What students know about climate change? a case study of high school students in Samboja, Indonesia

A W Nugroho
Research and Development Institution for Natural Resources Conservation Technology, Jl. Soekarno-Hatta km 38, Samboja, Kutai Kartanegara, Kalimantan Timur, Indonesia

email: arditanto.nugroho@gmail.com

Abstract. Indonesia is among the top 10 highest countries in the world producing huge amount of greenhouse gases (GHG) to the atmosphere. However, climate change including its impacts might not be understandable by public in Indonesia. This is because climate change is not a crucial issue in this developing country. Education can play important roles in supporting national policies in reducing GHG in Indonesia by communicating climate change and in raising environmental awareness among people including students in schools. This study aims to determine high school students’ perceptions about climate change, to provide insights for curriculum planning to combat climate change. Furthermore, this study can also provide some strategies to the government changes by improving formal education in combating climate change. This study is conducted in the 6 selected high schools in Samboja district, Kutai Kartanegara regency, East Kalimantan province, Indonesia. Data collection was conducted from February to March 2017. Primary data is collected by using questionnaires, which are distributed to the 1st, 2nd and 3rd grade students in each selected high schools. In total there are 360 students participating in this study. Results shows that majority of students in this study have heard about climate change, however their answer are inconsistent. This indicates that these students do not fully understand about climate change. Furthermore, students also do not know about the main causes of climate change. In conclusion, climate change issues need to be elaborated in science curriculum. It is suggested that the government should introduce policies in education sectors to inform about climate change.

1. Introduction
Indonesia is among the top 10 highest countries in the world producing huge amount of greenhouse gases (GHG) to the atmosphere. According to Climate Watch, the country’s total GHG emission is 2.47 Gt CO$_2$e in 2014, in which emission from land use change and forestry sector is the highest of emission, accounted for 1.7 Gt CO$_2$e [1]. A report from DNPI & MC Kinsey shows that deforestation and forest degradation including forest fires are the main source of GHG in Indonesia [2]. Meanwhile, Ministry of Environment and Forestry reports that the rate of deforestation in this country is significant, amounting 0.61 million ha per year in 2014 [3]. However, Indonesia is committed to decrease its national emission by 29% from business as usual scenario by 2030, which was stated in
the Conference of Parties (COP) 21 [4]. Therefore, significant efforts should be made to decrease the GHG emission in Indonesia.

However, climate change including its impacts might not be understandable by public in Indonesia. This is because climate change is not a crucial issue in this developing country. Most of public debates in Indonesia are dominated by country’s economic improvement as well as poverty elimination. A study reports that 81.9% of surveyed households in Indonesia have paid attention to climate change, but only 38.9% of those households are followed by reactive actions and 28.2% are followed by proactive actions [5]. This indicates that public in this country have not fully comprehended climate change. Therefore, providing excellent education about climate change can be a solution to raise awareness about climate change in Indonesia.

Education can play important roles in supporting national policies in reducing GHG in Indonesia by communicating climate change and raising environmental awareness among people including students in schools [6]. The increasing environmental awareness among students would influence public awareness. In addition, policy implementations which is aimed to reduce GHG in Indonesia seems to be ineffective due to lack of public awareness on climate change. Therefore, improving education and discourses about climate change and its impacts among people in this country is essential. As a consequence, it would facilitate the government in implementing policies related to GHG emission reduction. In addition, raising environmental awareness among students also has benefited by creating next greener generation in the future.

In Indonesia, studies related environmental education focusing on climate change is lacking. This education is important to support policy implementation aiming at emission reduction. This study aims to determine high school students’ perceptions about climate change, and to provide insights for curriculum planning to combat climate change. Furthermore, this study can also provide some strategies to the government changes by improving formal education in combating climate change.

2. Material and Methods

2.1 Study area

This study was conducted in the 6 selected high schools in Samboja district, Kutai Kartanegara regency, East Kalimantan province, Indonesia. Information about selected high schools was derived from the Ministry of Education website. From the website, high schools are selected based on its distance proximity from the government office of Samboja district. Based on observation conducted before, these 6 high schools represent the school quality based on public opinion.

