Analysis of Scientific Literacy Ability in Science Competency Aspects of Physics Undergraduate Students at Makassar State University

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Abstract. The objectives of this research are to analyze the scientific literacy abilities of physics department students in the aspect of scientific competence. This research used descriptive methods with a quantitative approach. The research sample was 101 university students from physics department who are taken fundamental physics I lecture, at Universitas Negeri Makassar. The sampling technique used purposive sampling. The data analysis technique is carried out by giving a score to each student's answer and then interpreting it into scores and categories of scientific literacy achievement. Scientific literacy is measured based on indicators of the scientific literacy aspect finding that, (1) 36,54 % can carry out effective literature searches; (2) 48,85% can Interpret graphs/tables correctly; (3) 64,66% can carry out inferences, predictions and drawing conclusions based on quantitative data; (4) 9,90 % can Solve problems using quantitative skills; (5) 44.22 % can make graphs correctly from the data. These results show that students' scientific literacy abilities in the scientific competency aspect have diversity in each indicator and are still very low based on categorizing scientific literacy abilities.

Keywords: Scientific Literacy Ability; Science Competency Aspects; Physics Program

1 Introduction

The 21st Century Education in Indonesia has undergone quite significant changes. a line with [1] stated that Education increasingly requires students not only to be able to master material concepts but also to be able to apply them to daily activities. One of the essential abilities in facing the challenges of the 21st century is the ability to read science. Literacy Literally, it means "literacy", while science means natural knowledge [2]. PISA defines science literacy as students' ability to engage with science-related issues, and with the ideas of science, as a reflective citizen[3] In another perspective science literacy means that students should be able to apply scientific concepts to ana-

A. Aswi et al. (Eds.), *Proceedings of the International Conference on Sciences, Technology and Education (ICSTE 2024)*, Advances in Social Science, Education and Humanities Research 898,
https://doi.org/10.2991/978-2-38476-335-1_4

lyse data and evaluate claims about the world around them[4]. Science literacy is important for students so that they not only understand science as a concept but also can apply science in daily life.

Table 1. Science Literacy Aspects

Science Literacy Aspects	Indicator
Identify issues (scientific problems)	Identifying valid scientific opinions (e.g. opinions/theories to support hypotheses
Explaining Scientific Phenomena	Conduct effective literature searches (e.g. evaluating source validation and distinguishing between these types of sources) Create precise graph from data Interpret charts/tables appropriately Solve problems using quantitative skills, including basic statistics (e.g. calculating averages, probabilities, percentages, frequencies) Understanding and interpreting basic statistics (interpreting errors, understanding the need for statistical analysis
Using Scientific Evidence	Inferring, predicting, and drawing conclusions based on quantitative data

Science literacy is divided into four dimensions, namely science competence/process, Science literacy is important for students so that they not only understand science as a concept but also can apply science in daily life knowledge/content of science, context of science application, and attitude of science. Scientific competence consists of three aspects, namely explaining scientific phenomena, evaluating, and designing scientific investigations, as well as interpreting scientific data and evidence [5]. The instruments used in this study are limited to the aspect of science competence so that the three aspects are reduced to several indicators as illustrated in Table 1.

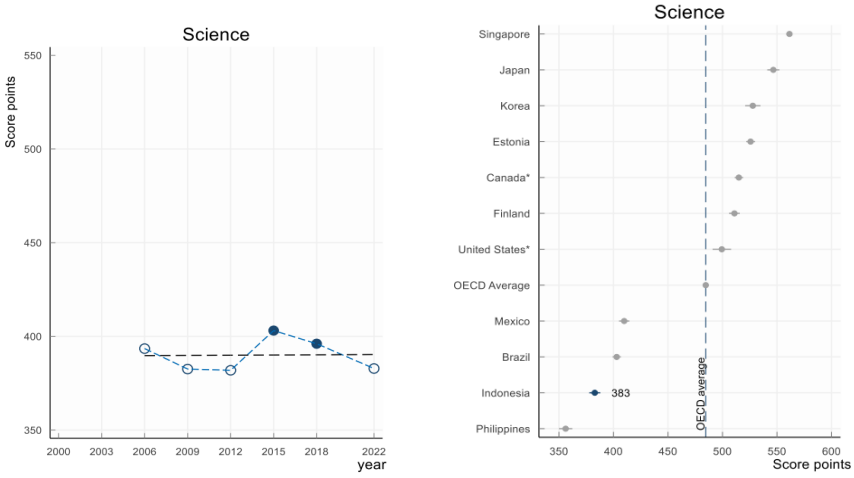

Fig. 1. Graph of PISA Study Results on Science Literacy Ability of Indonesia Students
Source: [3]

