Understanding and Awareness of Undergraduate Physics Student in Earthquake Phenomena in Indonesia: A Response of a Series Earthquakes on July 5-7, 2020 in Java

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Abstract. Earthquakes are a natural disaster that often occurs in Indonesia. This is due to geographic location and very active tectonic conditions. Indonesia experienced both small and large-scale earthquakes which sometimes accompanied by tsunami waves. One of the earthquakes occurred on the island of Java on July 5-7 in succession. From this phenomenon, researchers conducted research that aims to determine the attention or awareness of physics students on the earthquake phenomenon on 5-7 July 2020, to find out students' knowledge about the Earthquake Disaster and to find out physics students' understanding of the Causes of Earthquakes on 5-7 July 2020. This research used the questionnaire method and interview. The respondents in this research were 62 physics students at the State University of Surabaya. The results showed that the dominant response was 61.3% or as many as 38 physics students knew about the earthquake but paid less attention. Meanwhile, physics students 'understanding of the Earthquake Disaster was included in the intelligible category, and physics students' understanding of the Causes of the Earthquake on July 7, 2020, obtained the most dominant results, 29% answered that it was caused by the subduction activity of the Indo-Austrian plate. So, it can be concluded that the understanding and awareness of undergraduate physics students in the earthquake phenomenon in Indonesia is still lacking. Therefore, physics students still need to be given in-depth understanding and literacy about the earthquakes.

1. Introduction
Earthquakes are a natural disaster that often occurs in Indonesia. This is due to geographic location and very active tectonic conditions. Indonesia experienced small and large-scale earthquakes which sometimes accompanied by tsunami waves [1,2]. 80% of the territory in Indonesia is located in seismic areas that are at risk of an earthquake [3]. Indonesia is at the confluence of three large tectonic plates. They are the Eurasian plate in the north, the Indo Australian plate in the south, and the Pacific plate in the east [4]. One of the areas in Indonesia where earthquakes often occur is the island of Java. One phenomenon that earthquakes on 5-7 July 2020. on July 5, 2020, 5.3 magnitude earthquake occurred in the south of Blitar. And on July 7, 2020, an earthquake occurred in 4 different areas on the
Java island. They are 6.1 magnitude earthquake in the Java Sea, 5.1 magnitude earthquake in Lebak, 5.0 magnitude earthquake in Garut and the 5.2 magnitude earthquake in southern Sunda Strait [5]. Magnitude earthquake is a unit for measuring the strength of an earthquake which describes the amount of energy released during an earthquake [4].

Seismic characteristics in the Java region is the tectonics of the Java region and its surroundings, are controlled by the subduction of the Indo- Australian plate against the Eurasian plate. It causes the formation of a Sunda arc system in the offshore area consisting of the frequency and magnitude of earthquakes along the Sunda arc. Furthermore, the other characteristics that affect seismic in the Java region are normal faults and faulting in the Java sea [6]. The Java Subduction Zone with a length of 1100 km stretches from the island of Sumatra to the sea south of East Java in the region where there is a collision between the Eurasian and Indo-Pacific plates with a movement speed of 68mm / year [7]. Earthquakes that can trigger major damage are generally ≥ 5.6 SR. It is the point line earthquakes of southern Java with a shallow depth of < 30 km [8]. Many other areas are prone to disasters in Indonesia, so need efforts to reduce disaster risk with targeted and integrated approaches [9].

One of the efforts that can be made to reduce the risk of earthquake disasters is through an educational approach. Awareness and knowledge of the disaster require to make students aware of earthquake disasters. The awareness of disasters and natural phenomena can construct a sense of wanting to learn. Based on research in Imaduddina on the students of stats in regions and cities showed that they still considered not alert to the earthquake before held a training [10]. In the research discussion, it is only limited in knowing the attention or awareness of physics students in knowing the earthquake phenomena that have occurred, especially earthquakes in the Java region. In addition, from the other research, it shows that students' understanding of natural phenomena such as lunar eclipses is included in the category of sufficient understanding [11]. The research from Barrow and Haskins [12] also discuss earthquake phenomena but carried out on introductory geology students in 1996. Therefore, the researcher conducted a study on the understanding possessed by physics students at the State University of Surabaya in semester 5 (class 2018) and semester 7 (class 2017) regarding Student attention or awareness of the earthquake phenomenon on 5-7 July 2020, Students Knowledge about Earthquakes Disaster, and Students' Understanding of the Causes of Earthquakes on July 5-7, 2020. This research entitled understanding and awareness of undergraduate physics students in the earthquake phenomenon in Indonesia: Response to consecutive earthquakes July 5-7, 2020 in Java.

