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# Teachers and Students Knowledge about Global Warming: a Study in Smoke Disaster Area of Indonesia

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**ABSTRACT**

The average temperature on the Earth's surface has globally increased. This issue was generally caused by the increasing of greenhouse gases concentrations due to human activities. Therefore, the knowledge about global warming becomes major topics for students and educators. This research aimed to investigate how the teachers and students knowledge about global warming. The data was retrieved through objective tests on 230 teachers and 573 junior and senior high school students in Lampung Province as one of the most potential black smoke disaster area in Indonesia. Data were collected and analyzed using two Way ANOVA, and Tukey multiple comparison to understand the relationship of global warming knowledge towards gender, teachers' identity, students' educational level. The results showed that students and teachers knowledge about global warming are very low. The students knowledge is higher than the teachers. For students, it was found that an educational level hold the important factors of students' global warming knowledge, in which secondary school students has better knowledge and experiences relative to the primary students. There is no difference in students' knowledge of global warming caused by gender. There is a correlation between attitude and knowledge about global warming at a senior high school students while in junior high school students there is no correlation. The conclusion there is a difference in students' knowledge about global warming caused by differences in the learning experience but not by gender. There was no difference in knowledge between the teacher caused by field of study, gender, or where they teach. Students are more mature and have better knowledge about global warming would have a disagreement on the behavior that led to the increasing greenhouse gases and are willing to sacrifice pleasures.

**KEYWORDS**
Knowledge, Students, teachers, global warming

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## Introduction

Global warming is the effect of increasing average temperature of the earth and oceans because the exacerbation of the green house effect. This naturally green house effact is potentially caused by the addition of pollutants to the biosphere leads to

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posssible economic and climatic consequences (Kilinc et al., 2008; Rye et al., 1997). Many people start to debate whether global waming is real or not until finally, the data obtained by climate scientist proved that our earth is warming during over the past of 100 years. The average temperature has increased between 0.4 °C-0.8 °C caused by the burning of fossil fuels, land clearing, and agriculture lead to carbon dioxide and other greenhouse gases released. The gases released by those activities claimed to be the main source of the glomal warming that has occured at this last 50 years. Scientists from International Panel on Climate showed that the global waming has nowaday been expected to increase until 1.4°C -5.8° C in year 2100. It would be followed by the increasing sea levels that caused the melting of polar ice and increasing the incidence and severity of storm and other severe weather (Meehl et al., 2007).

Global warming is often discussed as a broad impact in various parts of the world. The concept of global warming is defined as an increase in the temperature of earth's and ocean's surfaces due to the increase in the amount of the greenhouse gases in the atmosphere (Çimer, Sabiha, & Ursavas, 2011). According to Cox, Peter, Richard, Chris, Steven, and Ian (2000), the progressive increase in carbon dioxide concentrations in the atmosphere due to anthropogenic emissions is estimated to lead to significant changes in the weather. About half of the emissions are currently being absorbed by the sea and by land ecosystems, but absorption is sensitive to climate, as well as the concentration of carbon dioxide in the atmosphere, creating feedback.

According to Lashof and Dilip (1990), in recent years, it has been noted that the combined effect on the climate of increased concentration of a large number of trace gases can rival or even exceed the increasing concentration of carbon dioxide. These trace gases, notably methane, nitrous oxide and chlorofluorocarbons, which is present at a concentration that is 2-6 orders of magnitude lower than carbon dioxide, but it is important because, per molecule, they absorb infrared radiation is much more powerful than carbon dioxide.Indeed, the latest study shows that the trace gas is responsible for 43% of the increase in radiative forcing from 1980 to 1990. The index for comparing the contribution of emission gases 'greenhouse' global warming is needed to develop effective strategies to limit this warming. Estimates of the relative contribution to the additional greenhouse force during a certain period do not fully account for differences in the residence time in the atmosphere of greenhouse gases which is important. Here we extend new jobs at halocarbons by proposing index global warming potential for methane, carbon monoxide, nitrogen oxides and carbon dioxide relative to the CFC.

