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Science literacy profile of student on landslide disaster mitigation in Semarang city

B Astuti[1]*, I Suryaningsih[1], A Rusilowati[1], Khumaedi[1] and H H Kusuma[2]

[1]Jurusan Fisika, Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Negeri Semarang
[2]Jurusan Fisika, Fakultas Sains dan Teknologi, Universitas Islam Negeri Walisongo Semarang

*Corresponding author : b_astuti79@mail.unnes.ac.id

Abstract. The purpose of this study was to determine the profile of students' science literacy on landslides disaster mitigation in Semarang City. This research method is a quantitative description with one shot case study. The sample of this research was the 10th grade students of SMA N 7 Semarang who were taken by using purposive random sampling technique. Data collection techniques used written tests, questionnaires and interviews. For data analysis using data triangulation technique in order to obtain qualitative descriptive data. The results showed that students' ability to mitigate landslides from the aspects of scientific literacy which included aspects of knowledge, context, competence and attitudes was still low.

1. Introduction

Scientific literacy is the ability of a person to process scientific information to solve problems and produce useful scientific products [1][2][3]. International student scientific literacy is measured by the Organization for Economic Co-operation and Development (OECD) through a Program for International Student Assessment (PISA). The aspects of scientific literacy measured by PISA include aspects of knowledge, competence / process, context, and attitudes. Based on the results of the 2018 PISA evaluation, students' scientific literacy in Indonesia is still low, where they only received 396 points from the international average of 489 points [4][5].

The low scientific literacy of students in Indonesia is due to the fact that science learning has not fully facilitated the development of scientific literacy skills optimally [6][7]. Learning is still focused on the cognitive aspect compared to thinking skills and does not involve competence or process abilities in obtaining scientific knowledge [8][9][10][11]. This makes students less understanding of problems in everyday life, especially the phenomenon of natural disasters [1][12].

Based on topographical conditions, the city of Semarang consists of a narrow lowland area and a hilly area that extends from the west to the east side. Such topographical conditions cause some places in the city of Semarang to be areas prone to landslides, especially during the rainy season [13][14]. Landslides are events of sudden movement of landslide material, where one of the main triggers is heavy rain or prolonged rain [15].

Landslides that occur can cause harm to society and the environment, including casualties, material losses, and changes in soil structure [16]. Landslide events can be discussed using the concept of physics which is part of science. The physics concepts that can be related to the landslide phenomenon are the

concepts of work, energy, impulse, and momentum. Learning that correlates material with natural phenomena will make learning more interesting, memorable, and meaningful to students [17]. This is done with the aim of supporting the improvement of the quality of education, where students are required to be able to correlate and apply their knowledge to the surrounding environment. In addition, students are expected to be more aware of natural disaster mitigation and care for the environment [18][19][20][21]. The purpose of this study was to see a picture of students' scientific literacy in mitigating landslides that often occur in the city of Semarang. The description of the scientific literacy profile is seen from the four aspects of PISA scientific literacy which include aspects of knowledge, competence, context, and attitudes.

2. Methods

The research method was used a description quantitative with one shoot case study research design. The sample of the research was the 10th grade students of SMA N 7 Semarang, were taken by using purposive sampling technique. The consideration was used that the location of the school is in Ngaliyan sub-district, which is an area with criteria that are very prone to landslides [16, 22]. Data collection uses scientific literacy-based instruments which have been declared valid and according to the 2015 PISA indicators by means of expert judgments. The instruments for data collection were tests, questionnaires and interviews. The test instrument used contains the link between physics and landslides in order to obtain data from aspects of knowledge, competence, as well as aspects of context. This is based on the 2013 OECD, specific aspects of context can be found in aspects of knowledge and competency. For aspects of student attitudes on flood disaster mitigation obtained by using a questionnaire instrument. The research data obtained in the form of students' scores in answering the correct questions in each aspect being tested. Then the score is converted into a percentage score with the following formula.

$$P = \frac{f}{N} \times 100\%$$

where f is the number of scores obtained, N is the number of cases and P is the number percentage. The scientific literacy score obtained is then categorized according to Purwanto [23]. Finally, interviews were conducted with several students who represented all the criteria for scientific literacy to strengthen the test and questionnaire data.

