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Research Article

The Science Education Students' Understanding About Global Climate Change Issues in Indonesia

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Abstract.

This research aims to conduct a preliminary study on the understanding of the concept of climate change for the first-year postgraduate science education students at Unesa. The purpose of this study is to determine the level of understanding of students' concepts of climate change and find patterns of sustainable climate change education that are expected to prepare Indonesian people to face the growing issue of climate change through effective teaching. The research subject is 17 postgraduate students of science education for the first semester. The method used is quantitative descriptive. Data were collected through distributing questionnaire instruments about climate change and global warming. The results of the study show that the concepts of climate change and global warming are still something new and interesting for science education students. Most students are not familiar with climate variables. They still have difficulty distinguishing the term climate change, global warming, ozone layer depletion, and the greenhouse effect. The results of this study are used as the basis for constructing sustainable climate change education in Indonesia.

Keywords: climate change, patterns of sustainable climate change education, effective teaching

1. INTRODUCTION

Climate change is a change in average climatic conditions over several decades [1]. It has become a central world issue in the last decade [2]v, especially for regions or countries that are located near the ocean [3], and has become a dominant challenge for environmental and social sustainability in the 21st century [4–6]. Climate change is a global problem that can affect the lives of millions of people, the stability of ecosystems,

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and various natural species [7]. The increase of the temperature on the planet earth is concerned and become the root of the problem resulting from global warming [8].

Various environmental changes and their impacts are a particular problem for most of the world's people. Most experts believe that the main factor causing climate change is human activity [9]. It is the same as experienced by the people of Indonesia, as a tropical country, feels the impact of climate change [10]. Indonesia is one of the most vulnerable countries facing climate change and is indicated as a country that contributes greatly to global climate change [11]. Based on the results of studies on climate change conducted by experts, it is shown that climate change in Indonesia is predicted to cause an increase in the average annual temperature between 0.2-0.3^{0}C; increasing annual precipitation on most islands in Indonesia, seasonal changes in precipitation are projected, and season delays of up to 30 days [12]. The impacts of climate change, including: decreased rainfall and is expected to occur continuously throughout the year with the high potential for drought, rising sea level, which have an impact on the loss of 80.00 km of coastline and the sinking of thousands of islands and marine resources, increasing average water temperature which can cause changes in circulation patterns and salinity levels of sea water, climate change has an impact on the existence of coral reefs, and has a serious impact on public health [13].

Indonesia is one of the countries in Asia that has the greatest chance of being affected by climate change in the world. This is due to the high population density, especially in coastal areas and the heavy dependence on natural resources as a source of income and consumption [14]. Based on World Bank poll result, 61% of Indonesians consider climate change to be a very serious problem, 19% consider it a common problem, 17% not something too serious, and 1% consider there is no problem [15].

The critical condition of environmental change due to climate change has become a social disaster that the community has not dealt with properly. The prolonged dry season due to seasonal shifts and followed by forest fires, flooding during the rainy season, which causes damage to agricultural areas, and high air temperatures, which have a significant impact on the loss of biological resources in most parts of Indonesia have a major impact on economic stability and economic stability. Public health. For this reason, efforts to build community resilience in the face of climate change are felt to be increasingly urgent. This cannot be separated from people's knowledge of the environment. Through good environmental knowledge, one can make informed judgments about environmental conditions and take fair actions [16].

The unpreparedness of society in facing climate change is a big challenge for climate change education in Indonesia. The main factors causing the high vulnerability of

the community in facing climate change are the lack of knowledge and awareness regarding the concept of climate change and its impact on life and the absence of real efforts to equip the community through education with effective skills in dealing with the evolving issue of climate change. One of the reasons is that there is no broad agreement regarding the most effective strategies for teaching climate change both [17], for students and the community. Effective communication in climate change education is essential, emphasizing mitigating and adapting to climate change [18]. Mitigation is focused on reducing greenhouse gas concentrations or minimizing carbon emissions in the atmosphere through forest conservation or reforestation. In contrast, adaptation minimizes the vulnerability of natural ecosystems and living things to the impacts of climate change through modification of social, economic, and ecological systems [19].

Climate change education is crucial for future students. Students must have a good understanding of the concept of climate change. They are able to explain the impact of climate change on life and are required to be better able to take attitudes and actions related to climate change. Students who cannot engage in climate change discourse will be excluded from the world of climate change [20]. An interesting idea from education in Taiwan that can be adapted in building sustainable climate change education in Indonesia is to increase environmental awareness and sensitivity through interdisciplinary learning, enrich environmental knowledge, cultivate environmental values, equip students with local environmental problem-solving skills. It is hoped that students become citizens who have environmental literacy when dealing with environmental problems both now and in the future and related to issues and sustainable development [21].

2. METHOD

This research is descriptive research with the research subjects are students of the first year Unesa postgraduate science education study program totaling 17 respondents with a composition of 3 males and 14 females with age < 20 years = 0%, 20 – 25 years = 23.53 %, 25-30 years 58.82% and > 30 years = 17.65 %. Data collection techniques using a questionnaire instrument containing questions and statements related to climate change. The data collected was analyzed descriptively to find information related to students' understanding of the concept of climate change.

