

Research Article

How Much Do Elementary School Students Know About Climate Change? A Report from Java's Primary School Students

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Abstract.

Climate change is a global issue that must be immediately responded to by the community. Responding to climate change requires awareness of climate change issues, from symptoms to impacts. Due to its complexity, the issue of climate change needs to be realized and understood by all levels of society, including elementary school students. This study aimed to describe the knowledge of elementary school students related to climate change. The method used was descriptive quantitative. The instrument used was a questionnaire using a Likert scale (1-4). A total of 1,410 elementary school students in grades 4-6 from several regions on the Island of Java participated in filling out a questionnaire distributed online. Knowledge data related to climate change were analyzed descriptively. The findings showed that, on average, students had limited knowledge and misconceptions about climate change. Minimal knowledge was shown about the causes, symptoms, effects, and efforts to mitigate and adapt to climate change. The implications of the research findings suggest the importance of explicit learning related to climate change starting at the elementary school level.

Keywords: Climate Change, Elementary School Students, Java's

1. INTRODUCTION

The social and environmental challenges facing society today and in the future are increasingly complex to understand and solve [1, 2], both at local, national and global scales. One of the global challenges faced today is climate change [3]. Based on the Global Change Research Program United States in 2009, climate change is one of

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the most significant environmental problems [4]. The IPCC report states that climate change is defined as a change in climate conditions that can be identified through changes in their average and property variability over a long period. The main cause of climate change is human activity which is divided into four areas of life, namely (a) forest destruction including changes in land use, (b) use of fossil energy, (c) agriculture and animal husbandry, and (d) waste [5] which all of which produce greenhouse gases as the main cause of climate change [5, 6].

Climate change affects all communities globally [7] because it threatens the sustainability of life on earth. The impacts of climate change include melting polar ice caps, shifting seasons, rising sea levels, crises in food and clean water supplies, widespread tropical diseases, and the loss of millions of flora and fauna species [5, 8]. This can exacerbate agricultural production, infectious diseases, migration flows, poverty, and even conflict [9].

To reduce the impacts and causes of climate change, everyone needs to change their beliefs and actions. One way is through education [4]. Education is needed so that the younger generation can comprehensively understand the concept of climate change from early age to reduce misunderstandings, preconceptions, and even misconceptions related to climate change [4, 9, 10]. Climate change education can also educate students on mitigation and adaptation measures [4, 9–11] where mitigation focuses on interventions to reduce greenhouse gas concentrations and adaptation focuses on adjusting to climate change [9, 11]. Through climate change education, students will also be able to engage in debate and decision-making and express informed opinions [12].

However, for climate change education to be effective, efforts are needed to reveal students' perceptions of climate change [4]. This is because the misconceptions in students can mislead their thinking, leading to their rejection of actions to overcome climate change [13]. This opinion is in line with constructivism theory which explains that students' prior knowledge affects their learning process in class. In several literature studies, the term perception is associated with implicit and subjective views, conceptualizations, and beliefs which are often constructed and reconstructed without reference to scientific knowledge but are shaped by personal experience, customs, traditions, and specific cultural values [14].

Several studies related to climate change knowledge have been conducted, including by Hannah & Rhubart who examines teachers' perceptions of climate change curriculum and pedagogy [15]. Herman, et al. reveal teachers' views on climate change [4]. Seroussi, et al. examine teachers' knowledge, beliefs, and attitudes about climate change [16]. Lombardi et al. examined student evaluations of climate change in more detail [17].

Furthermore, Papadimitriou investigated the understanding of prospective elementary school teachers about climate change, the greenhouse effect, and ozone depletion [18]. Ratinen, Virii, & Lehesvouri conducted research related to the understanding of prospective elementary school teacher students through four science sessions [19]. Research Littrell, et al. examine students' perceptions of high school students about climate change through filmmaking [7]. In her research, Tanyaniywa brings up indigenous knowledge systems and teaching climate change in Zimbabwean secondary schools [20]. Furthermore Shea, Mouza, & Drewes make climate change professional development for teachers. The findings identify the naive views of research subjects related to climate change [21].

Research that has been carried out related to climate change involves students from high schools, university students, and teacher candidates to teachers. However, it does not include elementary school students, even though climate change education needs to be done early. Thus, this study aims to reveal how elementary school students know about climate change. The findings in this study can provide basic information as a basis for providing learning related to climate change for elementary school students.