In Indonesia, global warming is one of the environmental problems being hotly discussed by several people lately, especially after the disaster of the smoke caused by forest fires in Sumatra and Kalimantan, Indonesia. Forest fires for months in Sumatra and Kalimantan significantly contribute as a greenhouse gas. In Indonesia, we can see that climate change and the season is not limited as a result of the impact of global warming. Other impacts which also have occurred in Indonesia are a change in the intensity and frequency of rainfall, crop system disorders, rising sea levels caused flooding, increased rainfall and strong winds triggered landslides and land subsidence (Susanto & Suyatna, 2015). In the UK, both temperatures and periods of intense daily rainfall have been increasing over the past century, with recent flooding affecting many areas which have never been threatened before (Environment Agency, 2001)

Doran and Zimmerman's (2009) survey found that 97% of climate scientists agreed that human activity is contributing to climate change. Human activity continues to add to the greenhouse gas, carbon dioxide, methane, and nitrous oxide into the Earth's atmosphere, global temperatures are expected to increase, causing the Earth's climate changes (Shepardson, Niyogi, Choi, &Charusombat, 2011). To change the behavior of individuals in order to reduce greenhouse gas emissions, will use multidisciplinary approach, education is an important component in this regard (Skamp, Boyes, & Stanisstreet, 2009). Realizing the huge impact of global warming in Indonesia, the government considers that it is important to take special measures to reduce the impact

of global warming. Indonesia is the world's third largest emitter of greenhouse gases. The deforestation, forest fires and the degradation of peat land have been the main causes for Indonesia being the world's third largest emitter of greenhouse gases. Some of the main impacts of climate change which are available in Indonesia, include, but are not limited to: temperature increase, intense rainfall, sea level rise, and a threat to food security. The effects climate change has on Indonesia's economy and poor people, human health, and Indonesia's environment and biodiversity. Action must take place at all levels, from the national and local to the international (Measey, 2010).

Indonesia is vulnerable to the impacts of climate change as one of the countries with the densest population and has thousands of small islands. It is also said that climate change was caused by human activity of which is the destruction of forests, burning of peat lands and the use of dirty fuel. The types of vulnerabilities that are the global temperature increase that triggers a rise in sea levels, causing the small islands become submerged. In addition, extreme weather will increase the intensity of hurricanes, droughts, landslides, floods, fires and heat waves. WWF also warned it could lead to outbreaks of diseases such as malaria, dengue fever, diarrhea and others. Another issue is the threat of food security as a result of crop failure (Global Environmental Conservation Organization in Indonesia, 2007). Therefore, Indonesian government has to make an immediately accelerated development of low carbon then change the renewable energy. It comes from solar energy, water, wind, geothermal, wave and bioenergy. We can predict it to save our finances, increase access to the clean energy, create a new jobs and also a sustainable environment. Therefore, the concept of global warming and its impact to the world should be understand by all levels of society.

Some countries have intensively taught and socialized its citizenship about global warming to build up an attitude towards global warming. For example: Turkish believe about the benefits of specifications for reducing global warming, their readiness to adopt them, and the relationships between these. The students appear willing to take certain actions such as switching off unused electrical items, but unwilling to undertake other actions such as increasing their use of public transport. Planting more trees has been thought to be the most useful action, whereas few students have appreciated the role that buying fewer new consumables might play (Kılınç, Boyes, & Stanisstreet, 2011). Furthermore, the citizens of Mexico led all fifteen countries surveyed in 2001 with just twenty-six percent of the survey respondents correctly identifying that burning fossil fuels was the primary cause of global warming. The citizens of the U.S., among the most educated in the world, where somewhere in the middle of the pack, tied with the citizens of Brazil at fifteen percent. Even the Cubans, at seventeen percent, were slightly more informed than the American public (Brechin, 2003).

