Investigating junior high school students’ perception of global warming topic using semantic network analysis

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Abstract. Understanding how students perceive global warming concept is important for their metacognition. A total of 241 junior high school students including all grades were involved in this research. With an open-ended question, this research identified students’ perception of global warming concept. Semantic network analysis was chosen as the method to determine and displayed students’ perception by checking the connection of the words used to response the open-ended question. After the process of analysis, there were three main statements from students to define global warming: (1) Increase of earth temperature, (2) depletion of ozone layer, and (3) greenhouse gas and human activities as the cause of global warming. The result of this research can be used to develop the teaching method which can motivate the students’ scientific thinking.

1. Introduction

The Intergovernmental Panel on Climate Change has stated that global warming is unavoidable and human activities are the main cause of it [1]. The impact of global warming is mainly due to our local use of fossil fuels such as in heating or supplying our homes transportation as a by-product of burning which produces carbon dioxide, and other gas containing-chemical. This issue made global warming as the global concern of 21st century [2].

Teaching about global warming to the students is important for advancing well-rounded students, and in order to control a critical deficiency in atmospheric science. Teaching about global warming gives a natural context for learning science, through personal and social implementation [3]. One aim of science education is to educate students who are actively interested in science [4]. Teaching about environmental issues such as global warming requires students to take responsibility for the management and policymaking, thus it is very important to open up their conceptions about these issues [5]. An emphasis on meaningful learning is compatible with the concept of learning as a building of knowledge, in which students try to explain their experiences [6]. In many resources the search for science content also forces students to have scientific literacy rather than information literacy. Science literacy itself is the capacity to understand scientific processes and use scientific knowledge accessible in everyday life in a practical way [7]. Referring to constructivism theory, learning science needs to determine learners’ existing cognitive structures and establish new understanding by changing or rearranging. Therefore, unveil learners’ existing knowledge and understanding will improve their cognitive structures [8].
Science education is one of the key reasons that are necessary for human development. One vital point that needs to be addressed is the student's conception as a learner [9]. Individual’s structure of knowledge consists of “pieces”, where their understanding or perception of a specific concept is connected to another concept [10]. These pieces of knowledge will build a structure of knowledge. The network of conceptual can be discovered by the words or the vocabularies used to define the perception of science concept [11]. The language network of analysis has been used to investigate and show students’ perception in educational field recently [12]. Semantic network analysis is one of methods that can be used to grasp students’ perception from written statement and also display the network of the statement [13]. Therefore the objective of this research is to investigate how the students from junior high school level including all grades define global warming topic. And the research question of this research was: how do junior high school students perceive the meaning of global warming?

2. Methods
The participants of this research were 241 students from Islamic-based junior high school (Mts) which located in Cimahi. The students which involved in this research were in their first (45 students), second (89 students), and third (107 students) grades of junior high school. Both of gender, male and female were also involved in this research. The research instrument used was an open-ended question related to the definition of global warming, questioning “What do you know about global warming?”. The open-ended question was translated into Bahasa because the school used Bahasa as their instructional language. The research question was distributed virtually using an online platform to the students.

The data collected then first translated into English using Google Translate functions that available in excel, since the program is only able to analyse data that written in English or Korean. The program used to analyse the data is NetMiner 4.0 software. NetMiner is application software used for exploratory analysis and visualise the pattern of a network data (Semantic Network Analysis). In order to make the data analysis adequate, not all the words on the data gained from the students were included. Some phrases such as “I do not know”, “I forgot” and other meaningless words were eliminated. Also “global” and “warming” words were not included because it appeared on the question and probably will affect the result of the analysis. From all the words available on the data, only the words which popped up 3 or more times (frequency) and had 3 or more connection to other words (weight) were chosen for the network analysis.

3. Result and Discussion
The result of students’ perception of global warming topic was displayed according to main words which performed in their responses. The main words were chosen based on its frequency (number of appearance), in-degree centrality (the connection between each words), and node betweenness (how much the words are in between the others). Those three elements can be operated as the indicator of a network analysis status [14]. Afterwards, the circle node which symbolized the words was visualized in the network maps. The higher value of frequency, the wider the circle node’s diameter will be.

3.1. words used by the students
As the result of the analysis, these were 17 words appeared as the most used words by the students to perceive global warming. The most frequent words along with its in-degree centrality and betweenness centrality value were displayed in Table 1.

