 302 samples of junior high school students consisting of 51.5% male students and 48.5% female students.

Table 1. Knowledge about Climate Change

No	Statements	Percentage (%)			
		SA	A	NA	SNA
1.	Carbon dioxide in the atmosphere affects the greenhouse effect (T)	52,6	35	7,2	5,2
2.	An overwhelming greenhouse effect may cause a global warming (T)	57,9	37,7	2,9	1,5
3.	Scientists have predicted that burning fossil fuels, especially coal will increase the greenhouse effect (T)	12,5	17,5	44	26
4.	Without clouds and water vapor, the earth would be colder (T)	22,5	38,7	25,5	23,3
5.	Without the ozone layer, life on Earth would be extinct (T)	42,3	41,7	13,9	2,1
6.	Scientists believe that large amounts of ozone in the atmosphere can increase ultraviolet radiation on the earth's surface (T)	21,1	54,6	17,8	6,5
7.	CFCs are the most serious concern for the ozone layer (T)	35,4	54,6	7,6	2,4
8.	Tropical rainforests are most likely can control the greenhouse effect (T)	30,1	45,3	20,5	3,6
9.	Exposure to ultraviolet radiation generally increases the risk of skin cancer (T)	32,4	46,3	16,2	5,1
10.	Scientists have not found evidence that ozone levels have decreased (T)	8,9	45,3	37,4	8,4
11.	Volcanic eruptions do not affected on the Indonesian climate (F)	12,5	17,5	44	26
12.	Indonesia is one of the largest greenhouse gas emitters in the world (T)	17,5	45,6	30,1	6,8
13.	By using renewable energy, global warming will increase (F)	16,2	53,9	22,5	7,4
14.	If global warming occurs, Indonesian crop and timber production would be affected (T)	33,4	52,3	9,9	4,3

Desciption: (SA) Strongly Agree, (A) Agree, (NA) Not Agree, (SNA) Strongly Not Agree

Based on Table 2, 87.6% of students realize that the amount of carbon dioxide (CO2) in the atmosphere affects the greenhouse effect and the remaining 12.4% still do not know. As explained by the constituent. Then, many of the students already know that the excessive greenhouse effect will cause global warming as shown by 95.6% of the students have answered correctly. It is explained in Surtani (2015) in the presence of greenhouse gases, the Earth can become warmer at just the right temperature (60ºF/16ºC) for the animals, plants, and humans to survive, without the greenhouse gas effect, the average temperature in the world could be -18ºC. 70% of students still do not know that scientists predict that burning fossil fuels, especially coal, will increase the greenhouse effect. According to Pratama & Kunci (2019) the greenhouse effect occurs due to the increase in the concentration of CO2 or carbon dioxide gas and other gases in the atmosphere. This increase in carbon dioxide gas concentration occurs due to an increase in the burning of fuel oil (BBM), coal, and other organic fuels that exceed the ability of plants and the sea to absorb it. Then many students understood that the earth would

be colder without clouds and water vapor. This is shown by 61.2% of students have answered correctly. Cloud conditions affect sunlight entering the earth, large cloud cover will cause the rays of solar radiation that enter the earth will be less (Anggreni & Adriat, 2018). Then there are 83% of students who already know that without the ozone layer, life on earth will be extinct. As said (Samidjo & Suharso, (2017) if there is a hole in the ozone layer, it means that UV rays emit directly, without any filters. All living things on earth will not be able to come into direct contact with these UV rays.

Students understood that CFCs are the most serious threat to the ozone layer, this is shown by 90% of students answered correctly. Chlorofluorocarbons (CFCs) are man-made gases that can cause ozone depletion and lead to a gradual decrease in global ozone levels. CFCs are utilized by modern society for example as refrigerants in refrigerators, sprayers, foam making and solvents especially for electronic refineries (Putu & Arwini, 2019). As many as 75.4% of students have known that the clearing of tropical rainforests is likely to control greenhouse gases. Tropical rainforest deforestation leads to degradation of biodiversity loss, decreased water quality and quantity, air pollution and CO2 emissions that induce greenhouse gases resulting in global climate change(Austin et al., 2019; Dianti, 2019). With more tropical rainforests, the earth will emit less greenhouse gases. Then as many as 78.7% of students have also understood that exposure to ultraviolet radiation can cause skin cancer. There is research conducted by Rahmawati et al. (2018) it is shown that ultraviolet light can cause sunburn, redness of the skin (erythema), darkening of the skin (tanning), and long-term effects in the form of premature aging and can cause cancer of the skin.

