Scientific Literacy Level of Biology Education Students, University of Mataram, Indonesia

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Scientific Literacy Level of Biology Education Students, University of Mataram, Indonesia

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Abstract

This study aims to determine: 1) scientific literacy level of Biology Education students, 2) differences in science literacy level of students based on semester, and 3) correlation between scientific literacy level and student learning experience. This research was a descriptive study with a quantitative approach performed on 179 Biology Education students, Faculty of Education, University of Mataram, Indonesia. The results showed that: 1) scientific literacy level of students was in a low category with a mean score of 57.00; 2) scientific literacy level of students was different between semesters with the highest scores obtained by students at VII semester with a mean score of 62.33; 3) scientific literacy level of students was positively correlated with the student learning experience as evidenced by the increase in student average scores from semester III to semester VII, and 4) scientific literacy level of students was high for conceptual or process dimension, and very low for the context dimension.

Keywords: *biology teacher candidates, scientific literacy, biology education students.*

1. Introduction

Koes stated that there are three definitions of science, namely (1) science is knowledge to study the natural world, (2) science is part of human progress and creativity, and (3) science is search for findings [1]. A person's skill to use science in daily life is stated as scientific literacy. In the Program for International Student Assessment (PISA) scientific literacy is the ability to understand science. Scientific knowledge is applied in order to draw conclusions from the shreds of evidence, identifying issues, describing particular events, and gaining information [2]. PISA sets three components of competence in scientific literacy assessment, namely identifying scientific questions, explaining phenomena scientifically, and using scientific evidence in problem solving [3].

Science literacy is very important for students because it plays a role in determining the progress of a nation [4]. Fatwamati & Utari stated that scientific literacy is important to be mastered by students because it is their provision to participate more intelligently in the social life of society [5]. Further, scientific literacy is important for students to have because scientific ways can be used to overcome life issues more responsibly for a better life. Scientific literacy is the key to success in facing the challenges of the 21st century [4].

The scientific literacy level of Indonesian students compared to students around the world can be seen based on the results of the PISA evaluation. The evaluation results of the PISA ranking of a country can provide clues to the success of the country education process [6]. The results of the PISA evaluation in 2012 showed that the scientific literacy level of Indonesian students was still relatively low. Of

the 65 participating countries as the objects of PISA research, Indonesia was ranked 64th with an average scientific literacy score of 382 [7]. Likewise, the results of the 2015 PISA evaluation showed that Indonesia was ranked 62nd out of the 70 countries [8].

The low score of Indonesian students' scientific literacy level is due to several factors related to the application of the education curriculum and system, the selection of learning methods and models by teachers, learning facilities, and teaching materials [9]. The findings of Fatmawati & Utari (2015) show that the low levels of Indonesian students' scientific literacy can occur because the learning process in schools tends not to give students the opportunity to observe scientific phenomena occurred, students rarely conduct experiments, and the learning emphasizes completing the material and does not emphasize process-oriented learning [5]. According to Ileriturk & Kincal (2018), the improvement of the quality of practices including laboratory activities that need to be carried out to improve communities' scientific literacy of a country [6].

The results of the PISA evaluation are guides for all education policy stakeholders in Indonesia to improve students' scientific literacy level because scientific literacy can help individuals to understand the environment and other issues faced by modern society that depends heavily on the development of science and technology [9]. The improvement of students' scientific literacy needs to be done immediately by improving the learning process in schools that no longer material is completing-oriented but improving science process skills and high-level thinking skills of students [5]. This is consistent with the opinion of Feyzioglu, Demirdag, Akyilidz, & Altun (2012) stated that science process skills are the key to the development of scientific literacy [10].

Students of Biology Education as biology teacher candidates are expected to have good scientific literacy so that they will become science teachers who are able to compete both nationally and internationally and are able to help the development of their students' scientific literacy. Therefore, students' scientific literacy level data need to be known as a reference for stakeholders in the Biology Education Study Program of Faculty of Teacher Training and Education, University of Mataram to improve learning processes for their students. But unfortunately, the data is not yet available. Thus, the purpose of this research is to study the scientific literacy level of students of biology education study program of the Faculty of Teacher Training and Education, the University of Mataram.