As seen in the Table 1, the most frequent words were “earth”, “temperature” and “increase”. It indicated that students perceive global warming as an increase of earth’s temperature. Global warming is an increase temperature on earth’s surface and environment [15].
Table 1. The Most Frequent Words Used by Students

| No | Words         | F  | IDC   | BC  | No | Words         | F  | IDC   | BC  |
|----|---------------|----|-------|-----|----|---------------|----|-------|-----|
| 1  | earth         | 24 | 0.562 | 0.250 | 10 | effect       | 5  | 0.187 | 0.024 |
| 2  | temperature   | 23 | 0.375 | 0.076 | 11 | process      | 5  | 0.000 | 0.000 |
| 3  | increase      | 22 | 0.312 | 0.061 | 12 | depletion    | 5  | 0.250 | 0.021 |
| 4  | average       | 11 | 0.250 | 0.002 | 13 | air          | 4  | 0.250 | 0.002 |
| 5  | ozone         | 10 | 0.250 | 0.074 | 14 | change       | 4  | 0.000 | 0.000 |
| 6  | cause         | 10 | 0.312 | 0.150 | 15 | gas          | 4  | 0.125 | 0.037 |
| 7  | layer         | 8  | 0.250 | 0.023 | 16 | atmosphere   | 4  | 0.250 | 0.000 |
| 8  | due           | 8  | 0.250 | 0.051 | 17 | human        | 3  | 0.125 | 0.000 |
| 9  | greenhouse    | 7  | 0.312 | 0.039 |    |              |    |       |     |

Information: F = Frequency, IDC = In-degree centrality, BC = Betweenness centrality

For in-degree centrality, the words “earth”, “temperature” and “increase” still owned the highest value. The high value of in-degree centrality indicated that the words were located in the centre of the network map. The words “average”, “ozone” and “cause” also owned high value of in-degree centrality. It implied that students are likely to include those words if they are asked to define global warming. For betweenness centrality, the word “earth” has the biggest value, meant it was the most used word to define global warming. It was also marked that students tend to used word “earth” to explain the definition of global warming.

3.2. the network analysis

The result of semantic network analysis also able to visualize the network map of words that selected based on those elements that have explained above to represented students’ perception. Figure 1 shows the network map of words from students’ perception. There were 3 groups obtain from students’ answer to define global warming.

![Network Map of Words of Students' Perception toward Global Warming](image)

3.2.1 G1. Ozone layer depletion

The first group’s (Figure 1, G1) the highlight words from this group were “depletion”, “ozone”, and “layer”. It emphasized that students explain global warming as the depletion of ozone layer. Depletion of ozone layer is a process of thinning out the ozone layer in the upper atmosphere [16]. The word “due” is also appeared and associated with the words “greenhouse”, “effect” and “air”. Ozone layer depletion or annual gradually thinning of earth’s ozone layer in the upper atmosphere that caused by the releases of gases containing chemicals, which contributed to the greenhouse effect and air pollution [17].
3.2.2 G2. Increase earth’s average temperature
In the second group (Figure 1, G2) students perceived global warming as a process of increasing the earth average temperature. It proved by the connection of the words “earth”, “process”, “increase”, “average”, and “temperature”. According to Aizebeokhai, global warming refers to a process that causes the earth’s average temperature increase gradually [18]. The word “change” also popped up and linked to words “earth” and “temperature”. It referred to global warming caused the temperature on the earth’s surface to change and it tends to increase over years [19]. The last word which appeared in this group was “atmosphere” and it connected to “increase” and “average”. It showed that students thought that global warming increased the average temperature of the atmosphere. That statement was supported by Vachnadze, some researchers stated that global warming is the rise of the average atmospheric temperature [20].

3.2.3 G3. The influence of human
In the third group (Figure 4, G3) the word “human” appeared, and lined to the word “cause”. The word “cause” connected to the words “gas”, “greenhouse” and “air”. It indicated that students have known that there was a connection among human, greenhouse gas, and air. Human activities contributed to the global warming by producing large amount of greenhouse gases and air pollution to the earth’s atmosphere [21]. The word “human” also linked to “cause”, “greenhouse” and “effect”. It showed that human affected the greenhouse effect. Human boosted the greenhouse effect, human activities, primarily the burning of fossil fuels, are rising the amounts of carbon dioxide and other heat-trapping gases, raising the natural greenhouse effect and the earth’s temperature [22].

4. Conclusion
The objective of this research was to investigate students’ perception of global warming topic in junior high school level including all grades of students. The method used to analysis the result was qualitative method with network analysis approach. Specifically, this research identified the main words used to define the concept of global warming in the students’ cognitive structure in junior high school level. As the result, there were three main statements to define global warming based on students’ answer. (1) Students perceived global warming as an increase of earth’s temperature. Since the words “earth”, “increase” and “temperature” were the most frequent words used by the students. (2) Students also identified global warming as a depletion of ozone layer, it showed by there were words “ozone”, “layer” and “depletion” appeared in students response. (3) Students also have familiar with greenhouse effect, greenhouse gases and human activities as the cause of global warming. It manifested from the word “cause” was linked to the word “greenhouse” which also connected to the words “gas” and “effect”, the word “human” was also associated with the word “cause”.

