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ANALYSIS OF SCIENCE LITERATURE ABILITY OF BIOLOGY EDUCATION STUDENTS IN PLANT PHYSIOLOGY COURSE

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ABSTRACT

Prospective teachers are required to have adequate scientific literacy skills to support the achievement of the National SDGs 2030 goals. Research is needed that aims to analyze the level of scientific literacy skills of students of the 2018 Biology Education Study Program, Medan State University in the Plant Physiology course which was held at UNIMED in May-July 2021. This study uses a mixed descriptive method with a sequential explanatory strategy. The sample in this study amounted to 76 students who were determined through a random sampling technique. The data in this study were collected through a closed questionnaire and an observation sheet for the KKNI Plant Physiology assignment. This study uses descriptive statistical analysis techniques for quantitative data, questionnaires, and interactive analysis for qualitative data, the KKNI's task observation includes three activity lines, namely data reduction, data presentation, and conclusion drawing. The results obtained through questionnaires showed that the scientific literacy skills of Biology education students at the State University of Medan in the Plant Physiology course were in the high category with a percentage of 63.72%. Meanwhile, the scientific literacy ability of Biology education students at the State University of Medan based on the task analysis of the KKNI for the Plant Physiology course is in the low category with a percentage of 55.69%.

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INTRODUCTION

The 21st century implies that every individual must be able to adapt to the development of science and technology in various aspects of life in society. Education is one aspect of life-related to science and technology development (Fadilah et al, 2020). Education has an essential role in preparing quality human resources to cultivate logical thinking skills, critical thinking, creativity, initiative, and adaptability to change and development (Zubaidah, 2016). These skills will deliver human resources who have scientific literacy abilities.

Scientific literacy is currently a hot topic in the world of education. Evaluation and development of scientific literacy on a global scale continue to be carried out in responding to the demands of 21st-century life, one of which is measuring scientific literacy competence in various countries around the world. The Organization for Economic Cooperation and Development (OECD), as an educational system evaluation institution, has created a scientific literacy assessment system known as the Program for International Student Assessment (PISA) with the primary objective of developing test instruments based on three basic competency areas, namely reading, mathematics, and science tested on 15-year-old students. The evaluation program is carried out every three years and started in 2000 with 79 participating countries (OECD, 2019). According to PISA, scientific literacy is defined as the individual's capacity to use scientific knowledge, identify questions and draw conclusions based on scientific evidence to understand and help make decisions related to nature and all its changes caused by human activities (Yuliati, 2017). In other words, scientific literacy is the ability to apply knowledge in solving problems related to science, explain scientific phenomena related to science, and apply scientific theories to everyday life based on relevant scientific evidence (Shofiyah, 2015). Therefore, every individual needs to have scientific literacy skills with adequate mastery of science, which is needed to overcome various problems (problem-solving) in the demands and challenges of 21st century life.

In measuring scientific literacy ability, PISA has determined three basic components, namely: 1) Scientific Concepts, 2) Scientific Processes, 3) Context (Scientific Situation) (OECD, 2007). Then, Gormally et al (2012) developed an indicator of scientific literacy ability based on the three aspects that PISA has proposed. The indicators include: 1) Identifying valid scientific opinions; 2) Conduct an effective literature search 3) Understanding the elements of research design and how they impact the findings/conclusions 4) Make proper graphs of the data; 5) Solving problems using quantitative skills, including basic statistics; 6) Understand and interpret basic statistics; 7) Conduct inferences, predictions, and draw conclusions based on quantitative data.

Regarding evaluating student educational outcomes, primarily scientific literacy as a reflection of educational progress, the State of Indonesia has been an active participant in PISA since 2000 until now and has become a matter of pride in the national education system. However, this achievement was not followed by the evaluation results issued by PISA for the state of Indonesia. The latest PISA data in 2018 shows that Indonesia's scientific competence is ranked 71 out of 79 countries. The science competency score obtained decreased to 396 points (OECD, 2018). Regarding the distribution of literacy nationally, it only shows a percentage of 25.38% of scientific literacy, which is sufficient, while the remaining 73.61% is stated to be lacking. Indonesia's ranking in the PISA assessment (2000-2018) reflects the Indonesian education system, which has not been able to facilitate the empowerment of students' scientific literacy (Narut & Supardi, 2019).