2. Research Method

This research was a descriptive study conducted with a quantitative approach. The research subjects consisted of students in the semester I, III, V, and VII of Biology Education Program, Faculty of Education, University of Mataram, with a total of 179 students. The object of this research is the scientific literacy level of students of Biology Education. The study was conducted in the odd semester on four different semesters, namely semester I, III, V, and VII. The research instrument consisted of tests to determine students' scientific literacy. The scientific literacy test consists of 41 questions with four answer choices. This scientific literacy test was adopted and modified from the scientific literacy ability test developed by PISA. Analysis of students' scientific literacy level was carried out descriptively to determine the mean score of students' scientific literacy. The interpretation of the mean score of the scientific literacy level was based on the criteria of Djaali & Mulyono [11] as described in Table 1. In addition, to determine the significance of differences in students' scientific literacy level between semesters, ANOVA (Analysis of variance) was used. Data analysis was performed using SPSS for Windows Version 16 statistical software.

Table 1. Interpretation criteria for science literacy level scores

Score Interval (%)	Interpretation
86 - 100	Very good
72 - 85	Good
58 - 71	Medium/acceptable
43 - 57	Low
0 - 42	Very low

3. Result and Discussion

3.1. Description of Students' Science Literacy Level

This study revealed the scientific literacy level of the semester I, III, V, and VII students of the Biology Education Study Program, Faculty of Education at the University of Mataram. The scientific literacy level in this study was focused on the topic of respiration. The description of the results of students' scientific literacy skills analysis is shown in Table 2.

Table 2. Description of the science literacy level of biology education students

Statistic	Semester			
	I	III	V	VII
N	20	23	18	18
Average	54.63	52.92	58.13	62.33
Min	37.00	34.00	29.00	44.00
Max	78.00	68.00	73.00	80.00
St. Dev.	11.77	9.17	12.69	10.04

Table 2 shows that the scientific literacy level of semester VII students with a mean score of 62.33 is higher than the average scores of other students in a different semester. Fifth-semester students have the second-highest score, with a mean score of 58.13, while third-semester students have the lowest average scientific literacy level score, which is 52.92. In this case, the score of the scientific literacy level of first semester students is higher than the scientific literacy level of third-semester students (54.63> 52.92) but lower than V and VII semester students.

The significance of differences in students' scientific literacy level between semesters I, III, V, and VII is shown through one-way ANOVA statistical analysis at alpha 0.05. ANOVA results show that there are significant differences ($F = 2.86$; $p < 0.05$) of students' scientific literacy level between semester I, III, V, and VII, as described in Table 3.

Table 2. Description of Anova test results of student science literacy level

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	171.816	3	57.272	2.858	0.042	2.726
Within Groups	1502.614	75	20.034			
Total	1674.430	78				

The difference in students' scientific literacy level is positively correlated with the student learning experience, i.e the students in higher semesters have higher scientific literacy levels. This can be seen from the mean score of student science

literacy level scores which are increasing from semester III, V, to semester VII, as shown in Figure 1.

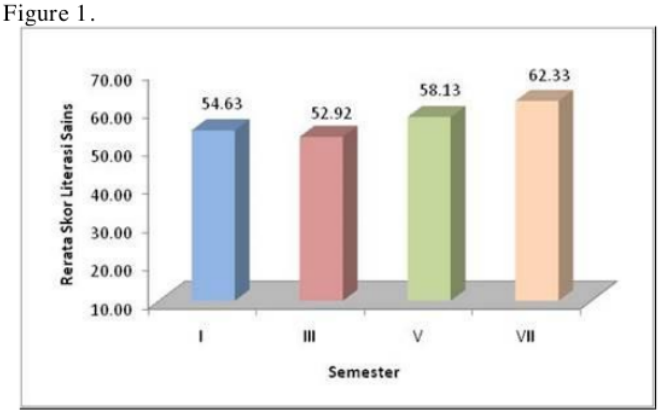

Figure 1. The average score of student literacy level in the semester I, III, V, and VII