The effects of global warming increase day by day. We can't leave that the earth's temperature warmer. Our knowledge about how the dangers, effetcs, dan preventive is important and become a claim for human. The effects have been predicted influence whether, see levels, beach, agriculture, wild animals, human's health, social and politics. We can not avoid its effects in the future by doing or even more discussing the steps, but we can prevent more increased climate change in the world, such as damage to the beach. That area should be protected by wall and barrier to prevent in sea water. The other way, the government should move the coastal populations to the higher place. As in USA, they saved plans and animals by keeping quite their habitats. So the long way from south till north empty and they could move to the cooler place. As comparison to Indonesia, the knowledge about global warming has not been a concern of Indonesian government because: (a) curriculum has not been perfect. It is shown from the lack of curriculum in Indonesia that gave the charge of global warming the material to suit every level of education, (b) Law enforcement against environmental preservation weak. It show the existence of cases of violations of law related to the logging that legal action was lacking, (c) there are still many people who do not know and do not care. This shows still foolishly future society to a polluted environment.

It is a result of the lack of knowledge about the importance of global warming, so we need further research on knowledge about global warming and how its implications in reducing the impact of global warming. Suyatna and Rosidin (2016) showed that student's understanding about the causes and effect of global warming was still low. The teachers need to design an assesment model to upgrade their learning in class, then solve the problem of global warming. One of the models is critical thinking. It can include all component of scientific approach by doing some techniques and test forms.

A study of 230 teachers and 573 junior and senior high school students in the province of Lampung, Indonesia was conducted for allegedly weak knowledge of teachers and students about global warming. In this paper, recent research about global warming, knowledge about global warming will be discussed, the position of knowledge about global warming in education, science findings on global warming and its implications will also be in a pillowcase in a comprehensive manner.

Realizing the huge impact of global warming in Indonesia, the government considers that it is important to take special measures to reduce the impact of global warming. One important factor in preventing the impact of global warming is the attitude of environmental care. Fosters environmental awareness can be built through the education process (Skamp, Boyes, & Stanisstreet, 2009). Taber and Taylor (2009) states that the strategies needed for effective learning for students about global warming. If the public's knowledge about the environment in general increased, then they will act carefully to avoid environmental degradation (Yazdanparast, Salehpour, Masjedi, Seyedmehdi, Boyes, Stanisstreet, &Attarchi, 2013). The Indonesian government took a step to combine the materials of global warming into a basic competence in physics and science lessons insenior high school and junior high school curriculum in 2013, but in 2006 Curriculum (KTSP), no discussion about global warming because at this time in Indonesia using two types of curriculum that is, KTSP and Curriculum 2013. Everyone has to learn, what is global warming and hot to decreasing the impacts. It can be started when studying at high school which is part of education communities (Suyatna & Rosidin, 2016).

The importance of knowledge about global warming has to be introduced to the public since the beginning by providing knowledge in school. Global warming materials can be obtained in the subjects of senior and junior high school physics curriculum 2013. The purpose of the curriculum is increasing the competence of global warming in the learning process because this knowledge which can gradually make people aware that the cause of global warming is due to human activity itself.

The results of the research presented by Yazdanparast et al., (2013) showed the students did not get enough information about the phenomenon of global warming. It is only about 5% of the students can explain the phenomenon of global warming well, while 50% of students were not able to answer questions about the research warming. Therefore, the understanding of global warming should be internalized to the teachers' and students' in Indonesian especially for primary and secondary school.

## Purpose

This correlation study was intended to investigate the knowledge and the attitudes of teachers and students toward global warming. For teacher, the teaching background (science, social, art, others), gender (male,female), where they teach (Junior High School/JHS, Senior High School/SHS), educational background (bachelor, master) are studied to find out its relationship with the teachers' knowledge of global warming. For student, the relationship between the knowledge of global warming with gender and initial concept are also studied for senior and junior high school students. It is very important in order to take out a policy on teacher preparation and search media, resources, methods, models of global warming effective learning to learn.

## Method

The research sample are 230 teachers (93 person teach in JHS and 137 in SHS as presented in table 1) and 573 students (251 person study in JHS and 322 in SHS as presented in table 2) that was taken purposively from 7 JHS and 11 SHS in the smoke disaster area in Lampung Province, Indonesia. The use of purposive technique in this research are based on the consideration of the location of school as the most frequent smoke disaster area in Lampung Province.