3. RESULT AND DISCUSSION

Based on student choices (Figure 1), the types of environmental issues that are considered very trending are air pollution (30.77%), waste (23.08%), climate change (21.15%), and the ozone layer hole (9.62 %). This data illustrates the lack of strength on the issue of climate change and the hole in the ozone layer for students of Master of Science Education Postgraduate Unesa. This condition is a strong reason for building geoscientific literacy for postgraduate students of the Science Education Study Program through Earth and Space Sciences learning, especially on climate change material.

Issues related to global warming, climate change, and the depletion of the ozone layer are not new issues for students. Based on the questionnaire distributed to students, all students said they had heard of the three issues. Only 5.88% of students stated that global warming, climate change, and the depletion of the ozone layer were the same event. Based on questions related to the notion of climate change, only 2 students (11.76%) answered correctly, namely changes in weather distribution within a certain time. From the students' answers, it can be seen that most of the students do not know about the concepts of weather and climate, so it isn't easy to distinguish them.

Students' answers to every question related to climate change are very fascinating to communicate. One of them is the factor that causes climate change. As many as 47.06% of students stated that climate change is caused by global warming, 17.65% answered that the cause of climate change is the increasing concentration of CO_2 gas in the atmosphere, some students answered that climate change is caused by the influence of pollutants and excessive use of energy, waste that is burning, logging of forests, and the establishment of factories. But some answer that climate change is caused by the thinning of the atmosphere and the depleting ozone layer on the Earth. Regarding the impacts of climate change, it is also very diverse and illustrates students' lack of knowledge related to climate change issues. Some students answered that the impact of climate change was global warming (29.41%), seasonal and weather changes (35.29%), species extinction (23.53%), and 11.77% of students' answers which were considered less appropriate, for example: different lifestyles, crop failure, drought, and flooding.

An equally interesting case is the student's level of optimism regarding solving the problem of climate change. As many as 94.12% of students agree that the problem of climate change can be overcome. Various forms of solutions are offered to solve climate change, including: using environmentally friendly energy, reducing the use of fossil fuels, reducing excessive CO_2 in the air, treating waste properly, doing reforestation, and being aware of the balance of the ecosystem.

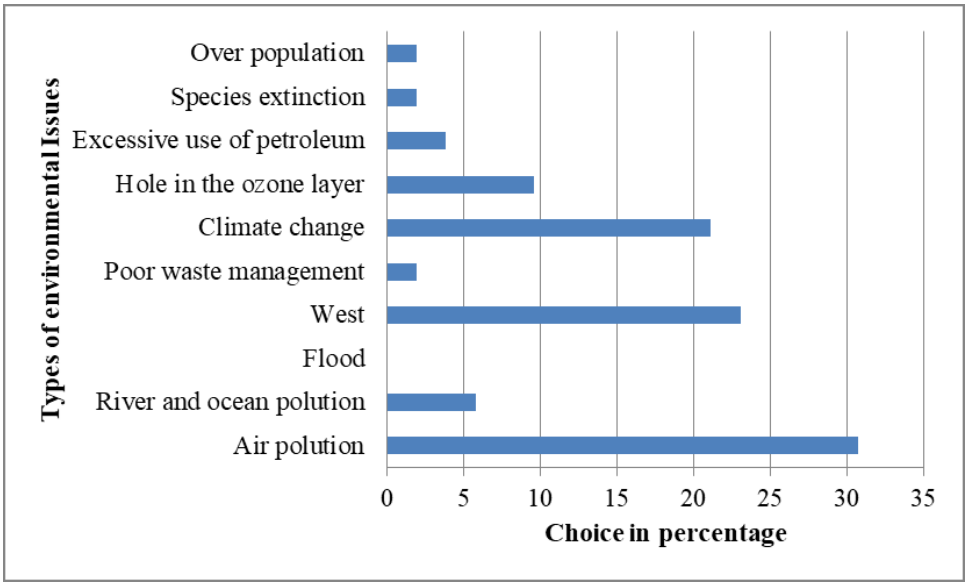

Figure 1: Student's choice of environmental issues.

Based on the analysis result above, it shows that student literacy related to climate change still needs to be improved. Considering that they do not know well about the concept of climate change and its impact on society and what can be done to reduce the impact of climate change. The depletion of the ozone layer is also still a problem for students. This can be proven from the results of student answers related to the questions posed. There are several questions related to the ozone layer problem, namely: understanding ozone, ozone depletion, factors causing ozone layer depletion, and the impact of ozone depletion. Regarding the understanding of the ozone layer, almost all students can define it well. On average, students answer that the ozone layer is part of the atmospheric layer protecting the Earth from ultraviolet radiation. Most students can also explain that ozone depletion is a decrease in the amount or volume of the ozone layer due to the reaction of ozone with gases released into the atmosphere. However, when explaining the possible impact of the depletion of the ozone layer, 58.82% of students on average gave incorrect answers. Among them, the depletion of the ozone layer causes the depletion of the ice sheets at the north and south poles due to increasing the Earth's temperature, rising the Earth's temperature and global warming, climate change, and the greenhouse effect. In comparison, 41.18% answered correctly that it could cause skin cancer due to the large amount of ultraviolet radiation received by the Earth.