Science literacy can be measured through the PISA study organized by the OECD (Organisation for Economic Cooperation and Development) every three years. The results of the PISA study for the science literacy skills of Indonesia students from 2000 to 2022 can be seen in Figure 1.

Figure 1 shows the low level of science literacy in Indonesia compared to other countries that take the PISA Test. The results of PISA Science literacy skills are still very low compared to the international average, even decreasing from 2015. These results indicate that Indonesia students have not been able to understand the concepts and processes of science and have not been able to apply the scientific knowledge they have learned in their daily lives. This a line with [5]; [6] who wrote that the low science literacy ability of students is influenced by several factors, namely low interest in reading, learning media that has not led to the development of science literacy, learning activities that are not oriented towards the development of science literacy and lack of teachers' knowledge about science literacy. Another factor of low science literacy is also studied by [7]; are school facilities that are not supportive.

Science literacy needs to be instilled and developed through various ways, including through the learning process in educational institutions [8]. The Science literacy measured by PISA includes the Physics subject matter, the measurement of students' Science Literacy in the physics topic is very necessary and meaningful learning can be obtained through students' Science literacy which is useful for problem solving in everyday life [9]. The low science literacy in schools also has an impact on undergraduate students' science literacy because it has been low since they were in school.

Based on these problems, the purpose of this study is to analyse science literacy skills in the science competency aspect of physics undergraduate students in 2024 at Makassar State University.

2 Research Method

The type of research used is descriptive research using a quantitative approach, namely describing or describing events that are the center of attention (students' science literacy skills) descriptively and based on quantitative data (Sugiyono, 2012). The sample in this study is physics students who program Basic Physics courses as many as 101 students using the purposive sampling technique.

The science literacy ability instrument used in this study was adapted from [10]. The following indicators are used based on the author's consideration.

Table 2. Indicators of Science Literacy Ability Based on Science Competency Aspects

No	Indicator	Item Number
1	Conduct effective literature searches	1,2,3
2	Graph precisely from data	4,10
3	Solve the problems using quantitative skills including basic statistics	5,12
4	Understand and interpret basic statistics	6,7
5	Indentation, prediction, and conclusion drawing based on quantitative data	8,9,10

The science literacy instrument uses a test instrument consisting of 2 multiple-choice items, 5 essay items, 3 complex multiple-choice items, 2 true/false items. The following is the assessment rubric for each instrument.

Table 3. Assessment Rubric

Multiple choices and true/false question	Essay question	Complex Multiple Choices question
1 = Correct answer 0 = incorrect answer	4: Write known, asked, correct answer, correct unit 3: Mention3 components 2: mention 2 components 1: mention 1 components 0: not write anything down	2 = All options correct 1= Partially or partially correct 0 = none is true

The data produced in this study was analysed using quantitative descriptive data analysis techniques. The data obtained from the results of the assessment of students' answers to science literacy questions were analysed in percentage terms using the following equation

$$Percentage\ (\%) = \frac{Student's\ Score}{Maximum\ Score} x\ 100\% \quad (1)$$

It is then converted into descriptive data according to categories based on the percentage obtained. The categories of science literacy skills are presented in the following Table 3.

Table 3. Interpretation of Science Literacy Proficiency Categories

Percentage (%)	Category
81 – 100	Very High
61 – 80	High
41 – 60	Middle
21 – 40	Low
0 – 20	Very Low

(adapted from [11])

Science literacy ability is not only reviewed based on the categorization table as in table 3, but also analyzed the percentage of each indicator by comparing the percentage of true and false. The correct percentage is obtained according to equation (1) while the wrong percentage is obtained based on the following equation (2)

$$\text{Pecentage}\ (\%) = 100 - \frac{\text{Student's score}}{\text{Maximum Score}} \times\ 100\% \quad (2)$$

3 Research Findings and Discussions

3.1 A Subsection Sample

The science literacy ability in this study is limited only to the aspect of science competence. The instrument used consisted of 12 items consisting of 5 derivative indicators from 3 aspects of science competence to measure science literacy skills. The analysis used shows that the percentage of science literacy ability is still in the low category as seen in the following science literacy categorization.