The students' knowledge of the statement that scientists have found evidence that shows a decrease in ozone levels is considered balanced because only 54.2% answered correctly and 45.8% answered incorrectly. Then, 60% of students already know about volcanic eruptions affecting climate change in Indonesia. As said by Wirakusumah & Rachmat (2017) the Tambora volcanic eruption in 1815 had an impact on many phenomena in the world, especially changes in world climate patterns such as 1816 called the year without summer. Then 63.1% knew that Indonesia is the largest greenhouse gas emitter in the world. The World Research Institute (WRI) has announced that Indonesia is among the 10 largest greenhouse gas emitters in the world. However, 70.1% of students do not understand that renewable energy does not cause global warming. And 85.7% of students have understood that global warming can affect the growth of plants and wood in Indonesia. There is a study on tree growth conducted by Susanto et al. (2018), which shows that there are changes in the quality of tree growth caused by climatic factors that change every year. Climate change causes changes in water availability. Water availability as well as light intensity that is not the same every year will cause an influence on tree growth.

Knowledge of Junior High School Students About Climate Change Based on Gender and Demographic Regions

The level of students' knowledge of climate change can be measured based on their gender and demographic region. Before the analysis using the T-test, the researcher analyzed the assumption of homogeneity using the Test of Equality of Variance. The results of the homogeneity assumption analysis can be seen in Table 3.

Table 3. Homogeneity Assumption Test

Test of Equality of Variance				
	F	df1	df2	p
Gender	0.915	1	302	0.340
Demographic Regions	0.350	1	302	0.554

Referring to Table 3, it is known that the P value is> 0.05, which means that the homogeneity assumption obtained is fulfilled. After obtaining the results of the homogeneity assumption test, it is continued by knowing the T-test to determine the level of student knowledge about climate change based on gender and the demographic region as shown in Table 4.

Table 4. T Test

Independent Sample T-Test			
	T	df	P
Gender	1.345	302	0.180
Demographic Regions	1.409	302	0.160

Based on the test results, it can be seen that there is a significant difference between the level of knowledge of students based on their gender and the demographic region. The results of the T-test analysis are described in Table 5.

Table 5. Description of T-Test

T-test					
Group	n	Mean	SD	SE	Coefficient of Variation
Male	155	10.374	1.748	0.140	0.168
Female	147	10.634	1.593	0.132	0.150
Village	181	10.681	1.799	0.165	0.168
Cities	121	10.401	1.604	0.119	0.154

Female students are proven to have a higher level of knowledge as indicated by the acquisition of a standard value of 1.748 while male students get a standard deficiency value of 1.593. As stated in Alston (2014), women are more vulnerable to climate change than men. Similar to research conducted by Jost et al. (2016), in Uganda women are considered to have a slightly higher understanding of climate change compared to men. Women are considered to be able to understand climate change knowledge due to their experience in various activities at the household and community level, and the amount of time they spend which makes them a valuable source of knowledge on various issues related to natural resource management, such as land and water (Mcleod et al., 2018; McNamara et al., 2021). In addition, women have experience in conserving natural resources for household and community consumption and have great insight into their surrounding environment. With the many activities carried out by women, the adaptive nature to environmental conditions including climate change can appear by itself. For this reason, the level of knowledge of female students about the phenomenon of climate change is considered higher than male students.

Then there is also a significant difference between students who live in rural areas and students who live in urban areas. This is evidenced by students living in rural areas obtaining a higher standard deviation value of 1.799 while students living in urban areas get a slightly lower standard deviation value of 1.604. As said by Mutolib et al. (2021) farming communities are considered to know about climate change, including climate classification and how to predict weather and climate. Similarly, research conducted by Salampessy (2018) found that farmers in villages tend to have an adaptive nature to climate change. In relation to that, it can be analyzed that students living in rural areas could have a higher level of knowledge about climate change due to the fact that many of their activities are directly related to nature. One example is by having parents or relatives who work as farmers, so that students can know the real reality of the natural conditions that occur.

Effect of Students Environmental Attitudes on Knowledge about the Climate Change Phenomenon

The purpose of this test is to determine students' attitudes towards the environment and their influence on knowledge about climate change in Indonesia. The results of testing students' attitudes toward the environment can be seen in Table 6.

Table 6. Environmental Attitude

No	Statements	Percentage (%)			
		SA	A	NA	SNA
1.	Humans must live in balance with nature to survive	57,9	37,7	2,6	1,8

2.	Human interference in nature often produces results that will be destroyed later	20,1	54,6	19,8	5,5
3.	Humans were created to rule over others	9,9	12,5	43,7	33,4
4.	Humans are very destructive to the environment	9,6	36,7	39,7	14
5.	Nature's balance is easily disturbed	24,1	54,9	17,2	3,8
6.	Earth is like space with limited space and limited resources	17,5	44,7	32,4	5,4
7.	The main purpose of the creation of animals and plants is to be used by humans	24,4	44	23,5	8,1
8.	We will reach a stage where the earth cannot meet the population's needs anymore	17,8	48,6	25,1	7,9

Desciption: (SA) Strongly Agree, (A) Agree, (NA) Not Agree, (SNA) Strongly Not Agree.