According to Rahayu (2016), these problems can be anticipated and overcome through optimally empowering scientific literacy in preservice teacher students. Empowerment from the ground up is expected to increase students' scientific literacy slowly. According to Arends (2012), student-teacher candidates have begun to have a responsibility to lead students to focus on meaning construction, accountability, active learning, use of technology, the certainty of choice, increasing student competence, and being in a multicultural society. However, in implementing scientific literacy, prospective teacher students today still have various obstacles, which are generally caused by internal factors from the students themselves. Furthermore, Syofyan & Trisia (2019) identified the causes of the emergence of these various problems such as the lack of high-level thinking students in learning, the weakness of students in communicating ideas or information straightforwardly, and the lack of insight of students in exploring various literature and low thinking skills.

According to Pujiastutik (2018), related to empowering scientific literacy for prospective teacher students, it can be applied to all courses, including Plant Physiology. Learning plant physiology requires high-level analytical skills because students will be required to understand all types of activities, metabolism, and physiology carried out by plants using sound scientific

reasoning (Svandova, 2014). In other words, Plant Physiology emphasizes that students can develop their scientific literacy skills optimally.

In one of the efforts to achieve educational goals and improve the quality of higher education in Indonesia, the government issued Presidential Regulation Number 8 of 2012 concerning the Indonesian National Qualifications Framework (KKNI), which became the basis for the preparation of higher education curricula that must be implemented in the next five years (Khairiah, 2015). In response to this statement, the State University of Medan (UNIMED) developed an achievement strategy that was considered adequate by giving six assignments to students, including Routine Tasks (TR), Critical Book Report (CBR), Critical Journal Review (CJR), Mini Research (MR), Idea Engineering (RI), and Projects. From the presentation of these tasks, students' scientific literacy abilities can be seen through the work of the KKNI (MR) task. In accordance with the assessment of students' scientific literacy indicators described previously. Through the MR assignment, students are expected to be able to apply their ideas and creativity in understanding phenomena scientifically so that they can deepen their insight and develop their scientific literacy (Rusdiana, 2019).

According to Lestari (2018), biology education students' low scientific literacy ability is due to the lack of understanding of rote theory, lack of motivation to learn, low understanding of science concepts, and low student applicative abilities. Student scientific literacy becomes a complex problem that must be addressed immediately. As stated by Setyaningtyas (2018), scientific literacy plays a vital role in developing the life skills of the Indonesian millennial generation, especially in the aspect of science and technology to accelerate the achievement of Indonesia's Sustainable Development Goals (SDGs) in 2030.

Through analysis of the need for initial observations in the UNIMED Biology Education Study Program, several problems were identified, namely: 1) Students still have difficulty understanding the concepts contained in Plant Physiology because they are more focused on working on KKNI tasks, 2) Some students do not understand the rules and components/elements in designing good research related to Plant Physiology, 3) Students are not so skilled in using quantitative skills to solve problems in Plant Physiology, and 4) There is no definite picture of the scientific literacy ability of biology education students at UNIMED.

Based on these problems and the importance of scientific literacy skills for the prospective biology teacher, research on students' scientific literacy is needed.

METHOD

The research was conducted at the State University of Medan (UNIMED) from May to July 2021. This study aimed to analyze the level of scientific literacy skills of students of the 2018 Biology Education Study Program, Medan State University in the Plant Physiology course. The population of this research is S1 students of the Biology Education Study Program class of 2018 FMIPA UNIMED, totaling 151 people. Through random sampling, the researchers set a sample of 50% of the total population with 76 students. In accordance with Arikunto (2013) statement, to determine the number of samples from a large population (> 100), a minimum of 20-25% of the total population can be determined.