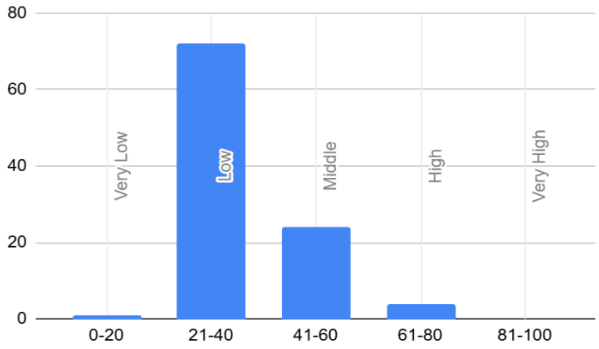

Fig. 2. Graph of Categorization of Science Literacy Skills for Physics Students 2024

The number of physics students with low abilities in science literacy from the aspect of science competence is still very significantly high compared to other categories. The number of students with medium ability is still less than half the number of students with low ability. This is influenced by the basic abilities possessed by students, the inability to read long texts and there are still some who experience misconceptions related to the basic concepts of physics such as force [12];[13].

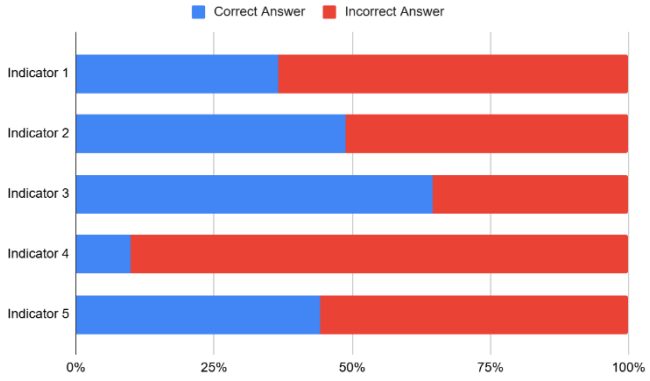

Fig. 3. Percentage of correct and incorrect answers based on indicators

It is unfortunate that none of the 101 students who were the subjects of the research were in the category of very high science literacy skills. Only 5 students are in the high

category. Meanwhile, there is only 1 student with very low ability. Science literacy ability Judging from the indicators used, it can be seen in the following figure 3

The highest percentage of students who answered correctly was on the indicator of Solving problems using quantitative skills including basic statistics. The instrument used is in the form of an essay so that it can be seen that students are able to identify known variables and be asked based on the data presented as shown in the following figure.

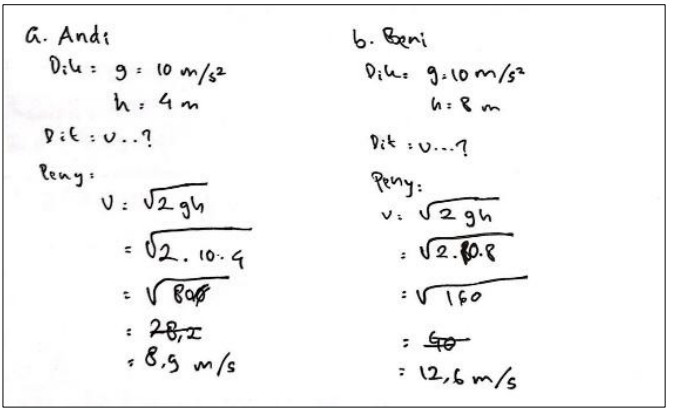

Fig.4. Student Work Results in indicator 1

It's just that students have not been able to identify directly related to the problems presented. Students tend to work on it separately as seen in figure 4 does not directly present a comparison between the two.

