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Assessing early level of literacy: a case study on science literacy in biotechnology

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Abstract. This study aimed to know the early level of science literacy skills of 9th grade of *SMPN 1 Campurdarat* in biotechnology. The students who are the subjects of this study were one class consisted of thirty-five students. This study was a part of learning device development study to improve students science literacy skills. The science literacy test consisted of thirteen questions with details four questions were simple multiple choice, four question were complex multiple choice, and five questions were easy. The science literacy test consisted of all levels science literacy with details one question was level 1a, four questions were level 2, three questions were level 3, three question were level 4, one question was level 5, and one question was level 6. The assessing showed results that 11.43% students were in level 1b; 65.71% students were in level 1a; and 22.86% students were in level 2. These results were appropriate with recent PISA surveys which taken on 2015 that showed the ability of Indonesia students literacy skill were in low category.

1. Introduction

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OECD defined science literacy as the ability to engage with science related issues and with science ideas, therefore scientifically literate person able to engage science and technology which needs the competencies to explain phenomena scientifically, evaluate and design scientific inquiry, as well as interpret data and evidence scientifically [1]. One of literacy instructional goals is to develop students' ability to think deeply about what they read and to express themselves in all context [2]. Kemenkbud stated that science literacy is important to be mastered by students in relation to how students be able to understand and make decisions regarding the environment, health, economics, and other issues faced by modern societies that rely on technology and the development of science [3]. Since science literacy is important, it is very necessary to do study about which level of science literacy that Indonesia student can be achieved. Thus, this study aimed to know the early level of science literacy skills of 9th grade of *SMPN 1 Campurdarat* in biotechnology.

The studies about science literacy has been done by OECD since 2000. Three recent surveys held in 2009, 2012, and 2015. PISA survey resulted in 2009 showed that the score of Indonesian science literacy reached 383 and on the order 57 of 65 countries [4]. PISA survey resulted in 2012 showed that the score of Indonesian science literacy reached 382 and on the order 63 of 64 countries [5]. PISA survey resulted in 2015 showed that the score of Indonesian science literacy reached 403, on the order 62 of 70 countries, and 42,3% students were below level 2 [6]. Thus indicated that science literacy level of Indonesia is still low.

The lowness of science literacy level that can be mastered by Indonesian students are caused by curriculum, learning, and assessment in IPA course which only emphasize content but forget the process and the context dimensions as required in PISA [7]. The low science literacy level of Indonesia students also can be caused by students who only learn science as product and memorize concepts, theories, and laws [8].

Based on explanations mentioned, therefore, learning in Indonesia should be applied to the learning that has been claimed to be able to train the science literacy, such as Science, Technology, Society, and Environment (STSE) learning. Science literacy has many goals together with the STSE that makes STSE learning as an appropriate learning to achieve the goal of science literacy [9]. One of benefits of STSE learning is encompassing a broader vision of science literacy [10]. Science, Technology, and Society (STS), the former of STSE, is considered important to achieve basic science literacy [11].

2. Method

The type of this study was descriptive quantitative aimed to describe the early level of science literacy of 9th grade of *SMPN 1 Campurdarat* in biotechnology. The students who were the subjects of this study were 35 students. The science literacy test conducted in March 2018. The science literacy test consisted of thirteen questions with details four question were simple multiple choice, four question were complex multiple choice, and five questions were easy. The science literacy test also consisted of all level science literacy with details one question was level 1a, four questions were level 2, three questions were level 3, three question were level 4, one question was level 5, and one question was level 6. The science literacy test was developed based on indicators: 1) explain phenomena scientifically, 2) evaluate and design scientific inquiry, and 3) interpret data and evidence scientifically.

The student science literacy level [12] were assessed step by step. First, give score to each question depends on its level as shown in Table 1.

Table 1. Question Score for Each Level

Level	Score
1b	262
1a	335
2	407
3	480
4	553
5	626
6	698

Second, determine students' achievement score using formula [13]:

$$\text{Score} = \frac{\sum \frac{Bi \times bi}{St}}{St} \times 100 \quad (1)$$

Bi is the amount of questions correctly answered by students, *bi* is score for each question (adapted from PISA), and *St* is teoritical score (score if the students can answer all questions correctly). Finally, if score has been obtained the students' science literacy level can be categorized as shown in Table 2.

Table 2. Score Categorization toward Science Literacy Level.

Score	Level
0.0-14.2	1b
14.3-28.5	1a
28.6-42.8	2
42.9-57.1	3

Score	Level
57.2-71.4	4
71.5-85.7	5
85.8-100.0	6

3. Result and Discussion

Table 3 shows the result data in assessing the students' science literacy test. The results of literacy tests were expressed in score and level as shown in Table 3.

Table 3. Science Literacy Test Result.

Students Code	Score	Level
S1	22.50	1a
S2	37.58	2
S3	13.89	1b
S4	6.37	1b
S5	20.26	1a
S6	26.65	1a
S7	27.78	1a
S8	21.41	1a
S9	21.41	1a
S10	30.07	2
S11	21.41	1a
S12	15.03	1a
S13	23.69	1a
S14	36.44	2
S15	19.14	1a
S16	21.41	1a
S17	17.32	1a
S18	21.41	1a
S19	19.14	1a
S20	25.51	1a
S21	19.14	1a
S22	21.41	1a
S23	27.78	1a
S24	28.92	2
S25	30.07	2
S26	28.92	2
S27	34.17	2
S28	19.14	1a
S29	21.41	1a
S30	21.41	1a

Students Code	Score	Level
S31	15.03	1a
S32	21.41	1a
S33	13.89	1b
S34	13.89	1b
S35	37.58	2

Table 3 shows that 35 students reached level 1a, 1b, and 2 with details four students reached level 1b, 23 students reached level 1a, and eight students reached level 2. Those results can be represented in percentage as shown in Figure 1.

