Scientific Literacy Profile of Pre-Service Elementary School Teacher Students

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Abstract: This research aims to determine the profile of the scientific literacy competence of pre-service elementary school teacher students. The method used is descriptive quantitative method. The samples are 52 elementary school teacher education students at a private university (23 students from class AO1 and 29 students from class AO2). The instrument used is the scientific literacy ability test questions consisted of 80 multiple choices questions that have passed the validity test. The data were then analyzed by using descriptive statistical analysis. The results showed that the scientific literacy competence of pre-service elementary school teacher students was in the moderate category. In details, the sub-indicator of explaining scientific phenomena is in the moderate category, identifying scientific questions or issues is in the moderate category, and using scientific evidence is in the low category. The results show that overall the sub-indicators are in the moderate category.

Keywords: Pre-service elementary school teacher students; Science literacy

Introduction

Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character and the skills needed by themselves and society (Rahman et al., 2022). Along with education, the potential of the community is expected to grow optimally to produce knowledgeable human resources to support national development.

Science education play an important role in preparing children to live in the world. The implementation of quality science education influences the achievement of national development. Science education depends on the learning method used. Science education enables students to engage in the impact of science on their daily lives and their role in society. By applying science concepts in science education, Indonesian students will be able to solve real problems in this 21st century era.

Science learning in the 21st century has turned into student-centered learning which can be developed by learning scientific literacy (Pertiwi et al., 2018). The success of learning scientific literacy is shown when students understand what is learned and can apply it in solving various problems in everyday life. Therefore, learning scientific literacy is important for students to understand what is learned (Pertiwi et al., 2018). Through science education, students can be involved in the impact of science in everyday life and the role of students in society. By applying science concepts in science education, Indonesian students are expected to be able to solve real-life problems in this 21st century era (Pratiwi et al., 2019).

Elementary school students are required to have better skills in studying science, especially those related to basic science concepts. Therefore, teachers who teach science in elementary schools must have adequate knowledge of science, especially regarding basic science concepts. In the learning process in elementary schools, the teacher is the person who most often interacts with

students, which also the role of the teacher is to determine the learning outcomes. Teachers are not only obliged to instill concepts and processes in learning, but also instill attitudes towards students. The very important role of the teacher makes him/her one of the components that determines the success of the learning. This is in line with the statement "the teacher is the main pillar in improving the quality of learning or education. Learning in schools is very dependent on the professional level of the teacher" (Rohmatillah et al., 2018).

Given the very important role of the teacher in learning, a teacher must have more abilities than others in improving the quality of education. The learning carried out by the teacher must also be able to generate students' interest to promote meaningful learning. Not only teachers, the pre-service elementary school teachers (students of the Elementary School Teacher Education Study Program) must also have better competence by the time they carry out their duties as teachers. Therefore, it is very important for the teacher students to have in-depth knowledge of science. In other words, the teacher students must have good scientific literacy. Scientific literacy is one of the six literacy types to acquire by teachers. Scientific literacy that must be possessed by the elementary school teacher students can be obtained from learning the basic concepts of science which is related to living things and their life processes, objects/materials, and their uses.

Scientific literacy is a person's ability to apply his knowledge to identify questions, construct new knowledge, provide scientific explanations, draw conclusions based on scientific evidence, and the ability to develop a reflective mindset so that he is able to participate in overcoming issues and ideas related to science (OECD, 2019). C.E. de Boer further stated that the first person to use the term "Scientific Literacy" was Paul de Hart Hurt from Stamford University who stated that Scientific Literacy means understanding science and its application to the needs of society. Scientific literacy according to the National Science Education Standards is "scientific literacy is knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity.

Scientific literacy can be interpreted as scientific knowledge and skills to be able to identify questions, acquire new knowledge, explain scientific phenomena, and draw conclusions based on facts, understand the characteristics of science, awareness of how science and technology shape the natural, intellectual and cultural environment, and a willingness to be involved. and care about science-related issues (Kemdikbud, 2019).

Scientific literacy is also defined as the capacity to use scientific knowledge, identify questions, and draw conclusions based on facts and data to understand the universe and make decisions from changes that occur due to human activities (OECD, 2006). Scientific literacy is a person's ability to use scientific knowledge and processes, not only to understand the universe, but also to participate in decision making and implementing (OECD, 2018).

Scientific literacy according to the Program for International Student Assessment (PISA) (2003) is defined as the individual's ability/capacity to use knowledge about science, identify problems, and build conclusions based on scientific evidence regarding scientific issues, in order to understand and make decisions regarding with nature and human interaction with nature (Griffin & Ramachandran, 2010). In the context of PISA, scientific literacy is a person's ability to use scientific knowledge, analyze questions, and draw conclusions based on evidence, to understand and make decisions related to nature and its activities with humans (Novili et al., 2017).

