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THE PROFILE ANALYSIS OF SCIENTIFIC LITERACY' PROSPECTIVE ELEMENTARY TEACHER AS AN INITIAL STRATEGY TO CONDUCT SCIENCE COURSES

Hanifah Mulyani[1], Rizki Hadiwijaya Zulkarnaen[1], Yanda Hernisa[1]

[1]Universitas Perjuangan, Tasikmalaya, Indonesia

***** Corresponding email: *hanifahmulyani@unper.ac.id*

ABSTRACT

Scientific literacy is one of the most important aspect students should have, either for now or in the future. Related to educational challenges of the 21st century, this literacy is actually needed to help students in taking decision when they try to solve any problem in any field, understand all the context of changes that probably occurred in society. According to PISA results in 2022, scientific literacy of students in Indonesia was categorized as low. Educational institutions have responsibilities to improve the quality of education, including students' scientific literacy. Teachers who have good scientific literacy are expected to offer some contributions in improving students' scientific literacy as well. This research was conducted to analyze the scientific literacy of prospective elementary teachers. Descriptive qualitative method was used, involving 120 students, called as prospective elementary teachers, as research subjects. The data was taken by giving test of scientific literacy using eight indicators of Gormally. questionnaire of students' learning history, and interview to some research subjects. Furthermore, the data analysis used in this research was inductive technique using Miles and Huberman Model, consisted of several steps; collecting, reducing, displaying, and verifying data as final steps to the conclusion. The result of this research was scientific literacy of prospective elementary teacher still categorized as moderate since the average score was 47,5 with range score around 27 until 63 in each indicator. This result indicated that the lecturer may consider some learning strategies where science process skill of students could be well-developed, integrate science and mathematics courses, engage students in more scientific reading, and together with institutions provide good maintenance in learning facilities.

Keywords: *scientific literacy*, *prospective elementary teacher*, *science courses*

INTRODUCTION

Scientific literacy is the ability to use scientific knowledge to understand the world around us. It involves asking questions, finding answers, explaining scientific phenomena, and drawing conclusions based on facts in reality (Jamilah, Astuti, Y.P. & AR., 2023). This skill helps to make informed decisions and participate in a society that relies on science and technology (Kähler et al., 2020). Scientific literacy is important for students as it helps them solve problems, understand societal changes, and prepare for the future. As stated by the World Economic Forum (2015), developing scientific literacy early on can equip individuals with the skills they need to succeed in the 21st century.

The rapid advancements in science and technology are driving the need for improved scientific literacy (OECD, 2018). However, recent global studies, such as PISA 2022, have shown a decline in students' scientific literacy. Indonesia, in particular, experienced a significant 13-point drop in its PISA score, falling behind the global average. While Indonesia did improve its overall ranking, it is clear that Indonesian students still struggle with scientific skills like identifying scientific claims, finding reliable information, analyzing data and drawing conclusions, and the last is using data to solve problems and make predictions (Rahmadani et al., 2018). The unexpected results of the PISA 2022 test were a wake-up call for Indonesia' education system. Schools need to improve the quality of education, especially in science. Adults, especially teachers, play a crucial role toguide students through experiments, answer their questions, and explain scientific concepts in simple ways. By doing this, teachers can help students develop a strong foundation in science and prepare them for the future learning (Bosse, S., Jacobs, G. & Anderson, 2019).

Universities, specifically through elementary teacher education programs (PGSD), are responsible in training prospective teachers who are scientifically knowledgeable and skilled in improving the scientific literacy of their students. Based on data, PGSD students of Perjuangan University come from various and different backgrounds which is unrelated to science education. This diversity leads to varying levels of scientific literacy, which can hinder the learning process. Over the past two years, both lecturers and students have encountered challenges such as differences in prior scientific knowledge, ineffective teaching strategies, student difficulties in independent learning, negative perceptions of science, and inconsistent evaluation standards. To address these issues and create a more equitable learning environment, a structured and systematic approach to teaching science courses is necessary. Based on those contexts above, the research about the profile analysis of prospective elementary teacher' scientific literacy in PGSD Perjuangan University was

conducted to determine the possible strategies held by lecturer in science courses.