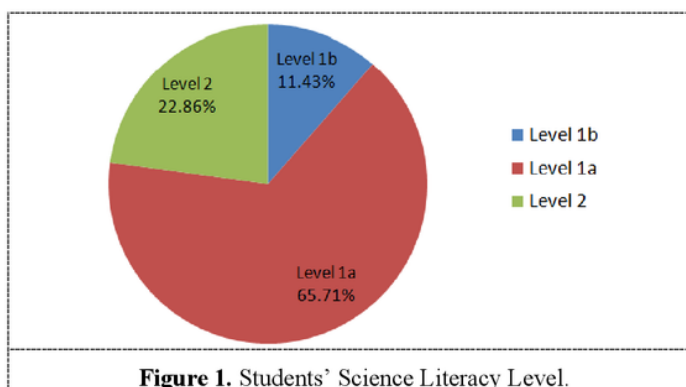


Figure 1. Students' Science Literacy Level.

Figure 1 shows that the students who reached level 1b are equal to 11.43%, level 1a are equal to 65.71%, and level 2 are equal to 22.86%. These meant students' science literacy level were low. These results are in line with PISA surveys in 2009, 2012, and 2015 that showed science literacy level of Indonesia students were still low.

As the students' science literacy level were low, the students' ability toward indicators in science literacy test are analyzed. The result shown in Figure 2.

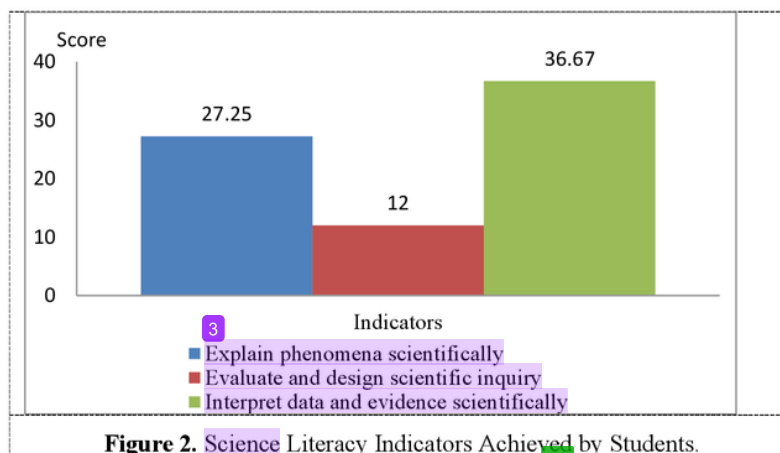


Figure 2. Science Literacy Indicators Achieved by Students.

Figure 2 shows that students got score: 1) 27.24 for indicator explain phenomena scientifically, 2) 12 for indicator evaluate and design scientific inquiry, and 3) 36.67 for indicator interpret data and

evidence scientifically. Those meant, the students still have low ability to master indicators of science literacy. The students' low ability in mastering science literacy indicators are caused by the learning which still apply the conventional learning which is teacher-centered learning. In biotechnology, learning is held by giving discourse, listening discourse, and taking notes. In addition, students don't have any practices and are still unfamiliar with science literacy test. Science literacy test is very different from usual daily test. Science literacy test in biotechnology requires students to read the passage and relate to the concepts to be able to answer the questions, while usual daily test in biotechnology just requires students to memorize the concepts to be able to answer questions. These facts are in line with Firman's statement which stated that Indonesia students had low science literacy level because of curriculum, learning, and assessment in IPA course only emphasize content but forget the process and the context dimensions [7], as well as Maghfiroh stated that the low science literacy level of Indonesia students are caused by students only memorize concepts [8].

Based on the results in assessing students' early science literacy level of one class 9th grade students in SMPN 1 Campurdarat, it is necessary to apply learning which can train the students' science literacy skill. This learning should train students to explain phenomena scientifically, evaluate and design scientific inquiry, as well as interpret data and evidence scientifically. This is necessary to do because students' literacy skill can't happen naturally but must be trained. Based on Lau statement, he stated that science literacy has many goals together with STSE that makes STSE learning as an appropriate learning to achieve science literacy goal [9]. Andi, Suyatno, and Supardi conducted research on development learning device based on STSE approach and obtained conclusion that the learning device was feasible to increase students' science literacy in reaction rate concepts in 11th grade [14]. In addition, based on research conducted by Lau it could be known that learning using STSE improves students' science literacy on aspects of application of science, scientific inquiry, as well as awareness of science, technology, society, and environment [9].

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4. Conclusion

Based on the results of study and assessing the data, it could be conclude that 11.43% students were in level 1a, 65.71% students were in level 1b, and 22.86% students were in level 2. Thus, students' early science literacy level was low. One of solutions offered is applying learning with STSE learning.

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