2. Method

This research is included in qualitative research. The research results are described descriptively after analyzed. The methods used in this research are questionnaire and interview methods. The number of respondents in this study was 62 physics students at the state university of Surabaya. They are consist of 27 students from the 2018 FRD class, 20 students from the 2018 FRE class and 15 students from the 2017 FRD class. They come from 3 concentration majoring in physics with details of 33.9% Earth Physics Concentration, 35.5% Physics Instrumentation Concentration and 30.6% Physics Material Concentration. This research was conducted in July 2020, during the Covid-19 pandemic. Therefore, the data collection questionnaire was carried out online by Interviews and questionnaires made with the help of Google Form. The results of the data obtained were collected and analyzed for each given question. The answers from students are classified into four different categories. They are dissatisfied (naïve), intelligible, plausible, and fruitful category [11]. The dissatisfied category is a condition in which students begin to doubt the concept that they understand or have a different opinion. The intelligible category is a condition in which the student explains the concept using their opinion and better than the previous categories. The plausible category is a condition where students have the concept that they have already entered a stage that makes sense but not with a perfect description. And the Fruitful category is a condition where students can find new concepts and explain them in a sensible and fruitful manner [11,13]. Besides, researchers compare striking differences in each viewpoint and attitude in understanding the causes of earthquake disasters [14]. So that the researchers can find different opinion in response to the causes of the earthquake disaster.
3. Result and Discussion

Based on the results of a questionnaire distributed via google form, the percentage of student awareness in Knowing the earthquake disaster on July 5-7 was as the figure 1:

![Figure 1. Percentage of Student Awareness in Knowing Earthquake Disaster Event on July 5-7, 2020](image)

Based on these results, 61.3% of 62 respondents knew about the earthquake but did not pay much attention. These results indicate that students know that earthquake occurs, but they do not understand how can the disaster occur. This shows the awareness of Physics students was less in knowing and paying attention to earthquake disasters which do not have a big impact in Indonesia. These results are almost the same as research conducted by AH Imadudina et al. [10] with the conclusion that students' awareness and preparedness are still low in facing earthquake disasters. It’s influenced by a lack of knowledge about earthquake disasters.

To know student understanding of the Earthquake Disaster, authors ask the student about the Earthquake and their knowledge about the process and the reason for Earthquake. Then the answers from each student are classified into four categories, called dissatisfied (naïve), intelligible, plausible, and fruitful. Several students fall into the lowest level or the first category, called dissatisfied (naïve). One example of opinion categorized into the lowest level is as follows:

"An earthquake is a shift in two of the earth's plates until a collision occurs. An earthquake occurs because of an imbalance in the ecosystems on this earth." [Fy]

In the next category called understanding, there are several opinions which are explained in their language and better than the first category. One example of this opinion is as follows:

"An earthquake is the shaking of the ground due to a shift in the plates. The cause and process of an earthquake is a shift in the earth's plate. This shift is what triggers the earthquake." [Di]

The next category is the plausible category in which students already have a good understanding of the concept and make sense but not with a perfect description. The following is an example of the opinion for plausible category:

"Earthquakes are vibrations on the earth's surface caused by the movement of the earth's plates. It could also be caused by volcanic activity. Tectonic earthquakes are caused by the movement of the earth's plates. The plates are constantly moving. Too much movement will cause the release of energy due to much pressure. Volcanic earthquakes are caused by magma activity before volcanoes erupt."[Nr]

And the last category is the fruitful category, that only limited opinions are found. Here is an example of opinion that fall into the fruitful category:

"Earthquakes are vibrations on the surface of the Earth due to the sudden release of internal energy which creates seismic waves. Earthquakes are usually caused by the movement of the Earth's crust (the Earth's plate). Earthquakes caused by earth plates occur when these plates shift, break, or even stick up. There are three types of earthquakes, tectonic earthquakes (due to shifting of the Earth's crust), volcanic earthquakes (due to volcanic eruptions) and rock earthquakes (due to human activity on the surface of the Earth)."[Ea]

Furthermore, the opinions of all students are classified and summarized in a graph, as shown in Figure 2.
Based on these results, it can be seen that the understanding of physics students in the knowledge about the processes and causes of earthquakes is included in the Intelligible category. It means that their understanding is good but not deeply, and it is less for the student level. These results are almost the same as M Fadilah research which analyzed the initial scientific literacy skills of Science Education students in the context of the earthquake disaster which focused on procedural and epistemic knowledge with the result that the knowledge level of science students was still low [15]. In addition, there are other similar studies conducted by Barrow, Loyd & Haskins, and Sandra whose research on introductory geology students' understanding of earthquakes shows that students still have insufficient knowledge of plate tectonic theory and introductory geology students have quite broad misconceptions about the earthquake. It is because the mass media (news sources) only provide students with more knowledge about causes and effects than the process [12].

Furthermore, the authors asked more detailed questions about the causes of continuous earthquakes in 5 different locations on the island of Java on July 7, 2020. This is to find out students' understanding of the causes of the July 7, 2020 earthquake. Then, the results are analyzed and classified according to the answers of each student as shown as in table 1:

| Question                                                                 | Answer                                                                 | Total students | percentage |
|--------------------------------------------------------------------------|------------------------------------------------------------------------|----------------|------------|
| Explain the cause of the series of earthquakes in Indonesia on 7 July 2020 According to your theoretical knowledge! | The earthquake occurred due to the subduction activity of the Indo-Austrian plate. | 18             | 29%        |
|                                                                          | The earthquake occurred because of the geographic location of Indonesia. | 5              | 8%         |
|                                                                          | The earthquake occurred due to the influence of the previous earthquake. | 6              | 10%        |
|                                                                          | Earthquakes are caused by a shift in the Earth's plate.                  | 3              | 5%         |
|                                                                          | The manifestation of the discharge of the voltage field at their respective sources. | 5              | 8%         |
|                                                                          | The cause of the earthquake is uncertain.                               | 12             | 19%        |
|                                                                          | Due to the movement of active earth faults.                             | 1              | 2%         |
|                                                                          | Answered did not understand.                                            | 12             | 19%        |
|                                                                          | Total                                                                  | 62             | 100%       |

Based on the Table 1, it can be seen that physics students can answer and predict the causes of successive earthquakes on July 7 that occurred in the Java region. However, 19% answered that they...
did not understand. Students who answered that they did not understand were very unfortunate, considering that the students' backgrounds were Physics students who studied and understood earthquakes.

From the reviews of articles related to the causes of earthquakes in Java, it is found that the Java subduction zone is a potential source of tectonic earthquakes. The western part of Java is bordered by a major tectonic plate junction between Eurasia and Indo-Australia [16]. Earthquakes occur due to the breaking or lifting of rocks in the area of friction between the plates. The magnitude of an earthquake depends on the width of the fault and the elastic reflection [6]. Based on the explanation in this article, the answer from physics student about the cause of the earthquake on July 5-7 was appropriate and can be categorized into understanding plausibility or logical.

Some relevant approaches are needed to increase students' awareness and understanding. One of them is by teaching students about the detailed concept of earthquakes at university. Besides, students are given training and basic knowledge about earthquakes and their preparedness. With good knowledge and understanding of earthquakes, it can reduce the risk caused by earthquakes. Therefore, it is necessary to improve an understanding of physics students about earthquakes by increasing their knowledge and literacy about earthquakes.

4. Conclusion
Based on the results and discussion, it can be concluded that the Physics students have less awareness in the knowledge and attention to the earthquake. Meanwhile, students ‘understanding of the Earthquake Disaster was included in the Intelligible category and students' knowledge of the Causes of the Earthquake on July 7, 2020, obtained the most dominant results, 29% answered that it was caused by the subduction activity of the Indo-Austrian plate. Therefore, to improve students' understanding of earthquakes, it is necessary to improve their knowledge and literacy about the earthquake phenomenon.

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