The average results shown by students in testing environmental attitudes can be considered positive. This is indicated by the number of students who prefer to strongly agree and agree on statements 1, 2, 5, 6, 7 and, 8. In the first statement, it can be seen that the results obtained are very high. it can be concluded that students have understood that humans must live in balance with nature in order to survive. To achieve a balance of life in the future, it is necessary to instill the nature of protecting, caring for, and loving nature starting from children. With many students who have understood about environmental conditions, the balance of life in the future will be achieved.

Then students prefer to choose disagree and strongly disagree on statements 3 and 4 which explain human greed towards nature. In response to statements expressing student disagreement, it can be seen that the third statement received the highest score. The students disagree that humans were created to dominate other creatures. Indeed, humans and other creatures were created to coexist in the hope of gaining benefits. This can be exemplified by the behavior of maintaining the forest ecosystem. With forests that get good treatment from humans, humans will certainly get many benefits from forests such as getting clean air, abundant water availability, and the most important thing is to prevent many natural disasters.

The relationship between students' attitudes toward the environment and students' knowledge of climate change was analyzed using a correlation test with the help of JASP software. The results of the correlation test can be seen in Table 7.

Table 7. Correlation Test

Pearson's Correlations			
Variable		V7	V9
V7	Pearson's r	-	
	p-value	-	
V9	Pearson'r	0.303	
	p-value	<.001	

In Table 7 there are variables V7 and V9, where V7 is the students' environmental attitude and V9 is the student's level of knowledge on climate change. Based on the results of the analysis conducted in Table 4, it is known that there is a relationship between students' environmental attitudes and the level of knowledge about climate change. This is indicated by the calculated R-value of 0.303. Thus, this table informs that students' environmental attitudes only contribute 30.3% to the level of students' knowledge about climate change. The results of this correlation test can also be seen in the form of a graph as in Figure 1.

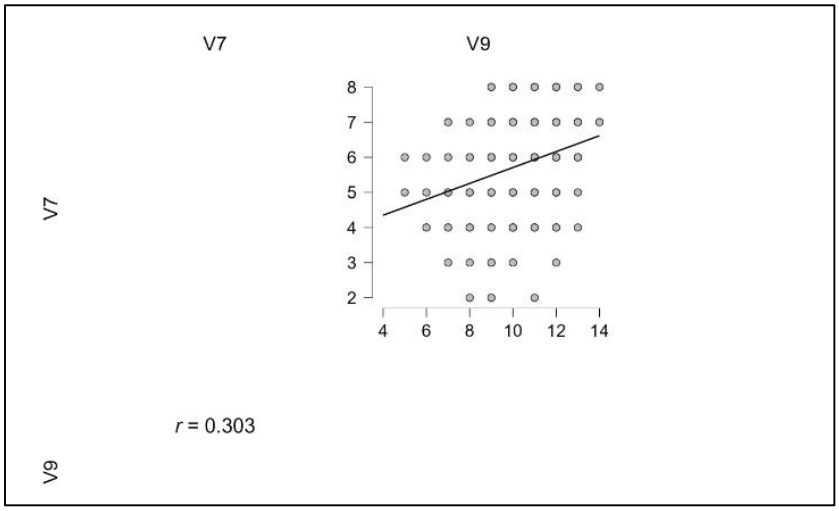

Figure 1. Correlation Test Graph

Based on Figure 1, we know that if the student has a high environmental attitude, then the level of student knowledge about climate change will also be higher. The results of this study support previous research by Azhar (2015) who found a significant relationship between the attitude toward preserving the environment and students' knowledge. Dewi & Wawan (2010) stated that if someone has good knowledge, the attitude formed is also good, and vice versa. As for similar research that discusses the influence of knowledge on the environment, it says that students who have environmental knowledge tend to pay more attention and empathize with the consequences of their behavior on the environment (Machalos et al., 2008; Munawar et al., 2019).

CONCLUSION

Based on the results of the research conducted, it can be concluded that the knowledge of junior high school students about climate change is relatively high. Then there is a significant difference between students' knowledge of climate change based on gender and student demographic areas where female students are higher than male students, and students who live in villages are higher than in cities. Furthermore, there is a positive relationship between students' environmental attitudes and students' knowledge about the phenomenon of climate change. It is hoped that this study provides further empirical insights into how teachers should facilitate students' knowledge of the phenomenon of climate change according to gender, demographic region, and attitude toward the environment. Suggestions for future research are to conduct similar research but using qualitative methods to examine more deeply the level of student knowledge about the phenomenon of climate change by gender, demographic regions, and attitudes towards the environment.

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