The data was collected using a written test that consist of 15 questions with three options (true, false, and do not know) to explore students' understanding about global warming. The test instrument was validated by 2 expert in science education and 1 expert in pedagogy. Moreover, validation result was discussed in Peer Group of Physics Education at University of Lampung to ensure the validity and reliability for each item test. Moreover, students' responses was scored for further analyses using *One Way* ANOVA to compare the mean difference of global warming knowledges between students' at different educational levels and gender. Furthermore, Tukey Multiple Comparison method performed to determine which variables are different, Correlations Spearman's rho was also performed to analyze of the correlation between attitudes and knowledge about Global Warming.

**Table 1.** The identity and background of the teacher sample

| Teacher Identity and background | | N |
|---|---|---|
| Field of study | Science | 50 |
| | Social | 98 |
| | Art | 41 |
| | Others | 41 |
| Gender | Male | 96 |
| | Female | 134 |
| Teaching in- | JHS | 93 |
| | SHS | 137 |
| Level | Bachelor | 215 |
| | Master | 15 |

**Table 2.** Class and the background of the student sample

| Classes and Schools | Already Studying Global Warming | N |
|---|---|---|
| SHS Grade 10 | No | 196 |
| SHS Grade 11 | Yes | 126 |
| JHS Grade 7 | No | 165 |
| JHS Grade 8 | Yes | 86 |

Note:
SHS = Senior High School
JHS = Junior High School

## Result and Discussion

Knowledge of global warming of teachers in Lampung Province is very low. The average score of only 3.2 out of 10 scale. The educational background of teachers have no

effect on the teacher's knowledge about global warming (Table 3). This is indicated by one-way ANOVA test results, there was no significant difference (p = 0.213> 0.05) in scores obtained knowledge about global warming.

**Table 3.** Scores Teachers Knowledge About Global Warming

| Education Background | N | Scores Knowledge About Global Warming |
|---|---|---|
| Other | 41 | 3.0<br>3.1<br>3.3<br>3.4<br>0.213 |

Knowledge of global warming of the students in the Province of Lampung is low but better than the teacher. The average score of 3.6 out of 10 scale. Educational backgrounds and levels of students have an effect on students' knowledge about global warming (Table 4). This is indicated by one-way ANOVA test results, there was a significant difference (p = 0.000 <0.05) in scores obtained knowledge about global warming.

**Table 4.** Scores Students Knowledge About Global Warming

| Level and Schools | Already Studying Global Warming | N | Scores Knowledge About Global Warming |
|---|---|---|---|
| SHS Grade 10 | No | 196 | 4.1 |
| SHS Grade 11 | Yes | 126 | 3.6 |
| JHS Grade 7 | No | 165 | 3.5 |
| JHS Grade 8 | Yes | 86 | 3.2 |
| p | | | 0.000 |

Note: SHS= *Senior High School* & JHS= *Junior High School*

Compared with the teachers, the students' knowledge about global warming is better. The average value obtained significantly different. It is obtained from the test results mean difference t-test, shown in Table 5.

**Table 5.** Differences Knowledge About Global warming Between Teachers And Students

| | | Levene's Test for Equality of Variances | | Independent samples t-test | | | |
|---|---|---|---|---|---|---|---|
| | | F | p | t | df | p | mean Difference |
| Score | Equal variances assumed | 17.568 | 0.000 | -3.751 | 801 | 0.000 | -0.40262 |
| | Equal variances not assumed | | | -4.121 | 523.827 | 0.000 | -0.40262 |

The results showed knowledge of teachers and students about global warming is very low. Knowledge of students is higher than that of the teachers. There was no difference in knowledge between teachers caused by field of study, gender, or where they teach (Table 6). There is a difference between SHS students who have studied global warming with who have not yet learned, but in JHS students no difference (Table 7). There is no difference in students' knowledge of global warming caused by gender (Table 8). Other findings from this study, which is about 66.67% of respondents have knowledge about global warming that affects their attitude towards the environment. It can be specifically demonstrated by the data in tables below.

