Geoscience Literacy Profile of Junior High School Students

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ABSTRACT
The purpose of this research is to find out the geoscience literacy profile of junior high school students in Surabaya. The method used in this research is quantitative method. The test is done online through google form. The problem used in the test instrument is an adaptation of the TIMSS (Trends in Mathematics and Science Study) question in the Earth Science sub-discussion. The question instrument contains 10 points of multiple choice questions, and 3 items of description questions that are the result of the development of indicator slices of TIMSS (Trends in Mathematics and Science Study) 2019 and basic competency indicators of curriculum 2013. The study subjects were 85 respondents who were grade VIII students of State and Private Junior High in Surabaya. The results showed that the geoscience literacy capability profile of junior high school students in Surabaya with an average score of 58.2% is included in the low criteria, there are two indicators that have low achievement criteria, namely identifying or describing changes in the earth's surface, and the impact of geological events; and describe the process of hydrological cycles and know the sun as a source of energy for the hydrology cycle, sufficient achievement criteria, contained in the domain of cognitive knowing and reasoning. While the criteria for achievement are low, it is found in the cognitive domain applying.

INTRODUCTION
Geoscience is widely defined as a study of Earth and planetary systems. Geoscience is a broad science, where geosciences also learn about the relationship of a process in the scale of a planetary system to explore the chemical reactions that occur in a mineral. Understanding of the earth, is a holistic understanding of the Earth's system covering the oceans, atmosphere, hydrosphere, and biosphere, as well as inter-system interactions (Manduca. 2012). Essential components in this geoscience include geoscience knowledge, predicting skills, and decision making skills. These essential components are necessary to face present and future challenges (Fermeli et al, 2014; Hariyono, 2017).

Anggrayni (2020) in her research also revealed that an understanding of geoscience is indispensable in facing the challenges and developments of the times. Some of these challenges include global needs that depend on the utilization of energy, where the energy produced was produced, and both of them happened on Earth. Thus, the condition indirectly also involves an understanding of geosciences. The next challenges are water, soil, and mineral sources that are beginning to be scarce in some areas due to rising global populations and industries, as well as climate change.

In the Educational field in 2003, Indonesia has proposed a new curriculum. The new curriculum changes the learning steps of exploration, elaboration, and confirmation. Teaching-learning approach that suitable in this condition was scientific approach (Wiyanto, 2017). Scientific approach is an approach that aims to knowledge through several steps such as: observing, questioning, experimenting, associating, and
communicating. However, this is not enough to answer the challenges of the future (Putra, 2020).

One of the challenges that will be faced by the young generation of Indonesia in the future is literacy skill. The younger generation of Indonesia must be a literate generation, who are literate in literacy. The government in this regard, has prepared a strategy to build a culture of literacy in schools, in order to form a literate generation. There are 3 ways, such as adjusting the physical environment in order to support literacy, trying to make the social and affective environment as a literate model of communication and interaction, and trying to make the schools as a literate academic environment system (Directorate General of Primary and Secondary Education ministry of Education and Culture, 2016). In one of the studies found a fact that in the application of literacy-based learning, teachers will ask their students to find some information using offline and online source in the library. This is such a useful activities to strengthen student’s learning abilities (Subekti, et al, 2019).

According to Rod Welford, who The Minister Education and Culture Queensland, Australia, literacy is at the heart of students' ability to learn and succeed in school and later levels, so it needs to be done to provide opportunities for learners to master literacy from an early age to 12 years so that it can face challenges in the 21st century. In the 21st century, education has a goal to encourage student’s skill. The most necessary thing to prepare in order to face the challenges on the 21st century is encouraging student’s skill so that they have a deep knowledge and understanding. The main goal is making the student as a live learner (Hariyanti, et al, 2019). Rod Welford also said that the priority of education is to improve students' literacy skills beyond standards, putting learners into different circumstances or conditions. Rod Welford also added that although the backgrounds of students are different, but the government must still strive for all learners to get a sufficient level of literacy to face the challenges that exist in the 21st century, because without adequate literacy skills, students will not be able to face the challenges that exist in the 21st century.