3. Result and Discussion

The profile of students' scientific literacy is obtained by testing aspects of knowledge, competence / process, context, and attitudes by using tests and questionnaires. The scientific literacy profile for the aspects of knowledge and competence is obtained through scientific literacy-based tests. The test is also used to determine the profile of scientific literacy in context aspects. According to the OECD in 2013, context aspects are specifically found in aspects of knowledge and aspects of competency. Meanwhile, the scientific literacy profile for the attitude aspect was obtained through an open questionnaire based on scientific literacy. For the profile of students' scientific literacy aspects of knowledge, competence and attitudes can be seen in Figure 1.
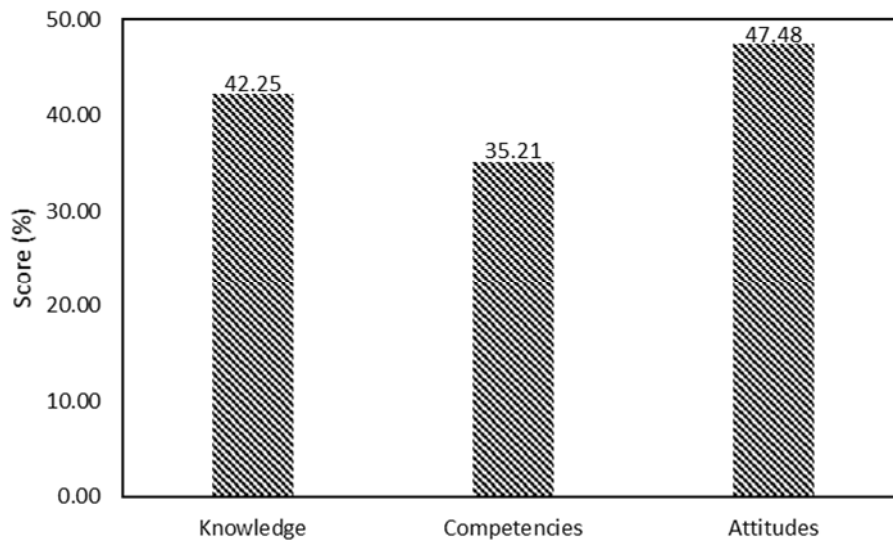
Figure 1. Profile of students' scientific literacy for aspects of knowledge, competency and attitudes.

From Figure 1 it can be seen that the students' scientific literacy for the aspects of knowledge, competency and attitudes are 42.25%, 35.21% and 47.48%, respectively. Furthermore, based on the criteria of Purwanto [23], scientific literacy for aspects of knowledge, competency and attitude included in the very low category. This is because students are not familiar with the types of questions based on scientific literacy [1, 6, 7, 9, 12, 24]. The low scientific literacy of the knowledge aspects of students is also due to the science learning process carried out, the teacher is still not used to emphasizing competence, and is still focused on mastering concepts [10, 25]. That way, students are still used to memorizing the concepts and formulas given by the teacher, without knowing the relationship between these concepts and the problems faced. As a result, students become smarter at memorizing but less trained in applying their knowledge in everyday life, especially for landslide mitigation [8,11]. This shows a lack of students' ability to explore the surrounding environment. Thus it can be said that science learning associated with the environment is very important, because in these activities there are many things that can be explored so that students get more meaningful knowledge [26]. These results were reinforced by the results of interviews which showed that most students said they were more accustomed to working on questions in the form of mathematical calculations according to the formula given by the teacher. In addition, the learning methods and teaching materials used also do not support scientific literacy skills. Snippets of interviews conducted with several students are shown in Figure 2.

Figure 2. Interview snippets related to the learning process.

Furthermore, the second aspect of scientific literacy studied is student competence. From Figure 1, it can be seen that the competency aspect is lower than the knowledge aspect and the attitude aspect. The low level of scientific literacy in the competency (process) aspect obtained is in accordance with the results of previous research [27, 28]. For this competency aspect, the biggest factor that affects is the teacher. As previously mentioned, teachers who in the learning process use methods or media that do not motivate and support students in literacy will cause students to have low scientific literacy [29]. It can be analogized that the competence of students in understanding the phenomenon of landslides is still low. This is because in the lessons that are carried out, the teacher does not provide information or knowledge of landslides, how landslides occur and how to deal with landslides is not discussed in the lesson. Thus it can be said that to develop scientific literacy students must do learning based on scientific literacy itself [30].

