An Analysis of Mathematics-Integrated Scientific Literacy Competence of in-Service Teachers in Elementary School

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Abstrak. Living in the era of globalization, people are required to have literacy competencies in order to build and validate the knowledge received. Furthermore, rapid technological developments demand everyone to be better able to sort out opinions and facts, and to recognize biased content or fake news. Therefore, teachers, especially in-service teachers have an important role in improving literacy competence of elementary school students. They have to meet three scientific literacy competencies that are integrated in mathematics to improve their quality as educators. This study then aims to determine the integrated mathematical literacy competence of in-service teachers in elementary school. The competence consists of three indicators, including 1) being able to explain scientific phenomena, 2) being able to assess and apply scientific procedures, 3) and being able to interpret data. This descriptive study employs a test of ten questions as an instrument. The results of data analysis show that mathematics-integrated scientific literacy competence of in-service teachers in elementary school in explaining scientific phenomena, and assessing and applying scientific procedures is high. Meanwhile, integrated mathematics scientific literacy competence of the teachers in interpreting data is low.

Keyword: Literacy Competence, Mathematics Integrated Science, in-service Teachers

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INTRODUCTION ~ Science learning helps elementary school students to improve thinking skills, improve skills and develop knowledge about the universe created by the Almighty. There are three definitions of science learning, the first is about science. The second is about the product or result of the knowledge gained. Third, attitudes and processes. Elementary school teachers assume that if they already have the ability to organize between theory and facts, it means that they already have good scientific literacy skills (Sopandi, 2013); (Yanti Fitria et al., 2018). In fact, they have not been able to solve problem-based questions or questions presented in PISA. This is very contrary to PISA (OECD, 2019) that learning science requires knowledge of concepts and theories, it also requires knowledge of general and practical procedures related to scientific investigations and how to integrate them.

PISA conducted a survey on scientific and mathematical literacy and found that the scientific and mathematical literacy skills of students in Indonesia had not yet reached the standard score set by the OECD internationally. The results of this PISA found that one of the countries that always occupies the lowest rank is Indonesia, although for the 2019 period there has been an increase but it is not significant (C. M. Y. A. Y. Fitria, 2019);(Atikah et al., 2020). This is also supported by the results of interviews with science lecturers who explained that the instruments used by teachers to

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measure science learning outcomes did not fully use the context of the surrounding environment or students' daily lives (Sari & Fitria, 2021). The assessment carried out is only based on the curriculum and lesson plans that have been made in the previous year without any updates and sometimes only based on the policies set by the Ministry of Education and Culture regarding affective, psychomotor and cognitive assessments.

PISA defines three aspects of the competency/process science component. Three scientific competencies are measured in scientific literacy. The three competencies are First, identifying scientific issues (problems) namely recognizing possible problems for scientific investigation, identifying keywords to search for scientific information, recognizing key features of scientific investigation. Second, explaining scientific phenomena, namely applying science in certain situations, describing or interpreting scientific phenomena and predicting changes, identifying appropriate descriptions, providing explanations, and predictions (Yanti Fitria et al., 2019). Third, using scientific evidence, namely interpreting scientific evidence and making conclusions and communicating, identifying assumptions, evidence, and reasons behind conclusions, reflecting on the social implications of science and technological developments (Bybee, 2009: 5).

Scientific literacy is the ability to solve problems based on understanding science, communication, and its application which also has an impact on being sensitive and concerned about the environment (Yanti Fitria, 2017); (Y. Fitria et al., 2018). Scientific literacy is one of the most important competencies to be mastered by every individual because it can help adapt to global challenges (Sari & Fitria, 2021); (Zuryanty et al., 2019), and can increase the competitiveness of knowledge-based countries. Efforts to train individuals to have high competitiveness can be started through education. Education can accommodate the development of scientific literacy equally if every individual has the same opportunity to obtain the best quality education. Students who are scientifically literate mean that students have knowledge and understand concepts (Y. Fitria et al., 2019) and scientific processes needed to make decisions, are able to realize and participate actively in discussions and have a sense of caring and able to make decisions about issues that occur in society and the world globally. The nine-year compulsory education policy is a policy related to the minimum standard of human resource quality. With this government policy, it is hoped that all Indonesian people will have scientific literacy.

Mathematics-integrated scientific literacy competencies according to the OECD (2019) are the ability to explain scientific competencies, apply scientific procedures, and interpret data. So that they can understand and make decisions about nature and the changes made to nature through human activities. To find out the percentage of mastery of elementary school teacher students in working on scientific literacy questions, analysis is needed. Analysis of the assessment of mathematical literacy in integrated science as a solution to make elementary school teacher students think

scientific literacy is integrated in mathematics.