METHODS

This research is aimed to analyze the scientific literacy of prospective elementary teachers. It went through six main steps starting by case study and problem identification, collecting relevant materials, defining research method and instruments, collecting research data, analyzing and interpreting data, and ended by drawing the conclusions. It actually was conducted by using descriptive qualitative method which is an inquiry strategy that emphasize value, definition, concept, characteristic, symptom, symbol, and description of a phenomenon by using some different methods, focusing on the quality, in the natural and holistic way, presented narratively (Yusuf, 2014). This research involved 120 first year-students of PGSD Perjuangan University, called as prospective elementary teachers, as research subjects. The data was taken by giving test of scientific literacy which refers to Test of Science Literacy Skills (TOSLS) by Gormally (Gormally et al., 2012), questionnaire of students' learning history, and interview to some research subjects related to their scientific literacy test' result. The scientific literacy test used in this research was developed based on eight indicators and was validated by expert before implemented to the research. The question distribution of scientific literacy test in this research instrument are presented below in Table 1.

Table 1. Question Distribution of Scientific Literacy Test

Indicator	*Number of questions*
Understand methods of inquiry that lead to scientific knowledge	
Identify a valid scientific argument	21, 22, 23, 24
Evaluate the validity of sources	25, 26, 27, 28
Evaluate the use and misuse of scientific information	29, 1, 2, 3
Understand elements of research design and how they impact scientific findings/conclusions	4, 5, 6
Organize, analyze, and interpret quantitative data and scientific information	
Create graphical representations of data	7, 30
Read and interpret graphical representation of data	8, 9, 10, 11
Understand & interpret basic statistics and solve problems using quantitative skills, including probability and statistics	12, 13, 14, 15, 16
Justify inferences, predictions, and conclusions based on quantitative data	17, 18, 19, 20

Another instrument which is the questionnaire of students' learning history was distributed to collect some information which possibly affect students' scientific literacy. As well as questionnaire, interview to some subjects was done to confirm what students have experienced thus far until they are here as prospective elementary teacher.

The after step was data analysis which is the main step lead to the research conclusion. This process was done before data collection, during data collection, and after data collection. Furthermore, the data analysis used in this research was inductive technique, applying Miles and Huberman Model. It actually compared the literature review and the specific factors appearing in this research to draw general conclusion (Umar, 2019). Figure 1. shows the scheme of data analysis of this research.

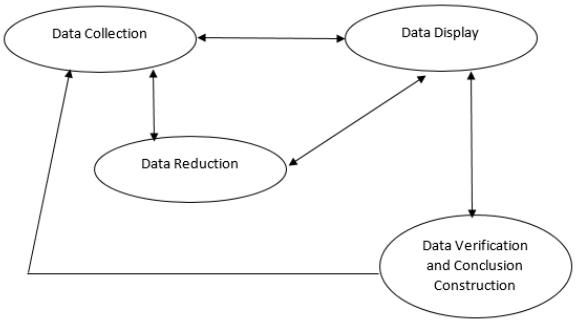

Figure 1. The Scheme of Data Analysis

RESULTS AND DISCUSSION

The scientific literacy of future prospective elementary teachers at Perjuangan University was assessed using a multiple-choice test based on Gormally's eight indicators. The average score was 47.5, which is considered moderate. None of the indicators reached a high level, as the minimum score for a high category is 67. These results suggest that the scientific literacy of these future teachers needs significant improvement. Figures 3 and 4 provide a detailed breakdown of their performance on each indicator.

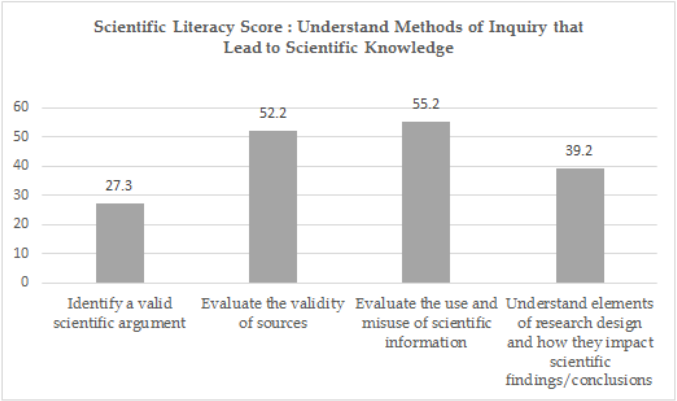

Figure 3. Average Score of Scientific Literacy in Indicator 1 until Indicator 4

Identify a valid scientific argument

The average score for this indicator is 27,3 and categorized as low. The low score in scientific argumentation is likely due to a lack of experience in scientific activities. Almost half of the students reported that their schools lacked proper labs, which limited their opportunities to participate in hands-on learning. This lack of practice can make it difficult for students to understand scientific phenomena and develop reasoning skills. Involving students in scientific argumentation give some benefits such as stimulating students' motivation in learning, supporting cognitive abilities, enhancing student performance, and developing critical thinking (Faize, F. A., Husain, W., & Nisar, 2017). Considering this context, a strategy that lecturers can implement to improve students' scientific argumentation skills is using argumentation models and linking science to the daily experiences to help students practice critiquing arguments, defending their claims, and presenting high-quality arguments.