Table 1. List of high school students involved in this study.

| No | Name of high school       | Number of students | Estimated distance from Samboja district office (km) |
|----|---------------------------|--------------------|------------------------------------------------------|
| 1  | SMA Negeri 1              | 90                 | 0.2                                                  |
| 2  | SMK Diponegoro            | 31                 | 3                                                   |
| 3  | SMK Pesisir               | 30                 | 5.5                                                  |
| 4  | SMK Al-Jabal Nur          | 89                 | 11                                                   |
| 5  | MA Nurrudin               | 80                 | 4                                                   |
| 6  | SMA Harapan               | 40                 | 11                                                   |
|    | Total students            | 360                |                                                      |

2.2 Data collection

Data collection was conducted from February to March 2017. Primary data was collected by using questionnaires. Primary data in this study are students’ perception about climate change which is implied from students’ answers. Questionnaires are distributed to the 1st, 2nd and 3rd grade students in each selected high schools. If there are more than one class in each grade, it is only taken one class to represent each grades and it is selected by the teacher. In total there are 360 students participating in this study. Questions are prepared by a research team, consisting pairs of open and closed questions.
The open questions are intended to provide freedom to the students in giving opinions and answers to the questions. Meanwhile, closed questions are intended to confirm previous questions, allowing to test consistency of the answers in the questionnaires. There are 3 pairs of questions in the questionnaires. Students are qu to answer “yes” or “no” in response to the closed questions, while in the open questions, students are questioned to answer and the answers are accompanied with some explanations, reasons and opinions.

In this study, consistency in responding each pair of questions is measured to obtain accurate responds from the students. Consistent answer from students are obtained if the students answer “yes” in responding to the close questions, followed by correct answer at the open questions. Here, the correct answers are indicated if the responds contained some key words, such as: global warming; changes in weather, temperature or season pattern.

Table 2. Questions list asked to 6 high schools in Samboja

| No | Closed Questions list | open Questions list |
|----|------------------------|---------------------|
| 1  | Have you ever heard climate change? | Can you please explain what climate change is. |
| 2  | Do you know what the main causes of climate change are? | Can you please explain what the main causes of climate change are. |
| 3  | Do you think that climate change is a global threat? | Can you please explain why climate change is a global threat. |

2.3 Data analysis
Descriptive and analysis of variance statistics (anova) are used to analyze data in this study [7]. Descriptive statistic is applied to describe responses of students to the questions in the questionnaires. Meanwhile, anova two-factor without replication statistics is applied to determine significant differences in responding each pair of questions between schools and school grades in this study. In this study, anova two-factor without replication is calculated using Microsoft Office Excel 2010.

3. Results and Discussions
3.1 Students’ Responses to Questions
Results of this study are shown in picture 1-3, while the statistical analysis is presented in table 3-5. In responding to the first question, average of 89% students from 6 high schools in Samboja District state that they have heard climate change term. However, of that 89%, the average proportion of consistent answers are much lower, accounted only 24%. This means that although most students in this study have already known climate change term, only small proportion of the students could explain correctly what climate change is. Meanwhile, 8% on average students of 6 high schools in this study state that they have not known the term of climate change, while the proportion of students who are not providing answer is 3% on average. Unfortunately, these students do not provide answers why they do not know the term of climate change.

In detail, the high proportion of 100% and 93% students in the 1st and 3rd grade of SMK Diponegoro claims that they have known climate change term but the proportion of consistent answers is only 33% and 29% respectively (figure 1). Surprisingly, 75% of all 2nd grade students in this high school have the highest proportion of consistent answers to the 1st question, compared to the other 6 high schools in this study (figure 1). There are only 8 2nd grade students of SMK Diponegoro who participate in this study and their answers state that ‘climate change is caused by global warming’. On the other hand, students who provide inconsistent answer are those who do not provide answer to the open questions.

In responding the 1st question, students who give consistent answers are mainly describing the main causes of climate change rather than defining the term of climate change (figure 1). Global warming, deforestation, greenhouse gases, and air pollution are the popular answers in responding the
1st question. On the other hand, students who give inconsistent answer to the 1st question mainly explains that climate change is: seasonal changes; weather changes; or changes in temperature and humidity. They might have heard climate change but they could not give accurate answer to the questions.