2. RESEARCH METHOD

This study aims to determine students' knowledge about climate change which was explored using a questionnaire. Therefore, this study is a descriptive study [22] that aims to describe the characteristics of both or events [23] of a group at one time or its changes over time but does not explore causal relationships [22]. In this case, the researcher explores students' knowledge of the causes, symptoms, effects, and mitigation and adaptation efforts to climate change.

The questionnaire used refers to Hiroki's questionnaire [24], which was adapted according to the characteristics of elementary school students. Therefore, there are several simplified terms in the questionnaire, such as global warming, warming the earth, etc. After the adaptation process, the researchers then distributed online questionnaires to elementary school students in grades 4-6 on the Island of Java which included West Java, Central Java, and East Java. A total of 1,410 elementary school students voluntarily filled out a questionnaire via Google form, with 23% of 4th-grade students, 41% of 5th-grade students, and 37% of 6th graders. The data collected was then analyzed quantitatively descriptively. The information obtained includes knowledge about the causes, symptoms, impacts, and efforts to overcome them. Thus, this research becomes

a preliminary study used as the basis for learning related to climate change, especially in elementary schools.

3. RESULTS AND DISCUSSION

3.1. Causes of Climate Change

Knowledge related to the causes of climate change was obtained through three questions. Questions cover the main sources, causative gases, and events or activities that cause climate change. The results of the analysis are presented in the following Table 1.

TABLE 1: Causes of climate change.

No	Causes	Response
1	Main sources	
	Human activities Nature activities Other	79.6 16.7 3.7
2	Gas	
	Carbon dioxide Nitrogen Methane Dinitroxide Water vapor Oxygen Argon	75.9 42 38.9 20.5 19 14 9.9
3	Activities	
	The increasing amount of gases that cause global warming Massive deforestation The depletion of the ozone layer Industrial activities Massive use of energy Continuous hot sun Acid rain Other	58.1 56.6 56.4 45.5 40.5 22.8 11.2 9.9

Referring to the Table 1, most of the students said that the main cause of global warming is human activity, and the main gas is carbon dioxide. This follows the results of a study by Seroussi, which revealed that human activities are causing an increase in greenhouse gases as the main cause of climate change [16]. However, surprisingly, students consider nitrogen, oxygen, and argon as gases that cause global warming. Furthermore, there are several misconceptions related to activities or events that cause global warming. Students assume that the depletion of the ozone layer and acid rain are the causes of climate change. They link pollution to global warming and climate change. This finding aligns with Papadimitriou’s study, which revealed that student-teacher candidates also have the same opinion [18]. In addition, they believe that another cause of climate change is the continuous heat of the sun, as revealed through research by Akagun & Adadan. Findings related to the causes of climate change indicate poor

knowledge regarding the causes of climate change [25]. Lack of knowledge about the causes will impact the difficulty of finding practical solutions and even tend to refuse the right solution [18].

3.2. Symptoms of Climate Change

Knowledge related to the symptoms or signs of climate change is obtained through one question. The answer option contains another column so that students who have different answers options can present their answers. The results of the analysis are presented in the following Table 2.

TABLE 2: Symptoms of climate change.

No	Symptoms	Response
1	Earth's temperature increase	78.2
2	Disasters are getting more severe due to drought and high rainfall.	59.7
3	The decline in the number and results of agriculture, forestry, and fisheries.	37.4
4	The destruction of all kinds of animals and plants	29.5
5	Other	4.2

Based on Table 2, the increase in the earth's temperature is students' most felt symptom of climate change. Another sign of climate change is the emergence of catastrophic droughts and heavy rains. In the other column, students write down several other symptoms such as erratic weather, rising seawater temperature, and sea level. The results of research support this finding by Akagun & Adadan [25], which showed that before being given treatment, elementary school students stated that the earth was getting warmer due to climate change.

3.3. Consequences of Climate Change

Knowledge related to the impact of climate change is obtained through two questions. The first question focuses on the effects of global warming and the second question focuses on the effects of climate change. The results of the analysis are presented in the following Table 3.

