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by Sjaifuddin Sjaifuddin

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An Assessment of Pre-service Biology Teachers on Student Worksheets Based on Scientific Literacy

RAZ El Islami^{1*}, IJ Sari¹, S Sjaifuddin¹, M Nurtanto¹, M Ramli², A Siregar³

¹Universitas Sultan Ageng Tirtayasa, Indonesia

²UIN Syarif Hidayatullah Jakarta, Indonesia

³UIN RadenIntan Lampung, Indonesia

* zakyislami@untirta.ac.id

Abstract. This study aimed to determine the assessment of pre-service biology teachers on student worksheets based on Scientific Literacy. This research was conducted at the Biology Education Department, Sultan Ageng Tirtayasa University. The method used was a Quasi-experimental. The research design used was one-shot case study. The subjects in this study consisted of 30 pre-service biology teachers. The instrument used was assessment sheets for student worksheets based on scientific literacy. The results of this study indicate the average assessment of pre-service biology teachers on student worksheets based on Scientific Literacy is 3.8 (valid category). Thus it can be concluded that student worksheets based on Scientific Literacy are suitable to be used in the research process and learning process.

1. Introduction

Scientific Literacy is one aspect that has become the focus of attention of the OECD member Countries (Organization for Economic Co-operation and Development). The OECD every three years conducts surveys of literacy, mathematical literatures, and literatures. The survey is known as PISA (Program for International Student Assessment) [1-6]

Indonesian students' scientific literacy ranked as one of the lowest based on PISA survey from 2000-2015 [1-6]. The latest PISA survey placed Indonesia at the 61st rank out of 70 countries [6]. This fact requires a special attention from experts and researchers especially in the field of science education.

Research in science learning in improving scientific literacy has been carried out in Indonesia, Asyhari and Hartati conducted a research in increasing students' scientific literacy skills through scientific learning [7]. The results of this study indicate that scientific learning can improve students' scientific literacy profiles on the aspects of competence and aspects of knowledge in the environmental pollution material. El Islami, et al conducted a study of the relationship of scientific literacy and students' confidence in the concept of acid base [8]. The result of this study indicates that there was no significant relationship between scientific literacy and students' confidence in the concept of acid base. Rakhmawan designed an inquiry-based Scientific Literacy learning in laboratory activities, the results of this study indicate that the design has characteristics in accordance with the development of students' literacy skills which are oriented to real contexts that often occur in daily life, oriented in building students' attitudes and awareness of the environment, and building students' inquiry attitudes with the objective of proving that inquiry-based Scientific Literacy learning is better than learning with inquiry approaches in improving scientific literacy skills [8]. Wulandari and Sholihin conducted a study on the analysis of scientific literacy skills on the aspects of scientific knowledge and competence of junior high school students in heat material. The results of this study indicate that junior high school students have good scientific literacy skills in aspects of scientific knowledge and competence [10]. Ardianto and Rubini



conducting a study of the comparison of students' scientific literacy through Integrated Science learning using a guided discovery learning model and problem-based learning [11]. The results of this study indicate that both learning model can improve scientific literacy. Rubini, et al conducted a study on the identification of scientific literacy from the perspective of science teachers. The results of this study indicate that 20% of teachers have scientific literacy skills in the low category, 65% in the moderate category and 15% in the high category. The science problem-based learning on the teacher's perspective is experiencing difficulties for Integrated Science learning, having limited knowledge related to the Integrated Science learning model, and lack of motivation in teaching Integrated Science consistently. Rusilowati, A, et al (2016) conducted a study on the development of scientific literacy assessment instruments on the cycle theme [12]. The results of this study indicate that the instruments developed have fulfilled the content, constructs, and concurrent validity in the valid, very valid, and valid category. El Islami, et al conducted a study on efforts to improve students' scientific literacy on the concept of acid base through guided-inquiry learning [13]. The results show that students' scientific literacy can be improved through guided-inquiry learning in the low category. Rahayuni correlates the critical thinking skills and scientific literacy into an integrated science learning with problem-based learning model (PBM) and community technology science (STM) [14]. This study indicates that there is a strong correlation between critical-thinking skills and scientific literacy, the STM model is better compared to PBM Model in improving critical-thinking skills, and PBM model is better than STM model in improving scientific literacy. Fitriani, et al conducted a study on the effect of problem-based learning model on students' scientific literacy abilities in the reaction rate material [15]. The results of this study indicate that the application of a problem-based learning model has a significant influence on students' scientific literacy abilities in the reaction rate material. Saefullah, et al conducted a study on efforts to improve students' scientific literacy through guided inquiry learning based on local wisdom of the Baduy tribe [16]. The result of this study indicates that students' scientific literacy can increase but are still in the low category. In addition, in the field of developing science learning media in an effort to improve scientific literacy, Ekantini and Wilujeng develop education-based Student Worksheets in the context of developing a sustainable environment to improve scientific literacy [17]. The result of this study shows that the students who use the worksheet are better in scientific literacy compared to students who do not use the worksheet. Sulistiyowati, et al conducted a research on the effect of STEM-based student worksheets (*Science, Technology, Engineering and Mathematics*) on scientific literacy [18]. The result of this study indicates that the development of STEM-based student worksheets is effective in improving scientific literacy. Nuangchalerm and El Islami conducted a comparison research on the capabilities of science application context, which is one of the domains of scientific literacy, between Indonesian and Thai's pre-service teachers [20-22]. The results of this study indicate that the Thai's pre-service teachers is better than Indonesia, but not statistically significant. Nuangchalerm and El Islami conducted a comparison research of science content capabilities which is one of the domains of scientific literacy between Indonesian and Thai's pre-service teachers. The result of this study indicates that Indonesian pre-service teachers' ability in science content is better than Thailand, but does not statistically significant.