Evaluate the validity of sources

According to the result in scientific literacy test, this indicator gained average score as much as 52,3 and categorized as moderate. The results indicated a common issue among students which is their difficulties in distinguishing between reliable and unreliable sources of information. A research claimed that students with a bit low knowledge are more likely to trust poor sites and fail to define the relevancy criteria when judging the trustworthiness of sources (Braten I, Stromso HI, 2011). This can lead to the misconceptions and invalid theories. Based on those analysis, lecturers can take the following steps such as introduce students to reliable sources, pursue them to identify scientific journals and other credible sources of information, and even encourage them to reading by assigning reading projects. Reading is a crucial skill that can benefit students in many ways. It can help them in develop critical thinking skills by analyzing information and forming their own opinions, improve problem-solving abilities by applying knowledge to real-world situations and enhance creativity by exploring new ideas and perspectives (Bradley & Wallace, 2008)).

Evaluate the use and misuse of scientific information

This indicator gained average score as much as 52,2 and it is in moderate category. The use and misuse of scientific information refers to recognizing a valid and ethical scientific action and identifying appropriate use of science to make societal decisions (Gormally et al., 2012). Scientific information processing actually could be implemented through some learning strategies such as approach, model, and method which involve students in some cases and

problem (Amar, G. I., Suranto, S., & Sajidan, 2020). It means, case study, project, and problem-based learning may be way more effective and efficient to be applied by lecturer as new learning experiences and innovations to the students. Regarding to the result of questionnaire, 43% of students have their own passion in science, 54% stated that they are not really into science, and just 3%of them having no passion at science at all. This kind of result could be a good input for lecturer conducting science courses due to their interests.

Understand elements of research design and how they impact scientific finding

This indicator states the ability of students to understand how a research could be designed and held by themselves. The average score is 39,2 and categorized as moderate. This number might be affected by some learning experiences they have pass through during school, for example when they had some laboratory works and experiments. Based on data of questionnaire, students coming from science major is about 29%, it means that possibly they often had laboratory activities, while other students did not. In the laboratory activities, students are invited to learn and observe phenomena, identify variables, classify and measure objects, use numbers, hypothesize the possibility, conclude the result, and communicate the object being studied (Kızılaslan, 2019; Kruea-In, C., Kruea-In, N., & Fakcharoenphol, 2015). When students have not been experienced this, they might be having difficulties in understanding element of research design and how to proceed it into findings. The lecturer could engage students in some laboratory works or any learning model or method that develop students' science process skill. According to Husna et al.(2022), science process skills is an investigative skill which allow and enhance students to design and carry out research.

Another result of scientific literacy indicators are shown in Figure 4 below.

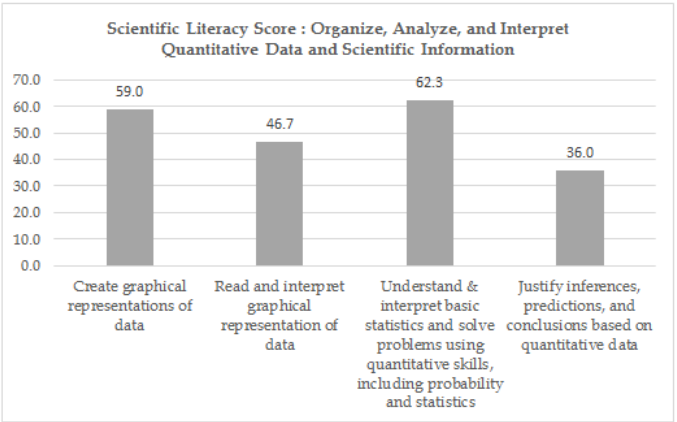

Figure 4. Average Score of Scientific Literacy in Indicator 5 until Indicator 8

Create graphical representation of data

The average score for this indicator is 59, which is considered moderate. Yet, unfortunately, this number refers to students are only moderately good at choosing the correct graph type for given data. While they can do this somewhat well in multiple-choice tests, they struggle when asked to create a graph themselves. Only 10% of students could do this, suggesting they lack the basic understanding of how to construct a graph, including the use of x and y axes. This case is likely linked to a weak foundation in basic mathematics. To address this, the lecturer could integrate mathematical concepts into science lessons using a scientific process skill approach or vice versa. This approach actually can enhance students' learning experience and improve their performance in both science and mathematics (Berlin & Lee, 2005)..

