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Analysis of Science Literacy Using Test of Scientific Literacy Skills (TOSLS) in Science Teacher Candidate Students

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Abstract: This study aims to analyze the ability of science literacy in science teacher candidates using the Test of Scientific Literacy Skills (TOSLS). This study uses descriptive quantitative research design. Sampling using random sampling technique on Science Study Program students with the number of students sampled as many as 60 people. The instrument used is a test tool for scientific literacy skills developed by the author with reference to the indicators contained in the development of the TOSLS test as many as 39 questions. The results showed that the indicator of understanding the investigation that leads to scientific knowledge was in the simply category with the interpretation of the average score obtained of 62.69, and the indicator of organizing, analyzing, and interpreting quantitative data and scientific information was in the simply category with the interpretation of the average score of 60.89. Meanwhile, when viewed based on the distribution of the number of respondents, 3% were found in the very good category, 34% in the good category, 43% in the sufficient category, 17% in the insufficient category, and 3% in the very insufficient category. Based on the results of the study, it can be concluded that prospective science teacher students already have science literacy skills in accordance with the good and simply categories, although there is one competency that is still less, namely in reading and interpreting graphical representations of data.

Keywords: Prospective science teachers; Science literacy; Test of Scientific literacy skills

Introduction

Scientific literacy is a very important basis for mproving the quality of education (Nurpratiwi et al., 2023). Science education is one aspect of education that is the same in the development of the times. In accordance with the nature of science, the orientation of science education includes three elements: product, process, and attitude through process skills. Based on these elements, science education is one way to improve science literacy (Hardianti et al., 2021; Alves et al., 2020; Smirnov & Bogun, 2010; Allum et al., 2018; Listiani et al., 2024; Gauld, 1982).

Science literacy as an educational goal for sustainable development focuses on the development of learning, research and "transfer" of skills so that the younger generation is able to use the knowledge, skills acquired in daily and professional activities (Ploj Virtič, 2022). Factors causing the low level of science literacy of students are: Inappropriate use of textbooks, Student misconceptions, Decontextualized learning, Poor reading skills, Learning Environment and climate, school infrastructure, human resources, and school management (Suparya et al., 2022; Fices et al., 2014; Fauville et al., 2015; Rundgren et al., 2012).

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Research on the level of science literacy of students conducted by previous researchers in various regions in Indonesia, showed mixed results. The level of science literacy of SMPN 2 Lhokseumawe students is known to be in the medium category (Mellyzar et al., 2022). The level of science literacy of 8th grade students of SMPN 1 Gresik in the low, medium, and high categories. The conclusion was obtained that the achievement of each indicator of scientific literacy obtained a different percentage (Rohmah et al., 2021). Meanwhile, the level of science literacy analyzed in grade XI high school students in Surakarta City shows a low category with an average achievement of 40.5% (Fadilah et al., 2020). The aspects measured include: aspects of knowledge, aspects of interpreting data and facts scientifically, aspects of mastering content and interpreting data and facts, aspects of explaining phenomena scientifically, aspects of compiling and evaluating scientific inquiry (Utami et al., 2022).

Many tests have been developed and conducted to determine the level of science literacy. Development of science literacy-based test instruments to measure students' science literacy (Nurfadillah et al., 2023; Shaffer et al., 2019; Impey et al., 2011). Development of contextual-based science literacy test instruments (Martinah et al., 2021; Akbarini & Anggrawal, 2024). Developing students' science literacy, it is very important to develop science literacy assessment tools to train students to become more literate (Chasanah et al., 2022). One of the instruments used to measure science literacy skills is the Test of Scientific Literacy Skills (TOSLS) (Utami, 2021).

The Test of Scientific Literacy Skills (TOSLS) is considered very suitable for use in testing students' scientific literacy skills (Pratiwi et al., 2023). TOSLS differs from PISA in that its scope is broad enough that it does not only focus on science, and PISA can only be tested on students aged 15 years. TOSLS can also be used to identify students' weaknesses in understanding subject concepts, improve the learning process of students, and determine whether the curriculum is effective.

Method

This study uses a descriptive quantitative research design (Priadana & Sunarsi, 2021; Sari et al., 2022; Hardani et al., 2020). With the intention of identifying and analyzing and describing science literacy skills in prospective science teacher students. The sampling technique used is random sampling, namely students of the Science Study Program of the Faculty of Teacher Training and Education, Serambi Mekkah University which includes Physics Education Study Program, Chemistry Education Study Program, Biology Education Study Program and Elementary School Teacher Study Program with a total of 60 students.

The instrument used is a test tool for science literacy skills developed by the author with reference to the indicators contained in the development of the TOSLS test. The distribution of science literacy questions in accordance with TOSLS (Gormally et al., 2012; Propsom et al., 2023; Sammel, 2014; Waldo, 2014), as in table 1.