PISA initially established three major dimensions of literacy, namely scientific competence (process), science knowledge/content (content), and science application context. In its development, PISA in 2015 determined that scientific literacy consists of four major interrelated dimensions (aspects), namely competence (scientific process), knowledge or science content, scientific context, and attitudes. The first aspect, namely the competence aspect, also known as the scientific process, is an aspect of scientific literacy which means the process of a person in answering a question or solving a scientific problem. To build scientific literacy skills in students, which are based on logic, reasoning and critical and creative analysis, the scientific competencies measured in scientific literacy skills according to PISA are divided into three indicators, namely identifying scientific issues or questions, explaining phenomena scientifically, and using scientific evidence (Jufri, 2017).

The results of the study indicate that, based on PISA (Program for International Student Assessment), the results of students' scientific literacy achievement in Indonesia is in a low level, namely the bottom 10 positions, yet scientific literacy becomes a very important factor in determining the quality of education in a country (OECD, 2015). The low level of scientific literacy of students is one of the problems in education in Indonesia. This is supported by data on the scientific literacy achievement of Indonesian students in the PISA (Program for International Student Assessment) scientific literacy assessment conducted by the OECD (Organization for Economic Co-operation and Development) every three years, where Indonesia is ranked 70th out of 78 countries in 2018.

According to PISA in 2012, Indonesia was ranked 64th out of 65 participants. In 2015, Indonesia made progress by being the 62nd position with a score of 403 out of 70 participants, yet still far from Thailand which was ranked 54th with score of 421 (OECD, 2015). Based on the PISA report, by December 3rd 2019, Indonesia's reading score is ranked 72nd out of 77 countries, while science score is ranked 70th out of 78 countries (OECD, 2018). The data shows that the level of scientific literacy of students in Indonesia is still very low. The low level of scientific literacy of students can be caused by the instrument technique that does not fully accommodate the criteria for assessing scientific literacy (Afriana et al., 2016). One of the factors that causes Indonesia's low PISA score is because the literacy skills of the students are not optimal (Ratri, 2015).

According to Huryah et al. (2017) in (Wahyuni et al., 2020), the results of low scientific literacy achievements indicate that the average scientific competence of Indonesian students has only reached the ability to remember and recognize scientific knowledge based on simple facts but has not been able to communicate and relate various science topics, let alone apply complex and abstract concepts in everyday life. The low level of achievement of scientific literacy in Indonesia is one of the empirical foundations for the creation of the 2013 curriculum. In the 2013 curriculum, scientific literacy is clearly seen through scientific inquiry learning. Scientific inquiry learning involves the process and attitude of science so that students are able to construct their own knowledge.

Learning science in elementary school has three general objectives. The first goal is to prepare students to study science at a higher education level. The second is to prepare students to enter challenges in their field of work in the future, and the third is to prepare students to become members of society who have good scientific literacy skills (Jufri, 2017).

The reasons why scientific literacy is important for students to have, namely: (1) understanding science offers fulfillment of personal needs and joy, which can be shared with anyone; and (2) countries in the world are faced with questions in their lives that require scientific information and a scientific way of thinking to make decisions and the interests of many people that need to be informed, such as air, water and forests (Zuriyani, 2017).

Scientific literacy is very important to train students or students so they can compete in the modern era where technological progress is so rapid (Novili et al., 2017). Scientific literacy supports students to create their own procedures based on the investigations they do (Irmita & Atun, 2018). Scientific literacy is very important in improving the academic ability of students in science major to connect with social issues (Al-Momani, 2016).

In the learning process at the university level, the teaching staff for Elementary School Teacher Education at Langlangbuana University also shows that the literacy ability of students is still very low. There are still many students who have difficulty understanding learning materials and also have difficulty analyzing learning materials, especially science learning. The low scientific literacy of prospective teacher students will have an impact on the occurrence of misconceptions in students so that their cognitive, affective and psychomotor learning outcomes are low (Fazilla, 2016). With various problems that exist at the basic education level, it is necessary to increase the scientific literacy skills of PGSD students so that later they can develop the potential of students and can help students to improve learning outcomes and trigger students to be able to solve problems that exist in the surrounding environment.

Based on the background of the problems above, the formulation of the problem in this study is as follows: What is the scientific literacy ability profile of prospective elementary school teacher students at the Teaching and Education Faculty Langlangbuana University?

The objectives of this research are: To describe the profile of the scientific literacy ability of prospective elementary school teacher students at the Faculty of Teacher Training and Education, Langlangbuana University.

Method

The method in this study is quantitative research with a descriptive approach. Descriptive approach is a research approach that is carried out to determine the value of the independent variable, either one variable or more (independent) without making comparisons or connecting with other variables (Sugiyono, 2019; Herlanti et al., 2019).