METHOD

The research approach used is a quantitative approach with descriptive analysis methods. Descriptive research is a research that explains or observes problems systematically and accurately regarding the facts and properties of certain objects. Descriptive research is intended to describe, describe and map facts based on a certain perspective or frame of mind. There are two types of sources used in this study, namely primary data sources and secondary data sources. Primary data were obtained from the results of students' scientific literacy tests, the results of questionnaires regarding students' scientific literacy abilities and the results of student interviews during the lecture process (learning) in class, while secondary data came from document studies in the form of documentation (photos) and other supporting documents. Data collection techniques in the form of scientific literacy tests in the form of tests, questionnaires, and interviews. The test was developed from indicators on aspects of scientific literacy. Questionnaires and interviews were used to determine the factors that influence students' scientific literacy skills and what efforts can be made to develop students' scientific literacy skills, especially in the aspect of competence. The data analysis technique uses descriptive statistics with the formula

$$PK = \frac{Ps}{Smax} x100\%$$

Information:

PK= ability percentage

PS= score acquisition

SMAx=Maximum Score

Students are said to have good mathematical integrated scientific literacy skills if they are more than 50%.

RESULTS AND DISCUSSION

The overall achievement of scientific literacy skills was obtained by calculating the average percentage of students who answered the questions correctly on each item. Before that, the initial stage of this research was the preparation of tests to measure scientific literacy competence and using indicators adapted from Bybee (2009). The general description or categories of scientific literacy abilities are arranged as Table 1.

Table 1. Science Competency Indicators

Science Competence	Indikator	Item
K I. Explaining scientific phenomena	Making graphs accurately from data	1-2
	Solve problems using quantitative skills, including basic statistics	3-4
K II. Applying scientific procedures	Drawing conclusions based on quantitative data	5-6
	Doing inference, prediction	7-8
K III. Identify scientific issues(problems)	Identify valid scientific opinions	9-10

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Furthermore, the tests that have been made are given to elementary school students. The results of the calculation of the percentage of elementary school students who answered the questions correctly on each item are presented in Table 2.

Table 2 Percentage of Students Who Answered Each Question Correctly

Science Competence	Indikator	Pesentase
K I. Explaining scientific phenomena	Making graphs accurately from data	48,68%
	Solve problems using quantitative skills, including basic statistics	42,15%
K II. Applying scientific procedures	Drawing conclusions based on quantitative data	76,32%
	Doing inference, prediction	77,63%
K III. Identify scientific issues(problems)	Identify valid scientific opinions	94,74%

The results of the student science literacy competency test show that the scientific literacy competence of elementary school students with the highest percentage is an indicator of identifying valid scientific opinions, which is 94.74% on scientific competence in identifying scientific issues (problems). Second, in science competence explaining scientific phenomena for indicators, making graphs accurately on indicators solving problems using quantitative skills, including basic statistics, the percentage is the smallest among all indicators, which is 42.15% and indicators for making graphs accurately from data get a percentage of 48, 68% is the second smallest percentage of completeness. Third, the competence to apply scientific procedures obtained an average percentage of 77.30%. The complete scientific literacy ability of students for each indicator can be seen in Figure 1.

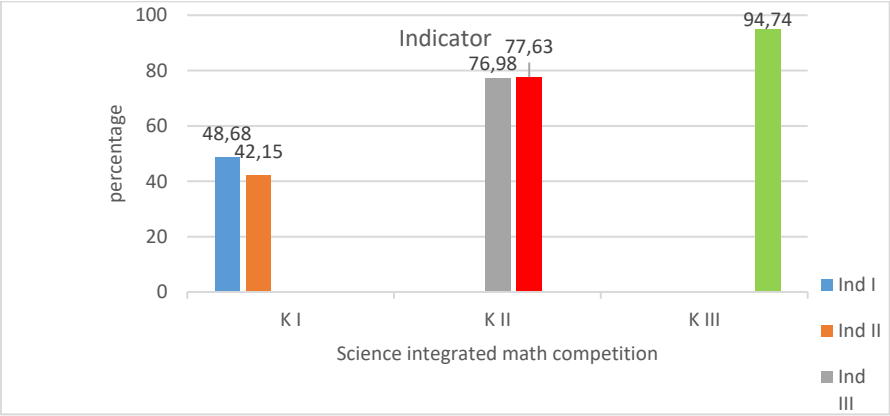

Figure 1. Percentage Indicator Math Integrated Science

In Figure 1 the percentage of students' answers are correct. In general, from all Figure 1 shows that most of the 38 elementary school students tend to have fairly good scientific literacy competencies, but competency 1 is still low, which is less than 50%. Figure 1 shows that the percentage of students' correct answers from the highest competency to 3 indicator 5 is 94.74%. Based on the category of scientific literacy ability, showing that the ability to explain scientific phenomena is still low, it can be seen from the two indicators that show very small results, namely below 50%, the lowest competency is indicator 2, which is 42.15% and the second lowest is indicator 2, namely 48.68%.