The improvement of students' scientific literacy level in a higher semester is related to the greater experience of students in learning science and to their increased semester. This increased experience has an impact on the improvement of student science concepts and the decrease of misconceptions about science concepts students have faced in the previous semester. This is in accordance with the constructivist principle stated that in the learning process, students get a lot of new information, then the information undergoes a process of assimilation and accommodation, resulting in the construction of new knowledge in students [12], [13]. In other words, the more students have a science learning experience, the higher the scientific literacy level they have.

In the current study, a number of similar studies have also been carried out by that digital literacy has been applied in instructional design in digital learning environments as a way to improve the learning experience of adult learners [14]. The results show that statistically, the relationship between the level of acceptance of confidence and collaborative digital literacy is significant. On the other hand, the ability of scientific literacy in men and women did not differ significantly [15]. Science literacy in most educators is responded positively [16], because the existence of scientific literacy can help educators in transferring knowledge to learners, addressing students' understanding [17], [18].
Based on the average of science literacy scores, the results showed that the student's scientific literacy level was still relatively low with the average score of students at 57.00. These results are in line with the results of the 2012 PISA and the 2015 PISA studies on the scientific literacy level of Indonesian students which was ranked 64th out of 65 countries and 62th out of 70 countries, respectively [7], [8].

The low level of scientific literacy of students of Biology Education Study Program can be caused by learning process factors. The learning process in the Biology Education Study Program has been carried out through lecture and practicum methods with practical instructions compiled by lecturers. It seems that the learning process in the Biology Education Study Program which is dominated by lecture and cookbook lab methods (clear instructions-based practicum) is less effective in improving students' scientific literacy level. This learning process causes opportunity-hindering for students to develop science process skills, critical

thinking skills, and the ability to construct new knowledge through various interesting and meaningful activities for students. According to Fatmawati & Utari, the development of critical thinking skills and the provision of broad opportunities for students to construct new knowledge is the key to develop students' scientific literacy [5]. According to Anggraini student activities in the cookbook, labs do not provide many opportunities for students to practice science process skills, especially higher-level skills such as discussing problems, formulating hypotheses, identifying variables, and designing experimental designs [19]. Thus, the improvement of the learning model in the Biology Education Study Program, Faculty of Education at the University of Mataram needs to be done.

Various research results have recommended learning models that can improve students' scientific literacy, for example, Odja & Payu recommend the application of the learning cycle model in developing students' scientific literacy skills [20]. Asyhari & Hartati stated that the application of learning models with scientific approaches can improve students' scientific literacy levels [21]. Meanwhile, Fatmawati & Utari stated that inquiry learning is an effective learning model to improve students' scientific literacy levels [5]. Based on these opinions, the opportunity for students to observe and solve problems in their environment with the investigation will provide opportunities for them to construct knowledge as much as possible so that greater scientific literacy level will occur.

3.2. Analysis of Student Literacy Level per Question Item

This study used an instrument in the form of multiple-choice tests, consisting of 41 questions with 4 answer choices. The test referred to the PISA scientific literacy test instrument. This study also determined students' scientific literacy level per item. The analysis results of the students' scientific literacy level per item are presented in Figure 2. Based on Figure 2, the achievement of scientific literacy students of Biology Education Study Program varies in each question.

The lowest score of scientific literacy level is found in item number 4.1 with a score of 6, then followed by item number 6.4 with a score of 8 and item number 8.2 with a score of 9. While for the highest score is for item number 3.6, with a total score of 76, followed by the item number 3.4 and 5.1 with a total score of 73 and 71, respectively.