This research revealed that the network analysis approach had neatly compiled students’ knowledge or perception of global warming concept and visualised the network map of words they used to define the concept. In addition, this approach can be used as an assessment tools in teaching learning process. The result can be used to develop the teaching method which can motivate the students’ scientific thinking.

5. References
[1] Masson-Delmotte, V., Zhai, P., Pörtner, H. O., Roberts, D., Skea, J., Shukla, P. R., … Waterfield, T. (2018). Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to. In Ipcc - Sr15.
[2] Alexandru A Ianculescu M Tudora E & Bica O 2013 ICT challenges and issues in climate change education. Studies in Informatics and Control 22 4 349–358.
[3] Shepardson D P Niyogi D Choi S and Charusombat U 2009 Seventh grade students’ conceptions of global warming and climate change. Environmental Education Research 15 5 pp.549-570.
[4] Putri A. U Rusyati L & Rochintaniawati D 2018 The Impact of Problem-Solving Model on Students’ Concept Mastery and Motivation in Learning Heat Based on Gender Journal of Science Learning 1 2 71

[5] Ursavas N 2011 Student teachers conceptions about global warming and changes in their conceptions during pre-service education: A cross sectional study Educational research and reviews 6 8 pp.592-597

[6] Wardani T B Widodo A & Winarno N 2017 Using Inquiry-based Laboratory Activities in Lights and Optics Topic to Improve Students’ Conceptual Understanding Journal of Physics: Conference Series 895 1

[7] Juleha S Nugraha I & Feranie S 2019 The Effect of Project in Problem-Based Learning on Students’ Scientific and Information Literacy in Learning Human Excretory System Journal of Science Learning 2 2 33

[8] Valadares J A C S 2013 Concept maps and the meaningful learning of science Los mapas conceptuales y el aprendizaje significativo de la ciencia 4 164–179.

[9] Atikah A Sanjaya Y & Rustaman N 2018 The Role of Visuospatial Representation to Improve Student’s Conceptual Mastery based on Gender in Learning Human Urinary System Journal of Science Learning 1 3 95

[10] Disessa A.A. and Sherin B L 1998. What changes in conceptual change?. International journal of science education 20 10 pp.1155-1191

[11] Hammer D 1996. Misconceptions or p-prims: How may alternative perspectives of cognitive structure influence instructional perceptions and intentions. The journal of the learning sciences 5 2 pp.97-127.

[12] Brewe E Kramer L and Sawtelle V 2012 Investigating student communities with network analysis of interactions in a physics learning center. Physical Review Special Topics-Physics Education Research 8 1 p.010101.

[13] Lee J K Shin S and Ha M 2015 Comparing the structure of secondary school students' perception of the meaning of experiment in science and biology. Journal of the Korean Association for Science Education 35 6 pp.997-1006.

[14] Lee S H Kim C E Lee I S Jung W M Kim H G Jang H Kim S J Lee H Park H J and Chae Y 2013. Network analysis of acupuncture points used in the treatment of low back pain. Evidence-based complementary and alternative medicine, 2013.

[15] Bhattacharjee P K 2010 Global warming impact on the earth. International Journal of Environmental Science and Development 1 3 p.219.

[16] Sharpe R G Goodall P A Neal A D Conway P and West A A 2018 Cyber-Physical Systems in the re-use, refurbishment and recycling of used Electrical and Electronic Equipment. Journal of cleaner production 170, pp.351-361.

[17] Langematz U 2018 Future ozone in a changing climate. Comptes Rendus Geoscience 350 7 pp.403-409.

[18] Aizebeokhai A P 2009 Global warming and climate change: Realities, uncertainties and measures. International journal of physical sciences 4 13 pp.868-879.

[19] Sivaramanan S 2015 Global Warming and Climate change , causes , impacts and mitigation Global Warming and Climate change causes , impacts and mitigation. (September).

[20] Vachnadze G S Tiginashvili Z T Tsereteli G V Aptsiauri B N and Nishnianidze Q G 2016 Carbon stock sequestered from the atmosphere by coniferous forests of Eastern Georgia in conditions of global warming. Annals of Agrarian Science 14 2 pp.127-132.

[21] Xi-Liu Y U E and Qing-Xian G A O 2018 Contributions of natural systems and human activity to greenhouse gas emissions Advances in Climate Change Research 9 4 pp.243-252.

[22] Anderson T R Hawkins E and Jones P D 2016 CO2 the greenhouse effect and global warming: from the pioneering work of Arrhenius and Callendar to today's Earth System Models. Endeavour, 40 3 pp.178-187.