Table 1. Distribution of Science Literacy Questions According to TOSLS

Indicators of Scientific Competence	Question Namber
Understand methods of inquiry that lead to science knowledge	
Identify valid science arguments	12, 20, 21, 29, 34, 37
Evaluate the validity of the source	13, 22, 28, 30, 33
Evaluate the use and misuse of science information	1, 19, 35, 38
Understand the elements of research design and how they affect scientific findings/conclusions.	3, 5, 27
Organize, analyze and interpret quantitative data and scientific information	
Create graphical representations of data	6, 10, 15, 18, 39
Read and interpret graphical representations of data	7, 11, 14, 16, 17
Solve problems using quantitative skills, including probability and statistics	4, 23, 25
Understand and interpret basic statistics	8, 9, 32
Justify inferences, predictions and conclusions based on quantitative data	2, 24, 26, 31, 36

Data analysis in this study by interpreting the level of science literacy skills used the conversion of test scores into values (Arikunto, 2021; Azzarkasyi et al., 2022).

$$Score = \frac{Score\ obtained}{Maximum\ score} \times 100 \quad (1)$$

Table 2. Score Interpretation Criteria

Score interpretation criteria	
Score Criteria Interval	Criteria
80 – 100	Very good
66 – 79	Good
56 – 65	Simply
40 – 55	Less
30 – 39	Very Less

The achievement value of science literacy skills obtained is then interpreted based on the criteria presented in Table 2 (Mariana et al., 2021).

Result and Discussion

The results of the data analysis of the level of science literacy skills based on the Test of Scientific Literacy Skills (TOSLS) indicators on prospective science teachers, referring to one of the dimensions of science literacy, namely indicators of scientific competence in accordance with TOSLS. The measured competency indicators consist of two indicators, namely:

Understand Methods of Inquiry that Lead to Science Knowledge

This indicator is divided into 4 sub-indicators of scientific competence in accordance with the TOSLS test instrument. The sub indicators in question are: Identify valid science arguments, Evaluate the validity of the source, Evaluate the use and misuse of scientific information and Understand the elements of research design and how they affect scientific findings/conclusions. The score interpretation of science literacy level of science teacher candidates from each sub-indicator is presented in Table 3.

Table 3. Interpretation of Competency Scores for Understanding Investigations that Lead to Science Knowledge

Scientific Competence	Score	Question Category
Identify valid science arguments	66.94	Good
Evaluate the validity of the source	57.00	Simply
Evaluate the use and misuse of scientific information	64.58	Simply
Understand the elements of research design and how they affect scientific findings/conclusions	62.22	Simply
Total	62.69	
Category		Simply

Data interpretation of table 3 shows that the science literacy skills of prospective science teachers based on each sub-indicator. The first sub-indicator, namely the competence of identifying valid scientific arguments, is an indicator that emphasizes the importance for students to recognize what can be considered scientific evidence and when the evidence can support a hypothesis (Nasrun et al., 2023). This sub indicator consists of 6 question items given with an average score interpretation of 66.94 in the good category.

The second sub indicator is the competency to evaluate the validity of the source, which is an indicator that requires students to have the ability to distinguish between various types of information sources, such as scientific articles, opinions, and content from social media (Ibrahim et al., 2023). In this competency sub indicator, there are 5 question items with an average score interpretation of 57.00 in the simply category.

The third sub indicator, namely the competency to evaluate the use and misuse of science information, is an indicator where students need to be able to distinguish between accurate and misleading information (Nuraini et al., 2023). The questions on the sub-indicator of evaluating the use and misuse of scientific information amounted to 4 question items with the interpretation of the average score obtained, namely 64.58 in the simply category.

The fourth sub-indicator, namely competence in understanding the elements of research design and how they affect scientific findings/conclusions, is an indicator to assess the extent to which respondents design research that can ensure the results obtained are reliable and valid. Then they can understand the research design better in interpreting data and drawing the right conclusions based on existing evidence. As well as respondents understanding how research is conducted, respondents can be more critical of the scientific information and arguments they encounter (Sumarni et al., 2021). The questions in this sub indicator totaled 3 question items with the interpretation of the average score obtained, namely 62.22 in the simply category.

From the four sub-indicators of science literacy competence above measured on prospective science teacher students, it can be seen that the interpretation of the average score obtained is 62.69 in the simply category. From the data obtained that the science literacy competence of prospective science teacher students in this indictor also exists in the very good category, namely in test items number 20 and 29 with the interpretation of the average score obtained 91.67 and 86.67.

Organize, Analyze and Interpret Quantitative Data and Scientific Information

This indicator is divided into 5 sub-indicators of scientific competence in accordance with the TOSLS test instrument. The sub-indicators in question are: Make graphical representations of data, Read and interpret graphical representations of data, Solve problems using quantitative skills, including probability and statistics, Understand and interpret basic statistics and Justify inferences, predictions, and conclusions based on quantitative data. The score interpretation of science

literacy level of science teacher candidates from each sub-indicator is presented in Table 4.

Table 4 shows data on the interpretation of the competency scores of prospective science teachers based on each sub-indicator. The fifth sub indicator, namely making graphical representations of data, is the ability to make graphs that represent data well, including the selection of appropriate formats for each type of data, as well as the ability to read and interpret these graphs effectively (Agustina & Rahmawati, 2021). The questions in accordance with the sub-indicators of this competency amounted to 5 question items with the interpretation of the average score obtained 59.67 in the simply category.