One of the areas of literacy that has been described by Kirsch was science literacy. Science Literacy derived from two words, namely literatus, which means marked with letters, literacy, or educated, and scientia which means to have knowledge. So science literacy is each individual’s ability to understand and apply knowledge in solving problems related to science and technology in everyday life (OECD, 2016). Dragos and Mih (2015) defined Scientific literacy as a skills to apply someone’s scientific knowledge in real situations. Someone had to use some strong evidence and data to evaluate the credibility of an information or scientific arguments. Also, (National Academy of Sciences, 1996) defines science literacy as knowledge and understanding of concepts and processes in taking personal decisions relating to social, cultural and the economy.

Science literacy was divided to some areas such as environment, climate, and earth. Science literacy which is related to geology or earth is called geoscience literacy or earth-science literacy. Geology as an geoscience was an integrated science such as biology, chemistry, and physics as they apply and explain about the Earth (Reis, et al, 2014). Ross (2010) defines geoscience literacy as an understanding of the earth, the dynamics of the earth, the impact of earth change on humans, and the impact of human activity on the earth. Geoscience literacy is an important thing, especially in Indonesia, because based on BMKG (Badan Meteorologi Klimatologi dan Geofisika) exposure
(2013) Indonesia was located in the ring of fire area and the meeting point between the three main tectonic plates. This makes Indonesia was often hit by earthquakes, tsunamis, and volcanic eruptions. Based on this, geoscience literacy is considered to be necessary, so that people not only know about the natural disaster phenomena, but also can understand and explain the phenomenon as an effort to be aware of everything that happened to the environment.

Nowadays, geoscience literacy become important skill that everyone should to have. This is related to the availability of our natural resources to support a sustainable life, climate change, also human activities that have a big impact to the Earth. Increased geoscience literacy skill will help anyone to face that kind of critical issues (Wysession, et al, 2012). The importance of geoscience literacy as part of science education has been a concern, therefore geoscience literacy is one of the benchmarks regarding the quality of science education. So it is very important for students and institutions to cultivate geoscience literacy in daily learning activities, so that students can form who master the ability of geoscience literacy. Through this study, researchers intend to know the profile of geoscience literacy of learners, related to aspects of geoscience literacy in TIMSS, namely the aspects of knowing, applying and reasoning. The results obtained later can be used to describe the ability of geoscience literacy in each aspect.

RESEARCH METHOD
General Background
This research uses quantitative method through test instruments conducted online on grade VIII junior high school students in Surabaya whom have obtained earth layer material or have completed basic competence (KD) 3.10 Explaining the layers of earth, volcanoes, earthquakes, and risk reduction measures before, at the time, and post-disaster according to the threat of disaster in the region. The problem used in the test instrument is an adaptation of the TIMSS question in the Earth Science sub-discussion. It provides the measure of the geoscience literacy skill of junior high school students. This research uses a random sampling to determine the subject of research.

Sample / Participants / Group
The study subjects were 85 respondents who were grade VIII students of State and Private Junior High in Surabaya whom have obtained earth layer material or have completed basic competence (KD) 3.10 Explaining the layers of earth, volcanoes, earthquakes, and risk reduction measures before, at the time, and post-disaster according to the threat of disaster in the region.

Instrument and Procedures
The problem used in the test instrument is an adaptation of the TIMSS question in the Earth Science sub-discussion. The instrument that used was developed through ADDIE model such as the figure 1.

![Flowchart of instrument’s development process](https://journal.ia-education.com/index.php/jorer)

Figure 1. Flowchart of instrument’s development process.
TIMSS test has already tested for the validity, so in this research, the validity of the test was measured by expert judgement. Based on the judgement, the instrument was valid. The instrument reliability was measured by ANATES software. Its reability was 0.74 which categorized as highly reliable (Jacobs and Chase, 1992). The question instrument contains 10 points of multiple choice questions, and 3 items of description questions that are the result of the development of slices of indicators about TIMSS 2019 and basic competency indicators curriculum 2013 from basic competence (KD) 3.10. Here are the slices of TIMSS 2019 and basic competence (KD) 3.10 indicators:

<table>
<thead>
<tr>
<th>KD 3.10 Indicator</th>
<th>TIMSS 2019 Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.10.1 Explaining the characteristics of the earth’s constituent layers.</td>
<td>1. Decriques the structure of the earth and the characteristics of its parts.</td>
</tr>
<tr>
<td>3.10.2 Explaining atmospheric characteristics.</td>
<td>2. Linking changes in atmospheric conditions to altitude changes.</td>
</tr>
<tr>
<td>3.10.3 Explaining the characteristics of the lithosphere.</td>
<td>3. Identify or describe changes in the earth’s surface, and the impact of geological events</td>
</tr>
<tr>
<td>3.10.4 Explaining the characteristics of earthquakes and their disaster risk reduction.</td>
<td></td>
</tr>
<tr>
<td>3.10.5 Explaining the characteristics of volcanoes and their disaster risk reduction.</td>
<td></td>
</tr>
<tr>
<td>3.10.6 Explaining the characteristics of the hydrosphere and its disaster risk reduction.</td>
<td>4. Describe the process of hydrological cycle and know the sun as a source of energy for the hydrology cycle.</td>
</tr>
</tbody>
</table>

**Table 1. The slices of TIMSS 2019 and KD 3.10 indicators.**

Data Analysis

Geoscience literacy score is calculated by percentage technique for each indicator, then the final score result will be interpreted with certain criteria according to the following Table 2.

<table>
<thead>
<tr>
<th>Criteria Interval</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>86% ≤ N &lt; 100%</td>
<td>Very Good</td>
</tr>
<tr>
<td>76% ≤ N &lt; 85%</td>
<td>Good</td>
</tr>
<tr>
<td>60% ≤ N &lt; 75%</td>
<td>Enough</td>
</tr>
<tr>
<td>55% ≤ N &lt; 59%</td>
<td>Low</td>
</tr>
<tr>
<td>N ≤ 54%</td>
<td>Very Low</td>
</tr>
</tbody>
</table>

**Table 2. Criteria of geoscience literacy score.**

RESULTS AND DISCUSSION

The questions of the test were adapted from The TIMSS 2019 Science Framework to sub Earth Science. The average geoscience literacy score obtained was 58.2%. Thus, the geoscience literacy profile of junior high school students in Surabaya is included in the low criteria. As the part of science literacy, this result was according to the research
conducted before, that the literacy achievement was still low (Odja & Payu, 2014; Nuraini, 2018). Also, Hariyono (2014) in his research stated that geoscience literacy skill in Indonesia still low. The following is a graph of the distribution of geoscience literacy scores percentage of junior high school students in Surabaya based on indicators used:

![Score percentage distribution in each indicator](image)

**Figure 2.** Score percentage distribution in each indicator.

To further clarify the score results of each indicator, the following is the exposure of geoscience literacy capability profile results based on the indicators used:

**Describe the structure of the earth and the characteristics of its parts**
In this indicator, a score percentage of 83.5% or as many as 71 respondents can answer correctly. So, in this indicator, junior high school students in Surabaya have a good ability in describing the structure of the earth and the characteristics of its parts.

![Layers of the earth](image)

**Figure 3.** The example of indicator 1 question.

**Linking changes in atmospheric conditions to changes in altitude**
In the second indicator, the average score percentage is 72.65%. The average is obtained from 4 question points on this indicator, where each question has a percentage of 80%, 64.7%, 81.2%, and 64.7%. Based on these results, students' geoscience literacy skills on indicators linking changes in atmospheric conditions to changes in altitude are included in the good criteria.
Dodi is a professional climber. He will climb one of the highest mountain. He must carry a breathing apparatus when climbing the top of mountain. Why is this necessary?

A. Low oxygen levels at the top of the mountain
B. There is a small amount of nitrogen at the top of the mountain
C. There’s a hole in the ozone layer
D. There is no oxygen at the top of the mountain

**Figure 4.** The example of indicator 2 question.

*Identify or describe changes in the earth’s surface, and the impact of geological events*

In this third indicator, the average score percentage was 56.3%. The average is obtained from 3 question points on this indicator, where each question has a percentage of 82.4%, 42.4%, and 44.3%. On this indicator, students' geoscience literacy skills include low criteria. Students were supposed to find the evidence and break down the concept that already they have. The low achievement of this indicator implicates that the students have low scientific competence in explaining phenomena.