The lowest percentage of science literacy ability lies in the fourth indicator, namely Understanding and interpreting basic statistics. The instrument used is in the form of multiple choice. The difficulty in this indicator lies in understanding the basic abilities of students related to context and mathematics, as well as misconceptions about the context in free fall. Another thing that the author obtained is that students still find it difficult to translate the questions from the given problems, some of them just guess the answer when choosing the five options given. In addition, another problem is that students assume that the phenomena around them have nothing to do with physics concepts [14].

The second lowest percentage lies in the first indicator, which is conducting an effective literature search. The instruments used are complex multiple-choice and true/false. The difficulties of students can be seen in the inability to scan and skimming the literature provided. Another reason that the author found is that students tend to be bored when given literature so that they are unable to identify the concepts of physics that occur related to literature. This is in line with [15] The students are not used to learning more about scientific issues. Students also do not understand the problem, because the reading level is low.

The indicator of inferring, predicting, and drawing conclusions based on quantitative data is in third position regarding the percentage of students who answered correctly. The instrument used is in the form of complex multiple-choice and true/false.

The Indicators of Create precise graphs from the data used in the form of an essay instrument. The author found several relatively similar errors, namely (1) students still cannot make scales based on data to be translated into graph form; (2) Not able to accurately describe the position of the X and Y axes, an example that can be seen is that students put negative values on the positive X or Y axis; (3) Unable to identify what variables are placed on the x or y axis, most still make it upside down; (4) Unable to translate tables into graph form. The form of error that the author obtained is as shown in figure 5.

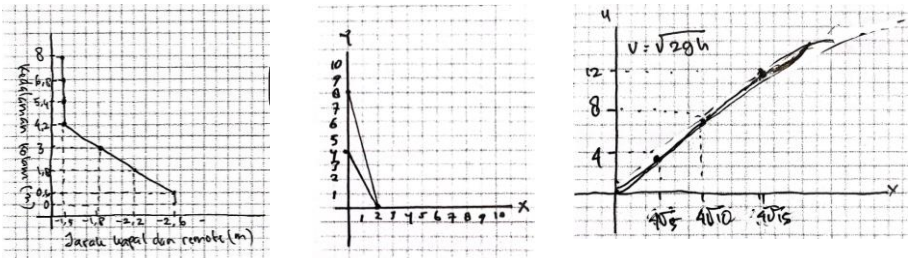

Fig.5. Results of wrong interpretation of student charts

However, there are also several students who are able to draw graphs precisely as shown in figure 6 below

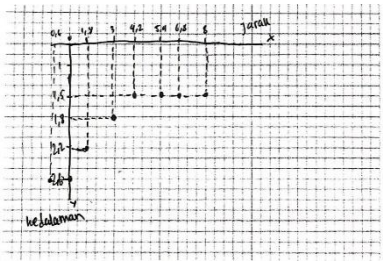

Fig.6. Precise chart interpretation results

Science literacy instruments are given to new physics students who take fundamental physics courses in 2024. This instrument acts as an identification of students' abilities, so it is highly dependent on the abilities they have before becoming undergraduate students. In line with [16] writes that the factor that is cause the low level of scientific literacy come from internal and external factors. Internal factors which affect consists of interest in science, motivation in literacy, attention to learning outside and inside the classroom, readiness to learn before learning. External factors consisting of factors in the teaching method of science literacy teachers, teachers' understanding of indicators of scientific literacy, classroom facilities, and peers.

New students need basic knowledge so this research is expected to be a reference for teachers, especially in the physics department, to create a more efficient learning process and strengthen basic science. Improving the Science literacy of Senior High School

students can be done by using science textbooks that are developed appropriately. Textbooks, worksheets, learning models, and evaluation instruments who develop based on Science literacy can improve the students' Science literacy [17]; [9]. It is hoped that lecturers will always prepare teaching materials in the form of contextual science literacy during learning so that students who are prospective educators can also apply what they learn on campus with real conditions that will later be used when teaching. Science literacy skills must be trained so that later they can give birth to new habits. This study can help educators to measure the scientific literacy ability of students, so the information gained from this study can become an evaluation and an improvement.

4 Conclusion

Based on discussion before we can conclude that these results show that students' scientific literacy abilities in the scientific competency aspect have diversity in each indicator and are still very low based on categorizing scientific literacy abilities.

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