Last, for students' attitudes were obtained using a questionnaire, to see how the attitudes students had in relation to landslides that occurred in the city of Semarang. The attitudes of student want to see are students 'knowledge of the phenomenon of landslides associated with physics (questionnaire no.1), and students' attitudes towards these landslides (questionnaires no.2 and 3), excerpts from the questionnaire are:

1. Physics is closely related to phenomena that occur in the environment such as landslides. Have you ever discussed the phenomenon of landslides and is related to physics?

2. Have you attended any education about natural disaster mitigation? If you have, how many times have you participated in lanslide disaster mitigation education?

3. Trees can strengthen slope stability, how many times do you plant trees to maintain slope stability?

The results of questionnaires nos. 1, 2, and 3 were still low with the respective percentages of 22%, 11% and 36.2%. This acquisition indicates that the students' ability to relate physics to natural phenomena, namely landslides is still low. This is because students' knowledge of landslides is still low. According to Ramadhan et al. [18], the low ability of scientific literacy in the aspect of knowledge can have an impact on the low application of science in life which ultimately affects the attitudes of students. The delivery of material through online learning also affects the understanding received by students and ultimately affects the attitudes of students. The low attitudes of students are also influenced by students' interest in discussing the phenomenon of landslides, both with teachers and fellow students themselves. This was supported by the results of interviews, most students stated that they knew the relationship between physics and landslides, by explaining how landslides occurred based on the concepts of work, energy and collisions. Students are able to explain the collision event that occurred between the landslide material and the settlement at the base of the slope. However, students were not precise in explaining what type of collision, even though they already knew that the final velocity was the same. So the type of collision in question is a collision that is not perfectly resilient.

Knowledge of mitigation, which is directly obtained through outreach will also help in shaping students' attitudes towards the environment. Based on questionnaire no.2, most students did not receive counseling on landslide mitigation, even though many of the students lived in landslide prone environments and had experienced landslides several times. This is in accordance with the statement of Al-Maraghi et al. [18] natural phenomena are one of the learning media found nearby, but are very easy to ignore. Based on the results of the interview, students already know the criteria for landslide-prone areas, know the causes of landslides and know how to anticipate landslides. This is in accordance with questionnaire number 3, students answered that they had participated in a tree planting program on the slopes around the house to maintain the stability of the slopes. Based on the questionnaire also obtained data that there are some students who have experienced landslides, and this can shape students' attitudes to face or prevent disasters. This is in accordance with the statement Zakwandi et al. [17], one of the factors that affect literacy skills, especially science, is the experience that students have with the disaster that occurs. The experience itself can be the experience of students when experiencing a disaster directly or indirectly, in the learning process and / or through websites and social media.

In general, based on Figure 1 it can be said that for scientific literacy the aspect of attitude is the highest compared to knowledge and competence. This shows that the students' attitude towards the landslide disaster that occurred was quite good. In other words, the level of awareness of students towards landslides is quite high. This is shown through efforts to start responding to landslides by maintaining stability of the slopes around the settlement [31, 32, 33, 34].

4. Conclusion

Based on the results of the study, it was found that students' scientific literacy for aspects of knowledge (42.25%), aspects of competence (35.21%) and aspects of attitudes (47.48%) of students in landslide disaster mitigation activities were classified as still low. This is because students are still not used to working on scientific literacy-based questions, and in the learning process they do not relate the concept of physics to natural phenomena, especially landslides. One of the factors that can increase scientific literacy is direct experience of the landslides experienced by students. Activities such as attending counseling and training that students participate intensively can also be a factor of students' readiness and skills in overcoming the dangers of landslides.