**Table 6.** Teacher Tests of Between-Subjects Effects
Dependent Variable: global warming Score

| source | Type III Sum of Squares | df | F | p |
|---|---|---|---|---|
| corrected Model | 35.810 [a] | 25 | 1,070 | 0.380 |
| intercept | 343.315 | 1 | 256.445 | 0.000 |
| field | 4.950 | 3 | 1.232 | 0.299 |
| Sex | 3.052 | 1 | 2.280 | 0.133 |
| Teach | 0.956 | 1 | 0.714 | 0.399 |
| Degree | 3. 978 | 1 | 2.972 | 0.086 |
| Field * Sex | 2.146 | 3 | 0.534 | 0.659 |
| Field * Teach | 8.423 | 3 | 2.097 | 0.102 |
| Field * Degree | 2.033 | 3 | 0.506 | 0.678 |

**Table 7.** Multiple Comparisons of Student Dependent Variable: Score Tukey HSD

| (I) Class | (J) Class | Mean Difference (IJ) | p | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| | SHS-LGW | -0.4674 * | 0.023 | -0.8883 | -0.0465 |
| SHS-NLGW | JHS-NLGW | 0.1254 | 0.840 | -0.2640 | 0.5148 |
| | JHS-LGW | 0.4194 | 0.107 | -0.0573 | 0.8961 |
| | SHS-NLGW | 0.4674 * | 0.023 | 0.0465 | 0.8883 |
| SHS-LGW | JHS-NLGW | 0.5928 * | 0.003 | 0.1568 | 1.0289 |
| | JHS-LGW | 0.8868 * | 0.000 | 0.3713 | 1.4023 |
| | SHS-NLGW | -0.1254 | 0.840 | -0.5148 | 0.2640 |
| JHS-NLGW | SHS-LGW | -0.5928 * | 0.003 | -1.0289 | -0.1568 |
| | JHS-LGW | 0.2940 | 0.411 | -0.1962 | 0.7842 |
| | SHS-NLGW | -0.4194 | 0.107 | -0.8961 | 0.0573 |
| JHS-LGW | SHS-LGW | -0.8868 * | 0.000 | -1.4023 | -0.3713 |
| | JHS-NLGW | -0.2940 | 0.411 | -0.7842 | 0.1962 |

Note: NLGW = Not Learning Global Warming & LGW = Learning Global Warming &
SHS = Senior High School & JHS = Junior High School

The analysis result has been obtained that the knowledge of teachers and students is very low, at 3.2 and 3.6 on a scale of 10. However, the students's knowledge about global warming is better than the teacher. The educational background of the students and school levels also show a significant difference. However, there is no difference in knowledge between teachers caused by field of study, gender, or place of teaching. SHS students who have been studying global warming have better knowledge significantly than who have never been studied, but this is not a significant effect on JHS students.

Based on gender, both boys and girls, do not show any significant differences in the level of knowledge on global warming.

**Table 8.** Student Tests of Between-Subjects Effects
Dependent Variable: Score

| Source | Type III Sum of Squares | df | F | p |
|---|---|---|---|---|
| corrected Model | 49 572 [a] | 7 | 3461 | 0.001 |
| Intercept | 6560.369 | 1 | 3206.303 | 0.000 |
| Class | 37,582 | 3 | 6.123 | 0.000 |
| Sex | .634 | 1 | 0.310 | 0.578 |
| Class * Sex | 3518 | 3 | 0.573 | 0.633 |
| Error | 1156.038 | 565 | | |
| Total | 8848.530 | 573 | | |
| corrected Total | 1205.610 | 572 | | |

The existence of the gadget should provide a better understanding of all things though are not taught in formal school. Quality information is accessible to the widest indefinitely. The combination of the role of parents and teachers are also required in this regard. In order to further strengthen the basis of the importance of the protecting environmental sustainability. Better yet, if the activities of students in private schools have maximized, giving the opportunity to more freely study nature without having distressed state. With frequent involving the environment to the learning process, students's knowledge and understanding will grow entrenched as the alternation of time.