The samples of this study were semester II students at Langlangbuana University, Bandung. Determination of the sample is done by using purposive sampling technique which is a deliberate sampling technique, where the researcher determines the sample herself because there are certain considerations, so that a sample of 2 classes, AO1 and AO2 were obtained with a total number of 52 students.

The data were collected through a written test. The test instrument used is a multiple-choice test with four options with the following science basic concepts material, namely: unit quantities, motion, force, simple machines, energy, wave and sound vibrations, electricity and magnetism, light and optical devices,

earth and the universe, changes in materials, living things and their environment and physiological functions in humans (digestive system, respiratory system, movement system and circulatory system in humans).

The data analysis technique used is descriptive statistical analysis which intends to describe the data obtained in the form of the lowest score, highest score, average score which is continued in certain categories. Students who are sampled fill out the question sheets that have been provided and then the score is calculated from the correct score for each question. The final results of all questions are in the form of the overall average and on each indicator. To analyze the data on the test, use the average with the following equation:

$$\text{Average} = \frac{Student\ correct\ answer}{Maximum\ score} \times 100\% \tag{1}$$

The average obtained is then classified based on the category which can be seen in table 1 below.

Table 1. Category of Student Science Literacy Achievement (Huryah et al., 2017)

Percentage (%)	Category
>70	Tall
60 – 70	Currently
< 60	Low

Result and Discussion

Data on scientific literacy abilities of elementary school teacher candidates were collected using a scientific literacy ability test using indicators put forward by PISA in 2015 which consisted of four major interrelated dimensions (aspects), namely competence (science process), science knowledge or content, context science and attitude. Competence (science process) as measured in scientific literacy ability according to PISA is divided into three indicators, namely identifying scientific issues or questions, explaining phenomena scientifically and using scientific evidence (Jufri, 2017).

This assessment was attended by 52 students. Scoring is done based on the results of student answers with predetermined scoring criteria. The scoring criteria are on a scale of 0-100 with the benchmark of the achievement score divided by the maximum score, then multiplied by 100. In this way a scientific literacy score or score will be obtained based on the results of student answers.

Based on the results of the calculations and analysis that the researchers carried out, the average scientific literacy score of prospective elementary school teacher students was obtained. The average data is indicated by a number, as an indication of the value of the object that

has been measured. Data from the analysis of scientific literacy abilities of elementary school prospective students are presented in Table 2.

Table 2. Achievement Scores of Student Science Literacy Elementary School Teacher Candidates

Science Literature Indicators	Total Score	Presentation	Category
Explain phenomena scientifically	874	62.22%	Currently
Identify scientific questions or issues	878	62.25%	Currently
Using scientific evidence	811	57.76%	Low
Average		60.74%	Currently

Based on table 2 above, it shows that the average value of students' scientific literacy skills in the sub-indicator of explaining phenomena scientifically is 62.22% in the "moderate" category identify scientific questions or issues 62.25% with categories "currently", and indicators using scientific evidence 57.76% with categories "low" and overall included in the medium category.

The measurement of scientific literacy is carried out on the basic concepts of science with the main subjectunit quantity, motion, force, simple machines, energy, wave and sound vibrations, electricity and magnetism. Light and optical devices, the earth and the universe, changes in matter, living things and their environment and physiological functions in humans (digestive system, respiratory system, movement system and circulatory system in humans).

Data from the analysis of the scientific literacy skills of elementary school prospective students for each subject were obtained as illustrated in table 3. Based on table 3 above, it shows that the average indicator of scientific literacy competence for the subject matter of Quantity and derivatives obtained an average score of 77.24% in the "High" category, the Subject of Energy and Business obtained an average score of 69.55% in the "moderate" category, the Subject of Temperature and Heat obtained an average score of 59.93% in the "low" category, Vibration and Waves obtained an average score of 66.06% in the "moderate" category, Material and changes obtained an average score of 55.12% in the "low" category, Electricity and magnetism obtained an average score of 65.38% in the "moderate" category, Earth and the Universe obtained an average score of 55.12% in the "moderate" category. low", Light and Optical Equipment obtained an average score of 61.21% in the "medium" category, Living things and their environment obtained an average score of 73.71% in the "high" category, the digestive system in humans obtained an average score of 54.16% in the "low" category, the respiratory system

in humans obtained an average score of 54.48% in the "low" category, the circulatory system in humans obtained an average score of 46.15% in the "low" category, the movement system in humans obtained an average score of 71.25% in the "high" category.