This study uses a descriptive method with a mixed sequential approach (mixed-method) through an explanatory strategy (quantitative-qualitative). The sequential explanatory strategy was applied to collect and analyze quantitative data in the first stage, followed by the collection and analysis of qualitative data in the second stage, which was built on the initial quantitative results. In this study, priority is given to quantitative data, and then the quantitative results are deepened with qualitative data. The main data source/primary data consisted of a closed questionnaire which was tested and analyzed quantitatively, then the student KKNI assignment observation sheet was tested and analyzed qualitatively. In research reporting, the quantitative depiction is more dominant, supported by observation results.

The collected data will be reduced by categorizing the data that has been obtained through questionnaires and observation sheets. Then after being reduced, the data is presented by calculating the score using the equation used according to Arikunto (2013):

$$\mathbf{P} = \frac{\boldsymbol{A}}{\boldsymbol{B}} \times \mathbf{100}\,\%$$

Information:
P = Percentage of respondents
A = Number of respondents' frequency scores
B = Total ideal/highest score of respondents

Furthermore, the calculated data will be interpreted through the scientific literacy assessment criteria presented in Table 1.

Table 1. Criteria for Scientific Literacy Ability

Interval	Criteria
25% - 43,75%	Very low
43,76% - 62,5%	Low
62,6% -81,25%	High
81,26 – 100%	Very high

RESULTS AND DISCUSSION

Data from the analysis of scientific literacy of biology education students in class 2018 through closed questionnaires and KKNI task observations can be seen in Table 2.

Table 2. Comparison of Science Literacy Ability Levels Through Questionnaires and Task Observations on the Seven Science Literacy Indicators

Aspect	Indicator	Questionnaire		Observation	
		%	Category	%	Category
Context	1. Identify valid scientific opinions	68,21	High	64,61	High
	2. Carry out an effective literature search	70,23	High	40,35	Very low
Content	3. Understanding the elements in research design	59,87	Low	58,17	Low
	4. Create graphs precisely from data	63,65	High	46,71	Low
	5. Solve problems using quantitative skills	62,99	High	64,47	High
	6. Understand & interpret basic statistics	56,80	Low	55,59	Low
Competence	7. Perform inferences, predictions, and draw conclusions based on quantitative data	64,34	High	59,95	Low
	Average	**63,72**	High	**55,69**	Low

Table 2 shows students' scientific literacy skills obtained through questionnaire analysis and observation of students' KKNI assignments. The results of the questionnaire analysis showed that students' scientific literacy skills were already high, with an average percentage of 63.72%. Meanwhile, the scientific literacy ability of students, which was reviewed based on the analysis of the KKNI Plant Physiology task, showed that scientific literacy was still relatively low, with an average percentage of 55.69%.

Suppose it is reviewed based on the seven indicators of scientific literacy. In that case, it shows different results on several indicators, such as indicator 2, "conducting an effective literature search," showing a high category of 70.23% through questionnaire analysis and a very low category through observational analysis with a percentage of 58 .17%. Furthermore, the difference in results is shown by indicator 4, "make a graph accurately from the data" the analysis through the questionnaire shows a high category with a percentage of 63.65, while the analysis through observation shows a low category with a percentage of 46.71%. The difference in the results is further shown by indicator 7, "doing inference, prediction, and drawing conclusions based on quantitative data" the analysis through the questionnaire obtained high results with a percentage of 64.34%. In contrast, the results of the observational analysis showed a low category with a percentage of 59.95. A comparison of students' scientific literacy skills through questionnaire analysis and KKNI task observations is presented in Figure 1.