References

[1]   Wahyu Y, Suastra I.W, Sadia I W and Suarni N K 2020. *Int. J. Instr.* **13** 343
[2]   Lawless K A, Browns W, Rhoad S C, Lynn L, Newtons D, Brodowiksa K and Wang M 2018
          Comput. Hum. Behav. **78** 389
[3]   Shaffer J F, Ferguson J and Denaro K 2019 *Life Sci. Educ.* **18** 1
[4]   OECD-2018 *Programe Int. Stud. Assess. (PISA) Result PISA*. 1
[5]   Kembara M D, Hanny R, Gantina N, Kusumawati I, Budimansyah D, Sunarsi D and Khoiri A
          2020 *Solid State Technol.* **63** 5845
[6]   Hordatt Gentles C 2018 *Carribean Q* **64** 149
[7]   Titu P, Rins-Whalen E A, Brown J C and Rochrig G H 2018 *J. Scinece Teach. Educ.* **29** 378
[8]   Asyhari A 2017 *J. Ilm. Pendidik. Fis. Al-Biruni*. **6** 137
[9]   Pahrudin A, Irwandani, Triyana E, Oktaris Y and Anwar C 2019 *Indones. J. Sci. Educ.* **8** 52
[10] Rusilowati A, Kurniawati L, Nugroho S E and Widiyatmoko A *Int. J. Environ. Sci. Educ.* **11** 5718
[11] Yuliyanti T E and Rusilowati A 2014 *Unnes Phys. Educ. J.* **3** 69
[12] Chi S, Liu X, Wang Z and Won han S 2018 *Int. J. Sci. Educ.* **40** 1284
[13] Pratiwi R D, Nugraha A L and Hani'ah 2016 *J. Geod. Undip* **5** 122
[14] Sudmeier-Rieux K, Jaquet S, Basyal G K, Derron M, Devkota S, Jaboyedoff M and Shrestha S
          2013 *Landslide Sci. Pract.* **12** 169
[15] Ganapathy G P and Hada C L 2012 *Int. J. Sci. Dev.* **3** 497
[16] Hostettler S, John A, Montes C, D'Acunzi A 2019 *Landslides*. **16** 1779
[17] Zakwandi R, Rochman C, Nasrudin D, Yuningsih E K and Putra S 2018 *J. Pendidik. Islam* **3** 47
[18] Ramadhan S, Sukma E and Indriyani V 2019 *IOP Conf. Ser. Earth Environ. Sci.* **314** 012054
[19] Deta U A, Ria P Z, Fadillah R N, Prakosol, Lestari N A, Yantidewi M and Prahami B K 2019 *J.
          Phys.: Conf. Ser.* **1417** 012095
[20] Yumusak A, Sargin S A, Baltaci F and Kelani R R 2016 *Int. J. Environ. Sci. Educ*. **11** 337
[21] Akman O and Alagoz B 2017 *J. Educ. Pract.* **8** 229
[22] Purba J O, Subiyanto S and Sasmito B 2014 *J. Geod. Undip* **3** 40
[23] Purwanto N 2009 *Prinsip-Prinsip dan Teknik Evaluasi Pengajaran* (Bandung: PT Remaja
          Rosdakarya)
[24] Pratiwi S N, Cari C and Aminah N S 2019 *J. Materi dan Pembelajaran Fis.* **9** 34
[25] Jain L, Lim B K and Abdullah N 2013 *Procedia Soc. Behav. Sci.* **90** 203
[26] Suciati, Vincentrisia A, Ismiyatin 2015 *Indones. J. Sci. Educ.* **4** 56
[27] Rachmatullah A, Diana S and Rustaman N Y 2016 *AIP Conf. Proc.* **1708** 080008
[28] Ridho S, Aminah N S and Supriyanto A 2018 *Int. J. Environmnet Sci. Educ*. **13** 719
[29] Putra I B P A, Pujani N M and Juniartina P P 2019 *J. Pendidik. dan Pembelajaran Sains Indones.*

1 25

[30]   Basam F, Rusilowati A dan Ridho S 2018. *Sci. Educ. J.* **3** 1

[31]   Ambusaidi A, Boyes E, Stanisstreet M and Taylor N 2012 *Int. Res. Geogr. Environ. Educ.* **21** 21

[32]   Higde E, Oztekin C and Sahin E 2017 *Int. Res. Geogr. Environ. Educ.* **26** 253

[33]   Bosschaart A, Kuiper W and van der Schee J 2015 *Int. Res. Geogr. Environ. Educ.* **24** 131

[34]   Rochman C, Yulianti R N, Nasrudin D and Malik A 2018 *IOP Conf. Ser.: Mater. Sci. Eng.* **434** 012015