Based on the answers given by the students, it turns out that they have not been able to properly explain the impact of the depletion of the ozone layer on the Earth. Students are still confused between the concepts of global warming, depletion of the

ozone layer and climate change. To strengthen the data, the findings can be seen from a questionnaire on student perception of climate change, global warming and the depletion of the ozone layer (Table 1).

Student responses shows that students' understanding of one of the geoscience concepts is low, namely climate change. Most students (52.94%) agree that one of the impacts of climate change is air pollution. This statement is based on the increasing air pollution thought to be caused by climate change. In addition, 52.94% of students also think that the depletion of the ozone layer and the greenhouse effect are two interrelated events. However, regarding global warming as the cause of climate change, most of the students agree or even strongly agree and almost all agree that climate change is caused by humans and is a marker of life in the modern era.

TABLE 1: Student responses about climate change problems.

No	Climate Change Problems	SA	A	D	SD
1	The result of climate change is air pollution.	5.88	52.94	41.12	0.00
2	The depletion of the ozone layer and the greenhouse effect are combining the same ideas.	23.53	52.94	23.53	0.00
3	Ultraviolet radiation is the cause of global warming.	17.65	64.71	17.65	0.00
4	Global warming is the cause of climate change.	58.82	35.29	5.88	0.00
5	Human activities can be the biggest cause of climate change.	35.29	64.71	0.00	0.00
6	Climate change is a logical consequence of modern life.	17.65	58.82	23.53	0.00

SA : Strongly Agree A : Agree D : Disagree SD : Strongly Disagree

Climate change is a major challenge for 21s-century education focused on how to integrate climate change as a real-life issue into the education system. To prepare the Indonesian people to face global climate change and its problems, an initial study is needed to determine the level of public understanding of the concept of climate change. The preliminary research aims is to obtain information as a basis for developing sustainable climate change education, especially for the people of Indonesia. This is done to provide better understanding and skills in the design of climate change education that is more suitable for the community to be better prepared to deal with it. Climate change cannot be avoided or prevented, but with a good understanding, it will reduce the impacts and risks posed to both the environment and the community itself.

The challenge of climate change is an important part of the education curriculum in several countries worldwide. Almost all countries are competing to prepare their citizens

to be able to survive in facing the issue of global climate change. The low understanding of the concept of climate change is not only faced by people in developing countries such as Indonesia. The United States is also facing the same thing. The interesting conclusion is quantitatively presented in the report are (i) 57% of the US public knows that the greenhouse effect is caused by heat trapped by gases in the atmosphere, (ii) 50% of the public knows that human activities mostly cause global warming, (iii) 45 % of people know that carbon dioxide traps heat on the Earth's surface, and (iv) 25 % of people know about coral bleaching activities or ocean acidification [22].

This finding is corroborated by the results of research who said that many US adults and adolescents were confused by climate change and the hole in the ozone layer. 35% of US teens believe that the ozone hole is the biggest contributor to climate change, 21% of US teens believe that aerosol sprays can be the biggest contributor to global warming, and 44% of US teens believe that stopping rocket launches that penetrate the ozone layer can reduce global warming. Based on these findings, in general it can be concluded that US citizens still have misconceptions about climate change, its causes, and impacts on society [23]. In addition, it was also found that the growing trend of US public concern about global warming is mainly related to general belief that global warming is happening and is detrimental to people in America today [24, 25].

There are three main component to support the success of sustainable climate change education in Indonesia, namely: (i) curriculum development and learning outcomes related to climate change literacy, not only focused on knowledge but with more emphasis on action competencies; (ii) creating a learning environment where students can practice their competence in responding to climate change by minimizing policy practices that are not relevant to the competencies taught related to climate change; and (iii) building action competencies related to climate change by targeting climate literacy targets for senior students and adults [26]. To support this, climate change education should pay attention to the need to provide teachers in both developed and developing countries with professional learning with the latest facts, more innovative training processes, resources and learning tools that can support and empower students as agents of change. Realizing successful learning related to climate change can be done by understanding the causes, impacts and solutions by looking at the climate change phenomenon in various ways and creatively integrating it with multiple disciplines [27].

4. CONCLUSION

Based on the findings from the results of the research, it was concluded that the majority of Postgraduate science students still have a misconception about climate change, especially on the problem of the relationship between climate change and global warming, ozone depletion, greenhouse effects. However, most already understand that climate change can cause an increase in global temperature. The topic of conceptual errors experienced by the student has similarities with those experienced by society in general. The same learning source can identify this. For this reason, a more comprehensive analysis is needed to find out the main causes of all these conceptual errors. There needs to be standardization of integrated climate change material competencies in the learning curriculum. Suppose there are problems related to learning resources about climate change. In that case, there needs to research in developing teaching materials appropriate to learning needs by presenting reliable concepts about climate change material.

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