Based on the data from the PISA's survey and previous research, the student worksheets with scientific literacy on cell concepts has never been developed before, so the researchers intended to develop a scientific literacy-based student worksheet on cell concepts for lectures in General Biology courses. The purpose of this study is to determine the assessment of pre-service biology teachers on student worksheets based on scientific literacy

2. Research Method

The method used was quasi-experimental research design, specifically one-shot case study (Frankel and Wallen, 2008). The subjects of this study consisted of 30 pre-service biology teachers. This research was conducted in July-August 2017 at the Biology Education Study Program at Sultan Ageng Tirtayasa

University, Indonesia. The instrument used was a science-based student worksheet assessment sheet that was previously validated by science learning experts.

The evaluation criteria for science-based student worksheets are said to be valid if the average score gets more or equal to 3 in the 1-4 scale. The assessment criteria are adopted from Khabibah [19].

3. Result and Discussion

This study was conducted within four meetings (4 x 100 '). The implementation of learning using Scientific Literacy-based worksheets was carried out in 3 meetings, in the 4th meeting; the assessment of the student work sheet was carried out to 30 pre-service biology teachers.

Assessment on student work sheet was carried out in three aspects, namely format, content, and language. The average assessment results per-aspects can be seen in Table 1 and the overall average assessment of student worksheets of can be seen in Table 2.

Table 1 Evaluation of Student Work Sheets Based on Scientific Literacy Based on each Aspect [19]

Aspect	Score	Category
Format	3,5	Valid
Content	4,08	Valid
Language	3,84	Valid

Table 2 Assessment Student Work Sheet Based on Scientific Literacy [19]

Score	Category
3,8	Valid

Based on these data we can conclude that the student work sheet used in learning is feasible in terms of format, content, and language so that it is suitable to be used for learning and research to develop scientific literacy.

Scientific literacy-based student work sheets given during learning contained learning objectives, orientation material, exploration, explanation, elaboration, and evaluation. The learning objective of the student work sheet was to prepare the students to know the purpose of learning in certain material. In this study, the learning objective was that the students were able to analyze cells as the basis of life. This learning objective was proposed to give students apperception about the concept of cells. Next, the students were expected to be able to analyze cells definitively both their functions and structures as the basis of life. The existence of learning objectives also gives students motivation to improve scientific literacy.

The orientation material presented in the scientific literacy-based student worksheets contains cell material. But the cell material presented was focused on life or real problems. This allowed the students to be more interested in reading carefully so they could understand the cell concept as a whole. One example of the orientation material was as follows: Based on the presence of the nucleus membrane, organisms are differentiated into eukaryotes and prokaryotes. From the difference in whether the membrane intact in the organism makes the organism different from the structure, size, function, etc. The size of the prokaryote is bigger compared to the eukaryotes. The prokaryote has the ribosome, nucleus, and membrane cells, whereas the eukaryote has many cells that have their own function.

The content of the next literacy based work sheet was exploration. In the exploration section, students were presented with daily problems related to cells. This section is the context of the application of science. One of the quotations of the problem in scientific literacy-based student work sheets with cell concepts was as follows: "Tony experienced pain in his head while learning in the afternoon. Tony stopped and thought, looking for what had caused the headache. Tony remembered that he had not had breakfast in the morning. Tony immediately had a meal to prove his guess. Since there was not enough time because he wanted to finish his study, Tony finally ate cereal. Then Tony returned to study. However, after one hour, the headache was coming back".

In the exploration section, there were also questions related to the science process literacy indicators; namely, identifying scientific issues, explaining scientific phenomena, and using scientific evidence

(OECD, 2007). The indicators to identify scientific issues, one of the questions was "Which molecule dominates the cereal?". The indicators to explain scientific phenomena, one of the questions was "Why did Tony ate the cereal? Is there a problem with substance transport? Explain". Furthermore, the indicator of scientific evidence, one of the questions was "What caused Tony to recover from having eaten the cereal?"

The questions posed in accordance with the scientific literacy indicators of the science process skill domain can stimulate students to understand cell concepts more deeply even if only in one case. The next step was explanation and exploration to look for cases in cell concepts more broadly and deeply and discuss them. This can create conditions and informative and supportive atmosphere in enhancing students' scientific knowledge. These activities are very important in the learning process, where currently the curriculum in Indonesia always supports teachers to create a discussion-centered atmosphere for students. At this stage, it is also important in exploring the knowledge, understanding, and insight of students in learning.

The last stage in scientific literacy-based student work sheet was an evaluation. This stage was used to measure the learning outcome. The evaluation section contained questions related to cognitive domain about the concept of the cell as a whole. When the students were able to answer the questions more than 80% with a predetermined time, the learning process was considered to be effective in improving the students' cognitive, especially in the application of scientific literacy.

4. Conclusion

Pre-service biology teacher assessed the scientific literacy-based student worksheets with an average score of 3.8 (valid category)

Suggestion

A further research to see the effectiveness of the application of scientific literacy-based student worksheets is suggested.

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