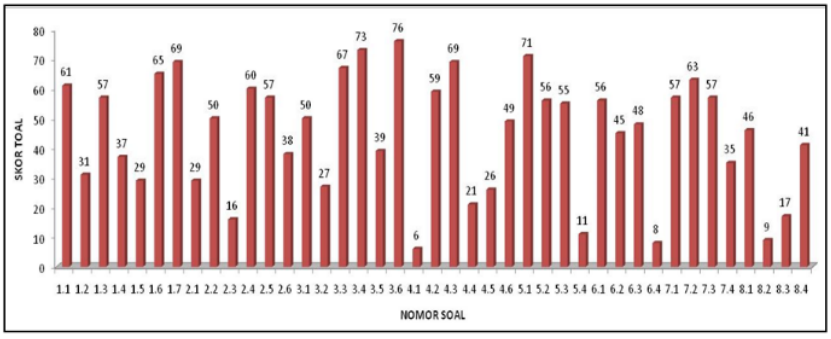

Figure 2. The analysis results of students' science literacy level per question item

Based on Figure 2, the highest score is obtained in item number 3.6 with a score of 76. Question item number 3.6 asked about the best way to help someone who suddenly develops asthma. The process assessed in this problem was to describe or

evaluate a conclusion. Seventy-six students answered correctly while the remaining 4 people answered incorrectly. This means that 95% of students were able to answer the question correctly. This indicates that students have been able to understand the problem well and are able to link knowledge or concepts. The results obtained are supported by the results of Angraini's research which examines high school students' scientific literacy abilities of class X in Solok City, which found that students' scientific literacy level in some questions that describe or evaluate a conclusion are in the high category [19].

Questions item number 3.4 and 5.1 asked the concepts displayed in the form of graphics or images. Question item number 3.4 asked the prevalence of asthma. The analysis shows that 91.25% of students answered correctly. This indicated that students had been able to understand the problem well, and were able to explore information in the form of concepts displayed in the form of graphics or pictures. This result was similar to that obtained in question item number 5.1 asked about the causes of cancer displayed in graphical form. The results of the analysis showed that 88.75% of students answered correctly. This result indicated that students had been able to understand the concepts and facts displayed in the form of graphics or images. The abilities of students to understand problems, give answers correctly based on information from text, graphics, or tables are included in the level of conceptual or procedural literacy [3] or in PISA it is included in the process dimension. In general, students of the Biology Education Study Program have scientific literacy levels at high conceptual or process dimensions.

The analysis results of the students 'scientific literacy level per item showed that the level of students' scientific literacy was low for questions item numbers 4.1, 6.4, and 8.2 (Figure 2). Question item number 4.1 asked about what happened to someone who breathes CO (Carbon Monoxide) in the air of 0.1%. This type of problem is included in the analysis problem. In scientific literacy, this problem is included in the level of multidimensional literacy, namely the ability to connect concepts with everyday life [20] or included in the context dimension. The analysis results of this item indicated that 7.5% of students answered correctly and 92.5% of students answered incorrectly. These results indicated that students' scientific literacy level at a multidimensional or context dimension is very low. Question item number 4.1 addressed the same as a problem as question item numbers 6.4 and 8.2 which is a matter of scientific literacy at multidimensional or context dimensions. The results obtained in this study are in line with the findings of Odja & Payu examined the analysis of students' initial literacy level in science concepts, and found that students are not able to answer questions at the multidimensional or context dimension [20]. The same results are also shown by Nofiana & Julianto research stated that of the three aspects (content, process, and context) in scientific literacy, the lowest scores of students occurred is in aspects of the science context with a score of 32% which is in the very low category [4]. The low score can occur because science topics learned in class are rarely seen and rarely associated with everyday life, so it does not provide many opportunities for students to train to analyze its connection at the multidimensional level.

4. Conclusion

Based on the results of the study it can be concluded that (1) the scientific literacy level of students of the Biology Education Study Program at the University of Mataram is in the low category with a mean score of 57.00 (2) the scientific literacy level of students of Biology Education Study Program, the University of Mataram is different between semesters with the highest scores obtained in semester VII, and (3) scientific literacy level of students of the Biology Education Study

Program is high for conceptual or process dimension, and very low for the context dimension.

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