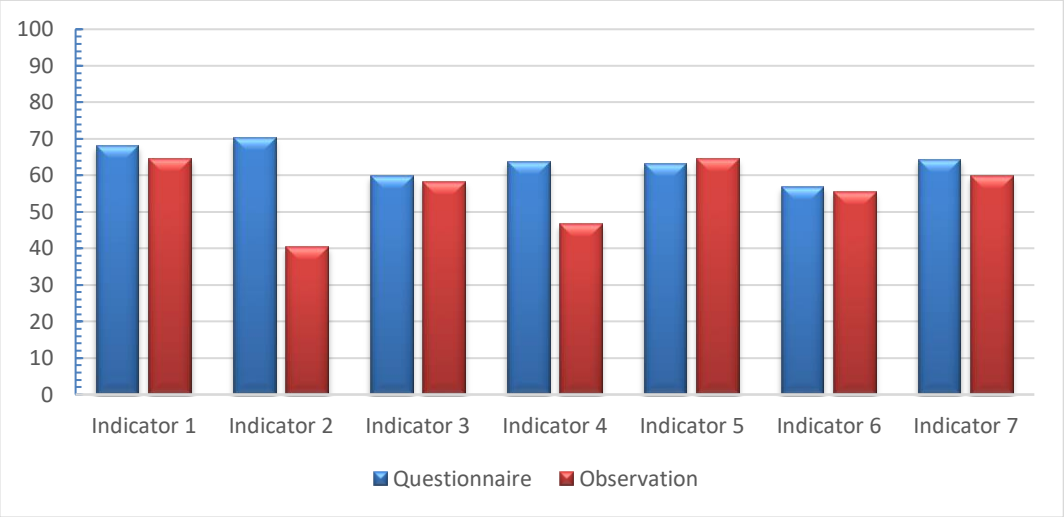

Figure 1. Comparison Diagram of the Seven Scientific Literacy Indicators Based on KKNI's Questionnaire and Task Observations

Aspects of Context (Scientific Issues)

The context aspect of scientific literacy contains the meaning of all situations that have to do with the application of science in everyday life, which is the material for understanding the concept of science (Sapinatul, 2015).

The results of the analysis of scientific literacy in the context aspect can be seen in the first indicator; namely, the ability of students to identify valid scientific opinions is already high. In other words, students can recognize, differentiate, define, identify, explore, and evaluate various scientific phenomena in the study of Plant Physiology.

These results are in accordance with the observations of students' KKNI assignments, classified as high. In carrying out assignments, students can provide personal scientific opinions, namely arguments about scientific issues and phenomena being investigated. In addition, the high level of curiosity in finding facts related to the problem to be investigated is also the cause of the high ability of students to identify valid scientific opinions. Novitasari (2018) stated that the high ability of students to identify valid scientific issues was directly related to the scientific knowledge understanding by each student so that the ability to identify various issues encountered in the process of working on KKNI assignments can be investigated scientifically.

However, the results of scientific literacy observations on the context aspect also show several weaknesses. Students still find it challenging to recognize various scientific keywords that are the demands of the IQF assignment. Due to the inconsistent use of writing formats and assignment outputs and the different perspectives of lecturers in understanding the concepts of Plant Physiology and in carrying out the tasks of the IQF. It was difficult for students to understand the intent and purpose of the assignments given by the lecturer.

In line with this statement, Ferdiana & Qorry (2020) stated that one of the causes of students' low scientific literacy skills in recognizing scientific keywords is lecturers who are less skilled in maximizing learning. According to Pratolo & Solikhati (2020), the skills and consistency of lecturers and the support of educational facilities are essential aspects of improving students' scientific literacy. Thus, the readiness of lecturers and students as well as facility support can maximize each lesson and hone students' scientific literacy skills as prospective biology teachers, especially in identifying various valid scientific issues to complete tasks relevant to the learning objectives of Plant Physiology as a requirement in the IQF.