The inability of students in the ability to explain scientific phenomena shows that students have not been able to solve problems scientifically and communicate the results of experiments carried out in writing and make graphs accurately from the data. The inability of these students shows that learning science or science in PGSD is still not implemented according to the nature of science. Overall, students have a fairly good scientific literacy competence. This is shown from the results of the scientific literacy ability test questions, students have been able to work on competence 2 and competence 3, but competence 1 elementary school students and teachers have not been able to determine the problem but cannot provide a scientific explanation. Some of the factors that cause it include elementary school students who are not accustomed to completing tests of scientific literacy skills or problems related to science process skills which are the main part of scientific literacy.

Based on the results of the analysis of the initial literacy abilities of elementary school teachers in the PGSD Study Program, it is necessary to have learning that can train science process skills so that students are accustomed to doing things related to activities including: identifying scientific questions, providing scientific explanations of phenomena and using scientific evidence . According to Diana et al., (2015), so that scientific literacy skills can improve properly, teachers are encouraged to start introducing and teaching materials using various strategies with aspects of scientific literacy, including teaching material through experiments that can stimulate higher-order thinking. and is contextual.

According to Rizkita et al., (2016: 780), increasing scientific literacy skills can be done through learning that emphasizes problem solving skills which can be done with Problem-Based Learning (PBL) strategies. In line with that, Trowbridge & Bybee (1996) recommends a learning cycle learning model in practicing scientific literacy skills. Modern society is very dependent on technology and the progress and development of science (Yusuf, 2003). If a student can combine concepts or facts found in school with natural phenomena that occur in everyday life, then the student has scientific knowledge. This is supported by the statement of Sudiatmika (2010) which states that insightful people can see science in several ways. First of all, people with scientific literacy can ask questions and find or determine answers to questions stemming from curiosity about everyday experiences. Second, people with scientific literacy can identify scientific issues that shape local and

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national decision-making and disclose scientific information. Third, people with scientific literacy have the ability to present and evaluate arguments based on evidence, and use conclusions appropriately. The conclusion presents a summary of the description of the results and discussion, referring to the research objectives. Based on these two things, new ideas are developed which are the essence of the research findings.

According to Lin (2011), scientific literacy is a starting point for students to find themselves ready to face social challenges. Scientific literacy can be used as a benchmark to determine a student's future career, even though the student is involved in science. The statement also confirms that there is no relationship between someone who has scientific literacy and the major he chooses, because every student must have scientific literacy skills. However, regardless of whether they pursue science studies in the future, scientific literacy is considered the primary learning outcome of all students' education at the age of 15 (OECD, 2016).

In addition, students are not used to dealing with speech problems and loading graphs, which also require professional knowledge to check. This is in line with the views of the American Association for the Advancement of Science (1993) in Rustaman (2003) and to solve scientific literacy problems in PISA exam subjects, it is necessary to analyze problems and the ability to read accuracy and understand reading content. Another factor that may cause the low scientific literacy ability of high school students is the difference in learning targets applied in schools even though they have used the 2013 Curriculum with the target of scientific literacy in PISA 2015. Science learning in schools includes more limited and strict assessments of science material/content, while the target in PISA is more on the application of scientific thinking (reasoning) in real everyday life (Fives et al., 2014), and focuses on the action of practical knowledge and measuring the ability to use scientific principles in non-academic contexts (Shwartz et al, 2006).

CONCLUSION

Based on the results of research and data analysis, obtained from this study, it can be concluded that the results of the analysis indicate that the higher elementary students' teacher-teacher scientific literacy competence is the third competency, namely the indicator of identifying valid scientific opinions with a percentage of 94.74%. While the results of the analysis of student scientific literacy competencies that are lower are the competencies of the two indicators of solving problems using quantitative skills, including basic statistics of 42.15%. The solutions that can be offered are the need for learning in college using problem-based learning models, discovery or inquiry, conducting experiments, and learning cycle learning models.

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