Referring to Table 3, the water crisis impacts students most feel. In another column, students write down several other consequences, such as the melting of polar ice caps, damage to coral reefs, many diseases, air pollution, etc. However, some students say that climate change is not a problem. This follows the research of Vinuesa, et al. which

TABLE 3: Consequences of climate change.

No	Consequences	Response	
1	Consequences of global warming		
	Lack of water due to long dry season	58.6	57.3
	Forest fires are becoming more frequent	56.3	36.4
	Hot weather often occurs	26.4	21.9
	Destruction of animal and plant habitats	8.2	0
2	Decreased quantity and quality of agricultural products		
	Rising sea levels and storms often occur		
	More and more heavy rain		
	Other		
	Consequences of climate change		
	Drought is getting more frequent	64.7	60.1
	Natural disasters are becoming more and more frequent, such as floods, storm surges, and high waves.	49.1	48.2
	More and more hot weather	46.4	43.5
	Disturbed environmental comfort	28	22.7
	The destruction of the quantity and quality of the harvest	0.8	2
The destruction of all kinds of animals and plants			
Infectious diseases are increasing			
Damage to buildings and public facilities, such as power outages and traffic disruption due to heavy rain			
No problem			
Other			

explains that students think they do not need to be responsible for climate change because it does not cause problems [26].

3.4. Climate Change Mitigation and Adaptation

Knowledge related to action on climate change is obtained through two questions. Questions cover climate change mitigation and adaptation efforts. The results of the analysis are presented in the following Table 4.

Table 4 shows that climate change mitigation efforts are more focused on reducing the use of fossil fuels and electricity. This finding is in line with the results of Papadimitriou’s study that one of the efforts to slow down global warming is to reduce the use of cars [18]. The adaptation efforts put forward by students are in line with their mitigation efforts, namely focusing on reducing the use of fossil fuels, electricity, and waste. However, some students state that nothing needs to be done to prevent global warming. Thus, this finding further strengthens that students do not have adequate knowledge about global warming and climate change [16].

Climate change is an undeniable reality because of the increasing emission of greenhouse gases produced through human activities. To prevent and overcome it, everyone needs to have adequate knowledge. However, the results of this study indicate that elementary school students tend to have limited knowledge regarding climate change. This is indicated by the overall unscientific answers of students and the inconsistency of their answers between one question item and another. Students’

TABLE 4: Climate change mitigation and adaptation actions.

No	Mitigation and Adaptation	Response	
1	Mitigation		
	Reduce car use	58	57.5
	Reduce electricity usage	45.2	31.7
	Don't use plastic bags for shopping	27.7	27.7
	Using used bath water for washing	25.3	2.4
	Regulating the temperature at home	3.9	
	Reduce the time used for bathing		
	Does not keep the rice warm in the rice cooker		
2	Adaptation		
	There's nothing to do		
	Other		
	Increase the use of bicycles and walking when traveling	69.2	58.9
	Unplug electrical equipment when not in use	50.5	49.7
	Reduce the amount of waste	49.1	41.5
	Using energy-saving lamps	41.1	39.4
	Reduce traveling by car	37.9	33
	29		
	Recycle as much as possible	23.2	23.1
	Increase renewable energy such as solar and wind	4.5	
	Using public transportation such as bus, train, etc.		
	Often turn off the lights		
	Using environmentally friendly chemicals		
	Replacing machines with more energy efficient ones		
Buy a car that is more fuel efficient			
Reusing bottles and food containers			
Buying a small car			

alternative conceptions related to global warming and climate change are also shown by the research results [25, 26].

The research findings revealed have implications for the importance of explicitly learning about climate change for students starting from elementary school. Collado, et al. explained that children tend to act friendly and care about the environment compared to their elders [25]. The opportunity to be responsible for the environment is more significant. In addition, climate change impacts increasing health problems, and children are the most vulnerable group [27, 28]. Knowledge related to climate change influences effective decision-making for mitigation and adaptation efforts [29, 30].

4. CONCLUSION

The results showed that elementary school student's knowledge of climate change was minimal, and they had some misconceptions. A minimal view is shown in knowledge about the causes, symptoms, impacts, and efforts to mitigate and adapt to climate change. The implications of the research findings indicate the importance of explicit learning related to climate change starting at the elementary school level.

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