Content Aspect (Explaining Scientific Phenomena)

The content aspect can be interpreted as an individual's understanding of facts, concepts, and theories that form the basis of scientific knowledge (Irwan et al, 2019). The content aspect of scientific literacy consists of 5 indicators. The questionnaire analysis and the observation of the KKNI task show that the second indicator, "conducting an effective literature search," and the fourth indicator, "making graphs accurately from the data," show different results. Based on the questionnaire analysis, the student's scientific literacy ability, in this case, is classified as high; on the contrary, the KKNI task observation shows that the scientific literacy ability is low.

The low ability of students to conduct effective literature searches is caused by students

who are not familiar with and familiar with research or mini research. In addition, the subjective nature of the KKNI assignment writing format from the lecturers allows students to freely use reference sources that are generally not valid and only describe subjective arguments based on the results of their observations. Following the statement of Fuadi et al (2020) if the low ability of students to use empirical literature is due to poor reading traditions and poor research traditions. Furthermore, the indicators' observations "make a graph accurately from the data" are relatively low. In the KKNI assignment reports, the students analyzed generally do not present their research data through graphs and diagrams but only use tables. In addition, the topics related to the assignment of the KKNI given by the lecturer for each student/group are generally also different. Hence, the data findings and presentation techniques are not the same.

The analysis results through questionnaires and observations also show that the third indicator, the ability to understand the elements in the research design, and the sixth indicator, namely the ability to understand and interpret basic statistics, are still relatively low. The weak ability of students to understand each element in research design is due to the lack of understanding of students in designing research and the lack of practical experience of students in writing scientific papers. In addition, students tend to describe the data narratively rather than using basic statistics such as descriptive percentages and frequency distributions and presenting data through graphs or charts from the research results obtained. Condition certainly must be addressed immediately. According to Takaria & Melvie (2018), students need to be given the training to strengthen analysis and interpretation skills through statistical literacy-based learning media. These abilities will be manifested through student skills in analyzing graphs, tables, and statistical information in text formatting. Thus, students will be accustomed to using statistical analysis in various research and other scientific activities.

However, students' scientific literacy skills in the content aspect, especially the ability to solve problems using quantitative skills, are already high. The results of observations show that students have been able to analyze the data correctly according to the design and research framework. In general, students can also answer various problems that become the formulation of the problem in research using the data obtained. It is just that students are not used to presenting data from their research results through various available statistical tools because of the lack of understanding of basic concepts related to statistics. In line with this, Andriatna et al (2021), in their research, stated that students' statistical literacy skills were not optimal due to weak basic statistical reasoning, which had an impact on students' difficulty in interpreting the data they found. According to Maryati & Pratna (2018), individuals can have good statistical literacy if they can understand various statistical tools/symbols and interpret them critically through various media.

Competency Aspect (Using Scientific Evidence)

The aspect of scientific competence refers to the mental processes involved when answering a question or solving a problem (Wulandari & Hayat, 2016). The results of the scientific literacy analysis on the competency aspect can be seen in the seventh indicator, namely, the student's ability to make inferences, predictions, and draw conclusions based on quantitative data. Based on the analysis of the KKNI's task observations, the students' scientific literacy skills incompetence is relatively low. Students are still constrained in formulating reasonable and correct hypotheses and drawing conclusions based on existing problems. Lack of understanding of students in constructing and formulating statistical hypotheses can impact justification or incorrect decision making. As Rismen (2015) stated in his research that one of the common obstacles students face in writing scientific papers is in formulating hypotheses. Students are not skilled in formulating hypotheses, so research is not on the right track because of drawing the wrong conclusions. Students must understand every statistical formula, what it is for, and how it is used. If this can be adequately understood, then the problems above can be minimized so that there are no errors in processing research data.

CONCLUSION

Based on the findings obtained through questionnaire data, it is known that the scientific literacy of biology education students class of 2018 Medan State University is in the high category with a percentage of 63.72%. On the other hand, the researcher found some discrepancies between respondents' answers and the results of observations made through the KKNI task in respondent mini-research. The observation results provide information that the scientific literacy of biology education students in the class of 2018 at Medan State University is in the low category with 55.69%.

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