![Have you ever heard about "climate change"? (%)](image)

**Figure 1.** Responses of 1st, 2nd and 3rd grade students in five high schools in Samboja when they respond to a question: “have ever heard climate change?”

| School          | 1st | 2nd | 3rd |
|-----------------|-----|-----|-----|
| SMA Herapam     | 98% | 81% | 100%|
| MA Nurdin      | 82% | 78% | 88% |
| SMK Al-Jabali   | 76% | 86% | 96% |
| SMK Pesisur     | 87% | 93% | 100%|
| SMAN 1 Samboja | 90% | 84% | 93% |

![Table 3. Statistical analysis results in response to the 1st pair of questions](image)

| Source of Variation | P-value | Statistical Results     |
|---------------------|---------|-------------------------|
| Number of student answering "Yes" to the 1st question | 0.0354929 | Significantly different |
| Number of consistent answers for 1st question | 0.006763 | Significantly different |

Results from statistical analysis show that there is a significant different in the number of students in answering “Yes” to the 1st question among the 6 high schools in this study (Table 3). This might be due to striking different in the average number of students’ respond to the 1st question. For example, there are totaling of 80 students from the 1st to 3rd grade who give that 1st answer in SMUN 1 Samboja, compared to only 26 students in SMK Pesisir who are responding similar question. This phenomenon is also similar to the number of consistent answers among the 6 high schools in this study. There are
20 consistent answers among the students of SMU N 1 Samboja, compared only 3 students of SMK Pesisir.

However, statistics analysis results also show that the number of students responding “yes” to the 1st question and the number of consistent answer are insignificantly different among school grades in this study (Table 3). This indicates that there is homogeneous in term of response among school grades in the 6 high schools in this study. These results indicate that only small proportion of high school students understand the definition of climate change.

There are several possible reasons why majority of high school students in this study could not provide climate change definition accurately. First, climate change is not taught as a main subject in high schools in Samboja but it is included in environmental education subject. However, environmental education is only taught in several schools because the subject is not compulsory. Furthermore, environmental education is not included in the subject of evaluation in the mid and end of semester. As a result, climate change is a less popular issue among high school students in this study.

The other reason why majority of high school students in this study could not provide climate change definition accurately is probably because of the existence of coal mining in Samboja. Coal mining practice creates bigger environmental issue in Samboja: floods, air pollution, and acid mining drainage. In fact, Samboja have been awarded as a district with the most mining permits in Indonesia [8]. These environmental problems directly affect not only students but also people in Samboja rather than climate change. As a consequence, climate change issue is overlooked due to coal mining.
Table 4. Statistical analysis results in response to the 2nd pair of questions

| Source of Variation | P-value   | Information            |
|---------------------|-----------|------------------------|
| "Yes" answer for 2nd question | Schools | 0.135344 | No significant different |
|                     | School grade | 0.666381 | No significant different |
| Consistent answer for 2nd question | Schools | 0.064317 | No significant different |
|                     | School grade | 0.772446 | No significant different |

In responding to the 2nd question (figure 2), average of 60% students from 6 high schools in Samboja District state that they have known what the main causes of climate change are. That figure could be lower because 100% of 3rd graders of SMK Diponegoro, claim they know what the main causes of climate change are (figure 2). At the 2nd and 1st grade of this school, the figure is also high, more than 80%. However, only 35% of that 60% average students in the 6 high schools could provide consistent answers. This indicates that only small proportion of high school students could explain the main causes of climate change correctly.

From the statistical analysis (table 4), results show that both the percentage of students responding “yes” to the 2nd question and the number of consistent answers are insignificantly different among the 6 high schools and among all the 3 school grades (table 4). This indicates that in all the six high schools in this study, the majority of students do not fully understood the main causes of climate change.

Students who give inconsistent answers to the 2nd question mainly provide reversed answers by describing the climate change impacts as climate change’s main causes, for example; ice melting, irregular weather or temperature changes. The other reasons why student give inconsistent answers to the 2nd question in this study are incorrect answers, for example; sea tidal wave, earth rotation and gravity, earth plate moving. Therefore, there are misunderstanding in term of causes and effects of climate change among the 6 high schools in this study.