Where are active volcanoes often found?

A. Near the river
B. The area where tectonic plates meet
C. In the ocean
D. The meeting area of land and water

**Figure 5.** The example of indicator 3 question.

*Describe the process of hydrological cycle and know the sun as a source of energy for the hydrology cycle*

In this indicator, the average score percentage is 45.8%. The average is obtained from 5 question points in this indicator, where each question has a percentage of 43.5%, 35.3%, 54.9%, 35.25%, and 60%. Based on these results, students' geoscience literacy skills on indicators describe the process of hydrological cycles and recognize the sun as an energy source for hydrological cycles including very low criteria.

The following is a drawing of the contours of the hills and valleys. Each contour of the line shows the height of the land surface above sea level.

Where is the river current?

A. Northeast
B. Southeast
C. Northwest
D. Southwest
E. It can’t be explained from the picture

**Figure 6.** The example of indicator 4 question.
The very low achievement was on the third and fifth indicator, it implicates that the students have low scientific competence in explaining phenomena. This competence may relate with their science knowledge about the earth (Wulandari & Sholihin, 2016). Students were supposed to find the evidence and break down the concept that already they have. The question on the test asks the student to link their knowledge with a common phenomena. Based on the cognitive theory, students will use their prior knowledge to process a new knowledge by linking them. The student’s prior knowledge was defined by the learning process. It might happen that the teacher mostly train the student by low level cognitive domain (Marlina et al, 2017). Based on the interview with teacher and some students, known that the learning process just train the student by using low level cognitive domain such as C1 and C2.

In addition to the exposure results according to the indicators, the following is a table of exposure to geoscience literacy scores based on three cognitive domains adapted from The TIMSS 2019 Science Framework:

<table>
<thead>
<tr>
<th>Cognitive Domain</th>
<th>Percentage (%)</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowing</td>
<td>65.18</td>
<td>Enough</td>
</tr>
<tr>
<td>Applying</td>
<td>42.40</td>
<td>Very Low</td>
</tr>
<tr>
<td>Reasoning</td>
<td>67.35</td>
<td>Enough</td>
</tr>
</tbody>
</table>

Based on the table, it is known that the literacy profile of junior high school students in Surabaya in accordance with the cognitive domain has not reached the criteria either. The lowest achievement or criterion is applying cognitive domain. The applying domain involve the application of scientific knowledge in some situations and relationship demonstration. Students are supposed to relate, classify, compare, and find the possible solution (Kablan & Kaya, 2013). Same as the problem before, the learning process as the main reason. The lack of implementation in learning-teaching process which include science process (Siagian et al, 2017). The low level of student’s geoscience literacy also may caused by student’s behaviour, because they never do the literacy test model (Devinda & Violita, 2019). The student said that they usually do a test which the answer available on their book. The learning process should to apply scientific approach to improve scientific process skill (Arohman et al, 2016). Moreover, geoscience literacy as a part of science literacy actually was not only built by student’s knowledge but also the support of all parties to improve the student’s ability (Yanti et al, 2018).

CONCLUSIONS
Based on the exposure of the results, that the geoscience literacy capability profile of junior high school students in Surabaya with an average score of 58.2% is included in the low criteria, there are two indicators that have low achievement criteria, namely identifying or describing changes in the earth's surface, and the impact of geological events; and describe the process of hydrological cycles and know the sun as a source of energy for the hydrology cycle, sufficient achievement criteria, contained in the domain of cognitive knowing and reasoning. While the criteria for achievement are low, it is found in the cognitive domain applying. Geoscience literacy as a part of science literacy actually was not only influenced by student’s knowledge but also the support of all parties to improve the student’s ability. It takes efforts in the future to develop teaching
materials based on geoscience literacy as a source of student learning, so that students are better acquainted with geoscience literacy.

REFERENCES


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