When variable educational background and gender already obtained the results, it appears the other variables that can be explained that there is a correlation between knowledge and attitudes that can affect the environment (Table 9). There is a correlation between knowledge and attitudes on SHS students on the environment, while at JHS students there is no correlation. This gives an indication that for JHS age students and the previous administration of knowledge about global warming must be given a strong foundation of their positive attitudes towards global warming. As for SHS age students and there after planting the attitude and the provision of knowledge about global warming can be done together or in tandem.This study were related with previous research result (Kumurur, 2008) which states that the attitude and knowledge correlated while a person's age also affects it too.

**Table 9.** Relationship between Attitudes and Knowledge of Global Warming

| Level, Schools, Experience | N | correlation Coefficient | p(2-tailed) |
|---|---|---|---|
| JHS students Grade 7-NLGW | 32 | 0.001 | 0. 998 |
| JHS students grade 8-LGW | 32 | 0.021 | 0.910 |
| SHS students grade 10-NLGW | 33 | 0.379* | 0.030 |
| SHS students in grade 11-LGW | 33 | 0.399 * | 0.021 |

Note: * Correlation is significant at the 0:05 level (2-tailed).
NLGW = Not Learning Global Warming
LGW = Learning Global Warming
SHS = Senior High School
JHS = Junior High School

Students are more mature and have better knowledge about global warming would have a disagreement on the behavior that led to the increasing greenhouse gases and are willing to sacrifice pleasures. Agree to save electric energy and are willing to ride bicycle

or bus Instead of the motorcycles in order to reduce the contribution of greenhouse gases into the atmosphere is approved by adult students who have a good understanding of the impact of global warming. This indicates that the importance of a better understanding of global warming as early as possible. In addition, it also points out that the attitude and knowledge correlated are influenced by a person's age. The longer the age, the more does not guarantee his/her attitude. Childhood perhaps have been taught how to dispose of waste in place, put things back in place, save paper, and so on. When mature, very few are still holding those principles. They are more demanded on the modernity of the times, the company's progress, and smooth construction without reconsider the balance of the environment.

## Conclusions

Based on research data, educational background of teachers do not affect the level of knowledge of global warming. In addition, teachers and students have little knowledge. This is reasonable because they do not learn about it in their previous studies. Thus, it can be explained that teachers and students are required to learn about it in order to understand well about global warming. This means the government must increase global warming materials with the educational curriculum. With their knowledge, they are expected to behave pro-environment. They always think twice to perform daily activities whether it can destroy or preserve the environment.

It becomes more interesting after knowing that when compared with teachers, students have better knowledge about global warming. It can be assumed that in the era of advanced technology, the students with their gadgets have more time to have access to information on global warming. Although they are not inadvertently given some success of public information campaigns on global warming (Whitmarsh, 2008). Therefore, the government must provide citizens, especially teachers and students more time to learn formally about it in school so that the knowledge they have regularly formed a pro-environmental behavior. In addition, there is no difference between teachers' knowledge caused by field of study, gender, or where they teach. This means that one of the factors that may affect the level of knowledge is information from the frequency of involvement in global warming. The teachers and students more often interact with it, the higher knowledge they have.

Based on the results of data analysis, it can be concluded that the knowledge of teachers and students about global warming is very low. Knowledge of students is higher than the teachers. There was no difference in knowledge between the teacher caused by field of study, gender, or where they teach. There is a difference between knowledge of SHS students who have studied global warming with who have not yet learned, but in JHS students there is no difference. There is no difference in students' knowledge of global warming caused by gender. There is a correlated between attitudes and knowledge about global warming at the SHS students and there is no correlated between attitude and knowledge at the JHS students. Students are more mature and have better knowledge about global warming would have a disagreement on the behavior that led to the increasing greenhouse gases and are willing to sacrifice pleasures.

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## Disclosure statement

The Authors reported that no competing financial interest.

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