In addition, in responding the 2nd question, there are 35% on average of students in the 6 high schools in this study state that they do not know what the main causes of climate change are. In detail, the highest proportion of 70% of the 1st graders in SMU N 1 Samboja and lowest proportion of 11% of the 1st graders of SMK Diponegoro declare that they do not know what the main causes of climate change are (figure 2). Meanwhile, the average proportion of students giving no response to the 2nd question among 6 high schools is only 4%.

Table 5. Statistical analysis results in response to the 3rd pair of questions

| Source of Variation | P-value   | Information            |
|---------------------|-----------|------------------------|
| "Yes" answer for 3rd question | Schools | 0.25909 | no significant different |
|                     | School grade | 0.627146 | no significant different |
| Consistent answer for 3rd question | Schools | 0.139947 | no significant different |
|                     | School grade | 0.154842 | no significant different |

Student responses to the 3rd questions are relatively similar to the 2nd question’s responses. As many as 56% on average of students in the 6 high schools in this study think that climate change is a global threat, with the average proportion of consistent answer of 32%. This indicates that large proportion of students among the 6 high schools in this study consider that climate change is not a major problem. In detail, only 28% (with 22% of consistent answer) of 2nd graders of MA Nuruddin believe that climate change is a global threat (figure 3). This is the lowest proportion related to the response of 3rd question. On the other hand, as many as 79% (with 59% of consistent answer) of 3rd graders in SMA N 1 Samboja believe that climate change is a global threat, which is the largest proportion related to the 3rd question’s responses.
Figure 3. Responses of 1st, 2nd and 3rd grade students in five high schools in Samboja when they are asked a question: “Do you think climate change is a global threat?”

The analysis statistic also confirms that there is no significant different among the 6 high schools and school grades which are indicating that majority of students in the 6 high schools have relatively similar opinion related to the threats of climate change. In addition, average of 38% of six high schools in Samboja district believe that climate change is not a global threat, while average 7% give no answers.

Students who answer consistently to the 3rd question are mainly think that climate change can cause diseases; climate change can lead to disasters, floods, landslides, drought, forest fires, crop failures, rising temperatures or ice melting. On the other hand, inconsistent answers to the 3rd question given by students are mainly due to incorrect answers in responding further question of why climate change is considered to be a global threat.

3.2. How “big” climate change issue is understood among students?

As a global environmental problem, climate change needs to be communicated to the students. Similar to Indonesia, climate change might not a “big” issue among students in several countries in the world. A study reports that considerable proportion of eight and eleven grade students are unable to accurately recognize the main causes of climate change in Greek, only 33% of 344 eight graders and 43% of 282 eleven graders could provide right answer in answering the main causes of climate change [9]. The study reveals that students are better in explaining climate change impacts and in providing
their solutions rather than finding the climate change causes. The study also reveals that television is the main source of information related to climate change (81% for 8th graders and 87% for 11th graders).

Another study reports that 52% of 646 7th grade students in Turkey have heard about climate change, but only 29.9% states that climate change is catastrophic [10]. In addition, a study reported that 10th grade students including pre-service teachers in Queensland, Australia have low understanding and knowledge of climate change [11]. Thus, climate change might also be less important issue among students in the world.

3.3. How to improve student’s understanding about climate change?

This study indicates that there is lack of understanding about climate change among students in Samboja, East Kalimantan which could potentially occur in the other high schools in the other part of Indonesia. This is because in East Kalimantan climate change is not directly taught in high schools, therefore students might obtain information about climate change from other sources such as television, internet or other sources. However, there is no study to support this argument. Nevertheless, in combating climate change, some efforts have been made by the provincial government of East Kalimantan, for example: the establishment of climate villages [12].

To improve students’ understanding on climate change, there are several strategies suggested from some studies. For example, improving understanding about climate change for students that could be done by improving scientific literacy among students, which could be achieved by participating in a sociological inquiry based learning project [13]. Meanwhile, Nam & Ito (2011) report that scientific literacy by attending climate change course also improve climate change understanding among undergraduate students [14]. Media literacy is also promoted by Cooper (2011) to improve public understanding and acceptance about climate change [15]. In addition, Svihla & Linn (2012) suggest interactive visualization to improve students understanding on climate change [16], while Jacobson, Seavey, & Mueller (2016) promote to integrate art and science for communicating climate change [17].