Table 4. Interpretation of Competency Scores for Organizing, Analyzing, and Interpreting Quantitative Data and Scientific Information

Scientific competence	Score	Question Category
Make graphical representations of data	59.67	Simply
Read and interpret graphical representations of data	50.33	Less
Solve problems using quantitative skills, including probability and statistics	63.33	Simply
Understand and interpret basic statistics	66.11	Good
Justify inferences, predictions, and conclusions based on quantitative data	65.00	Simply
Total	60.89	
Category		Simply

The sixth sub indicator is the competency to read and interpret graphical representations of data, which is to measure respondents in making graphs that clearly describe data, read and interpret this information effectively and solve problems by utilizing quantitative skills, including a basic understanding of statistics (Nasrun et al., 2023). The questions in this competency sub-indicator totaled 5 question items with the interpretation of the average score obtained 50.33 with the category less.

The seventh sub indicator is the competence of solving problems using quantitative skills, including probability and statistics, namely in this competency requires students to know how to measure respondents in the use of statistics and probability to draw conclusions based on quantitative data (Haq & Priatmoko, 2022). The questions in this competency sub-indicator totaled 3 question items with the interpretation of the average score obtained 63.33 in the simply category.

The eighth sub indicator of competence in understanding and interpreting basic statistics is that respondents can realize the importance of statistics in supporting scientific arguments (Agustina & Rahmawati, 2021). The questions to measure this competency amounted to 3 items about the interpretation of the average score obtained 66.11 in the good category.

The ninth sub indicator of competency to justify conclusions, predictions, and conclusions based on quantitative data is a competency to measure respondents in developing the ability to make predictions and conclusions based on data analysis (Azzarkasyi & Rizal, 2023; Utami et al., 2020; Pei et al., 2013). The questions to measure this competency amounted to 5 question items with the interpretation of the average score obtained 65.00 in the simply category.

From the above sub-indicators of science literacy competencies included in the indicators of organizing, analyzing, and interpreting quantitative data and scientific information measured on prospective science teacher students, it can be seen that the interpretation of the average score obtained is 60.89 in the sufficient category. From the data obtained that the science literacy competence of prospective science teachers in this indicator is still lacking, namely in the sub-indicator of reading and interpreting graphical representations of data, this is because test items number 16 and 17 are obtained in the very poor category with the interpretation of the average score obtained 36.67 and 33.33.

Distribution of Science Literacy Skills of Science Teacher Candidates

The results of the data analysis of the distribution of the level of science literacy skills based on the Test of Scientific Literacy Skills (TOSLS) indicators on prospective science teacher students, referring to one of the dimensions of science literacy, namely indicators of scientific competence in accordance with TOSLS. The competency indicators measured are two indicators and divided into 9 sub-indicators. Data collection was carried out by presenting 39 items of questions given to 60 respondents who were taken as samples in the study. Description of the distribution of science literacy skills of prospective science teachers can be mapped in Figure 1.

The results of the analysis of Figure 1 can be explained that the science literacy skills of prospective science teachers based on the criteria are 3% of 2 people in the very good category, 34% of 20 people in the good category, 43% of 26 people in the simply category, 17%

of 10 people in the less category and 3% of 2 people in the very less category.

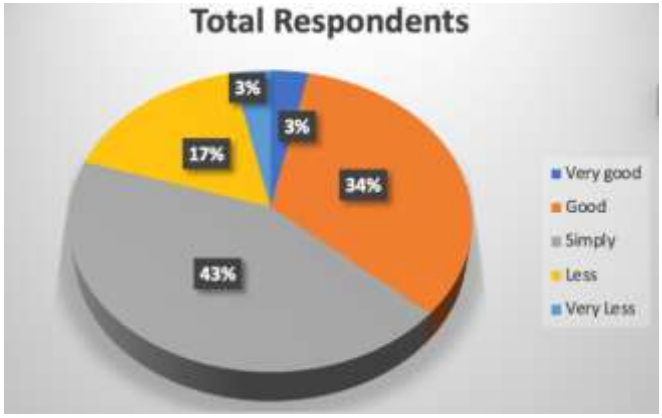

Figure 1. Distribution of science literacy skills of science teacher candidates

Conclusion

Based on the results of research that has been conducted on the science literacy competence of prospective science teacher students using the Test of Scientific Literacy Skills (TOSLS). The competency indicators measured are two indicators and divided into 9 sub-indicators. So it can be concluded that the science literacy competence of prospective science teachers on indicators of understanding investigations that lead to scientific knowledge is in the simply category with the interpretation of the average score obtained 62.69, and indicators of organizing, analyzing, and interpreting quantitative data and scientific information are in the simply category with the interpretation of the average score of 60.89. Meanwhile, when viewed based on the distribution of the number of respondents, 3% were found in the very good category, 34% in the good category, 43% in the simply category, 17% in the less category, and 3% in the very less category.

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