Of the 13 subjects of elementary science basic concepts, 3 subjects were categorized as high, 4 subjects were categorized as moderate, and 6 subjects were categorized as low. Of the 13 subjects there are 6 which are in the low category of around 46.15%. This implies

that it is necessary to carry out learning that involves scientific processes,Because learning is the most important part in determining the achievement of mastery of scientific literacy (Yuyu, 2017). And learning that focuses on achieving scientific literacy is learning that is in accordance with the nature of learning science in which learning does not only emphasize rote knowledge but is oriented towards the process and achievement of a scientific attitude (Yuyu, 2017).

Table 3. Achievement Scores of Scientific Literacy Ability Based on the Context of Elementary Science Basic Concepts

Science literacy Indicator	Subject												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Explain phenomena scientifically	69	86	52	68	70	67	58	71	65	48	74	51	95
Identify scientific questions or issues	95	63	72	92	23	64	77	46	87	45	68	51	95
Using scientific evidence	77	68	63	43	79	73	37	74	78	76	28	42	73
Total	241	217	187	203	172	204	172	191	230	169	170	144	263
Percentage	77.24	69.55	59.93	65.06	55.12	65.38	55.1	61.21	73.71	54.2	54.48	46.3	72.3
Category	Tall	Currently	Low	Currently	Low	Currently	Low	Currently	Tall	Low	Low	Low	Tall

Note: 1. Main Discussion Magnitude and derivatives; 2. Energy and Effort; 3. The subject of temperature and heat; 4. Vibration and Wave; 5. Materials and changes; 6. Electricity and magnets; 7. Earth and the Universe; 8. Light and Optical Instruments; 9. Living things and their environment; 10. Digestive system in humans; 11. Respiratory system in humans; 12. Human circulatory system; 13. Movement system in humans

Indicators explain scientific phenomena are indicators in applying science in certain situations, describing or interpreting scientific phenomena and predicting changes, identifying appropriate descriptions, providing explanations, and predictions. For indicators *identify scientific issues (problems),* characterized by the ability to recognize possible problems for scientific investigation, identify keywords to search for scientific information, recognize key features of scientific investigations. And indicators of using scientific evidence are the ability to interpret scientific evidence and make conclusions and communicate, identify assumptions, evidence, and reasons behind the conclusion, reflecting on the social implications of science and technological developments (Bybee in Winata et al., 2018).

In general, the scientific literacy ability of prospective elementary school teacher students is still in the moderate category. Nevertheless, scientific literacy that students have is a complex problem and must be improved immediately, because scientific literacy is very important in everyday life that has direct application to life. As prospective teachers, prospective elementary school teacher students must also have high scientific literacy skills. The scientific literacy ability of prospective elementary school teacher students is very influential on science learning in schools, if the scientific literacy of prospective elementary school teacher students is low, it is feared that elementary science learning that will be carried out in schools is not good,

so that students' ability to understand science material is also low and only oriented to the final value only.

Elementary school teacher candidates must have good literacy because the teacher's role is very important in carrying out learning activities. A very important role makes the teacher as one of the important components that determine the success of students. Elementary school teacher candidates as science teaching staff in elementary schools must have sufficient knowledge of science (theory and practice in learning science) so that students have better abilities in learning science, especially those related to basic science concepts (Rini et al., 2021).

Based on the results of the average scientific literacy ability of the pre-service elementary school teacher students are in the moderate category. This can indicate that the learning process, in this case the Science Basic Concepts course, cannot be said to be optimal. This is in line with Winata et al. (2018) who states that the inability of students in scientific literacy skills proves that students have not been able to solve problems in everyday life scientifically and communicate experimental results (Winata et al., 2018).

The low average score of scientific literacy in science basic concepts course can be influenced by various factors. According to Anggraeni et al. (2019), there are several factors that cause low literacy outcomes of students, namely: (1) subject matter that has never been studied so that students experience difficulties in answering the questions; (2) students are not used to

working on questions in the form of discourse; and (3) teachers are not familiar with the learning process of students in supporting scientific literacy development.

Based on the explanation above, related to scientific literacy skills which are included in the moderate category, it shows that there are still many contexts, content, and processes in the basic concepts of science that have not been maximized. There are still many teacher students who do not fully understand more deeply about the concepts that exist in science. Good literacy skills are expected to improve a better understanding of basic science concepts.

Conclusion

In general, the scientific literacy skills of prospective elementary school teacher students are in the moderate category, with details on sub-indicator elements, namely: explaining the phenomenon scientifically of 62.22% with the moderate category, identifying scientific questions or issues of 62.25% with moderate category, and using scientific evidence of 57.76% with low category. Overall, the scientific literacy competence is included in the medium category.

Conflicts of Interest
The authors declare that no conflict of interest exists related to this research. There is no financial support or relationship that might lead to a conflict of interest that could influence research results or data interpretation.

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