4. Conclusions

In conclusion, climate change is considered not an important problem for majority of high school students in this study, even though they have recognized the problem. Almost all of students in the 6 high schools in Samboja have heard about climate change, however only small proportion of them who can explain what climate change is. This indicates that large proportion of students in this study do not fully understand climate change. Meanwhile, although more than half proportion of students in this study state that they have known the main causes of climate change, only small proportion among them can provide accurate answers. Only a third of high school students in this study think that climate change is a global threat.

Based on the study, it is recommended that climate change needs to be taught to students to raise awareness and improve understanding about climate change. Therefore, climate change could be considered as an important issue. Climate change could be taught in environmental education subject to improve students’ literacy, and thus public understanding about climate change improves. Ministerial of education of Indonesia might need to be involved to combat climate change, particularly in schools.

Acknowledgements

We thank to the Ministry of Environment and Forestry of Republic of Indonesia for funding this research. We also thank to the high schools in this study for granting permission to conduct the study: SMUN 1 Samboja, MA Nuruddin, SMK Diponegoro, SMK Pesisir, SMK Jabal Nur, SMA Harapan. We would also like to thank to Mukhlisi, Adi Surya, and Widyawati for assisting the data collection and data entry during the fieldwork.
References
[1] Climate Watch 2018 Indonesia Greenhouse Gas Emissions and Emissions Targets (Washington DC: World Resource Institute and Partners)
[2] DNPI and MC Kinsey 2010 Indonesia’s Greenhouse Gas Abatement Cost Curve (Jakarta: Kementerian Lingkungan Hidup)
[3] Ministry of Environment and Forestry 2015 Statistik Kementerian Lingkungan Hidup dan Kehutanan Tahun 2014 (Statistics of Ministry of Environment and Forestry 2014) (Jakarta: Ministry of Environment and Forestry)
[4] UNFCCC 2015 Paris Climate Change Conference - November 2015 (Bonn: UNFCCC)
[5] Bohensky E L, Smajgl A and Brewer T 2013 Patterns in household-level engagement with climate change in Indonesia Nat. Clim. Change. 3 4 348
[6] Anderson A 2010 Combating climate change through quality education (Washington, DC: Brookings Global Economy and Development)
[7] Sugiyono 2005 Statistika untuk Penelitian Vol 8, ed A Nuryanto (Bandung: Alfabeta)
[8] Wiharzandi A 2012 Samboja, Kalimantan Timur: Kecamatan dengan Ijin Tambang Terbanyak di Dunia. (Kalimantan Timur: Mongabay.com)
[9] Liarakou G, Athanasiadis I and Gavrilakis C 2011 What Greek Secondary School Students Believe about Climate Change? Int. J. of Env. and Sci. Edu. 6 1 79–98.
[10] Özdem Y, Dal B, Öztürk N, Sönmez D and Alper U 2014 What is that thing called climate change? An investigation into the understanding of climate change by seventh-grade students. Int. Resch. in Geo. and Env. Edu. 23 4 294–313
[11] Boon H J 2010 Climate change? Who knows? A comparison of secondary students and preservice teachers Australian J of Teach. Edu. 35 104–120
[12] Ghofar M 2018 Kalim Targetkan 200 Kampung Iklim (East Kalimantan to Target Establishing 200 Villages of Climate) Retrieved May 24, 2019, from https://www.antaranews.com/berita/744404/kaltim-targetkan-200-kampung-iklim
[13] McCright A M 2012 Enhancing students’ scientific and quantitative literacies through an inquiry-based learning project on climate change. J. of the Sch. of Teach. and Learn. 12 4 86–101
[14] Nam Y and Ito E 2011 A climate change course for undergraduate students J. of Geosci. Edu. 59 4 229–241
[15] Cooper C B 2011 Media literacy as a key strategy toward improving public acceptance of climate change science. BioSci. 61 3 231–237
[16] Svhila V and Linn M C 2012) A design-based approach to fostering understanding of global climate change. Int. J. of Sci. Edu. 34 5 651–676
[17] Jacobson S, Seavey J and Mueller R 2016 Integrated science and art education for creative climate change communication. Ecol. and Soc. 21 3