Read and interpret graphical representation of data

The average score for this indicator is 46.7, which is considered moderate. This means that students have a moderate ability to draw conclusions from data presented in graphs. The goal of this indicator is students are able to make conclusion of a study findings through a graph (Gormally et al., 2012) and to note what changes and what information are revealed by the manipulations and to identify the changing role of axes and to plot elements from graph to graph (Bright, G. W., & Friel, 1998; Garfield & Ooms, 2015). Yet, over half of the students struggle with reading and interpreting graphs. This issue can be addressed by providing more opportunities for students to practice these skills. One effective approach is to have students manipulate data between different graph types, observing how the changes in representation affect the information conveyed. This practice can help students develop a deeper understanding of graphs and improve their ability to draw meaningful conclusions from data.

Understand & interpret basic statistics and solve problems using quantitative skills

The average score for this indicator is 62.3, which is the highest among all indicators and is considered moderate. This ability is linked to basic mathematical knowledge. To improve this skill, integrating science and mathematics can be beneficial. This integration allows students to apply mathematical concepts to real-world scientific problems. By working together, science and mathematics lecturers can create projects that enhance students' understanding of both subjects. This integrated approach can facilitate better connections between concepts, processes, and skills across different subjects. It can lead to more meaningful learning and a deeper understanding of how mathematics and science are interconnected. Additionally, collaborative learning can help students overcome individual shortcomings and support the

development of better practices in both subjects (Rennie, L., Venville, G., & Wallace, 2012). Therefore, it is recommended that science and mathematics lecturers collaborate to update their curricula and integrate their courses to better develop students' skills in this area.

Justify inferences, predictions, and conclusion based on quantitative data

The average score of this indicator is 36, which is the second lowest score among all indicators. This ability may help students in making logical hypothesis, taking decision of cases, recognizing flaws in arguments, and evaluating solution of problem (Gormally et al., 2012). Enhancing this indicator, the lecturer may involve students in learning that using science process skills approach. This kind of approach involve students in some activities, like observation, measurement, classification, taking data, that possibly enactive them to do inference, prediction, and defining conclusion. Some researcher stated that science process skill may support the science inquiry of students (Juhji, 2016; Kruea-In, C., Kruea-In, N., & Fakcharoenphol, 2015). Besides that, Komikesari (2016) and Nugraha, et. al. (2019) stated that science process skill is the foundation to form logical thinking abilities of someone which describe their ways of thinking through scientific investigation or experimentation. Then, it could be claimed that science process skills are one of the most important aspects to be improved in the science courses as it helps students to be able to produce concepts, theories, and principles as well as justify inferences, prediction, and conclusion based on quantitative data (Adriyawati, U., Rahmawati, Y., & Mardiah, 2020; Pratono, A., Sumarti, S.S., Wijayati, 2018).

CONCLUSION

Based on the result of this research, it may concluded that the scientific literacy of prospective elementary teacher in PGSD Perjuangan University is still categorized as moderate, with the average score is equal to 47,5. Some aspects were considered as the reason why this number of scientific literacy attained, such as students' learning history and background, lack of experience in scientific laboratory activities or else which consider students' science process skill, teaching style of teacher, HOTS or PISA-typical question experience, students' interest in science, and even school facilities to support science learning. This result indicates that scientific literacy of PGSD students should be improved in term of the quality of graduates as elementary teacher in the future. Some efforts could be strategized by science lecturer to facilitate students in improving their scientific literacy. The initial strategy that may be conducted in science courses such as facilitating students in learning process that support their development in science process skill, include reasoning and argumentation skill, like having experiment, laboratory works, and application

of modern teaching and learning model. These effort are expected to increase their interest of science. Other strategies such as the integration of science and mathematics course where both lecture could do some collaboration in update the curricula to achieve this goal, engaging students in more scientific reading for example through scientific journal, and even good maintenance in learning facilities.

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