# The Scientific Literacy's Profile of Primary Education's Teacher Candidates

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**Abstract.** This study aimed to identify the scienctific literacy's profile of primary education's teacher candidates in Malang. The research method used was descriptive with quantitative approach. The research was conducted in the academic year 2022/2023 at Primary Education's Major at Universitas Islam Raden Rahmat. The population in this study were all students of primary education teacher candidate that are studying science subject, totaling 125 students. The sample of this study amounted to 84 students obtained by random sampling technique. The result showed that the scientific literacy of primary education student is low. The average of scientific literacy of primary education teacher candidate's students is 45, 28%. The scientific literacy of students of primary education's teacher candidate evidenced by the score in identifying a valid scientific opinions 44, 04%, performing literature searches were effectively 50, 59%, understanding the elements of research design and how it will impact the findings/conclusions 45, 83%, making precise graph of the data 51, 19%, solve problems using quantitative skills, including basic statistics 36, 01%, understanding and interpreting basic statistics 52, 08%, performing inference, prediction, and drawing conclusions based on quantitative data 37, 20% .

**Keywords:** Scientific Literacy · Profile · Primary Education Student

## 1 Introduction

Skills in the 21st century are the main focus of education today, especially in science education [1]. This skill is a basic need of science learning which is currently still not appropriately taught in schools [2]. One of the skills that is very important to pay attention to so that students are able to apply science appropriately is scientific literacy [3]. [4] Stated that scientific literacy skills are one of the main needs of learners in the 21st century.

Scientific literacy is the ability of the human person to apply knowledge and skills about science in real and different places and situations [5]. Scientific literacy according to [6] is knowledge of various events or substantive science, understanding of science and its implementation, knowledge of science, freedom in science learning, ability to think scientifically and critically, ability to solve problems with scientific knowledge, participate intelligently in responding to science issues, and the impact and benefits


H. Saptaningtyas et al. (Eds.): ICOMSI 2022, ASSEHR 751, pp. 425–433, 2023.
https://doi.org/10.2991/978-2-38476-072-5_41

of science. Scientific literacy makes a person have the ability in terms of knowledge, understanding scientific concepts, and solving problems or becoming a problem solver of problems encountered in society or in everyday life, so that scientific literacy is important to be applied at various levels of education, including in universities. Individuals who are scientifically literate will be able to live in a society that is currently dominated by the development of science and technology [7]. Someone who does not have scientific literacy skills will find it difficult to adapt to increasingly modern technological developments and it is difficult to make decisions on various phenomena that occur in society.

Programme for International Student Assessment (PISA) establishes three aspects of the science competency/process component. There are: 1) identifying scientific issues (problems), namely recognizing possible problems for scientific investigation, identifying keywords to search for scientific information, recognizing key features of scientific investigation; 2) explaining scientific phenomena is applying science in certain situations, describing or interpreting scientific phenomena and predicting changes, identifying appropriate descriptions, providing explanations, and predictions; and 3) using scientific evidence, that is, 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 [8]. According to that, seven indicators are used in determining science literacy abilities. The seven indicators refer to the scientific literacy indicators from [9]. There are: 1) identifying valid scientific opinions; 2) conducting an effective literature search; 3) understanding the elements of research design and how they impact findings / conclusions; 4) making precise graphs from the data; 5) solving problems using quantitative skills, including basic statistics; 6) understand and interpret basic statistics; and 7) inference, prediction, and conclusion drawing based on quantitative data.

PISA tried to sudied the achievement of learning outcomes for fifteen year old students. PISA findings are used to compare the reading, mathematics and science literacy of students from one country to another and to understand the weaknesses and strengths of the education system in each country [10]. The achievements of Indonesian students in the 2018 according to PISA test released by the OECD (2019) found that Indonesia ranks low in the field of science. Indonesia is ranked 70th out of 78 countries participating in PISA. Indonesia's PISA test scores also did not develop and did not increase over a period of 18 years. The difference between the scores of Indonesian students and the average scores of students from developed countries who are members of the OECD shows a reduction in all fields that have been tested, including the field of science. The difference in science scores between Indonesian students and OECD countries was 101 points in 2000. The difference in the scores was reduced to 93 points in 2018.

Several studies have shown that students' scientific literacy is still low. [11] revealed that the scientific literacy of UNIROW students is still low. The highest achievement was in the indicator of conducting an effective literature search with a percentage of 40.15%, while the results of the analysis of students' lower scientific literacy ability were indicators of solving problems using quantitative skills, including basic statistics with a percentage of 6.82%. [12] shows that the scientific literacy of primary education student Almuslim Bireuen is still low. Of the total 74 students from units A and B

who were used as research subjects, 25 people (52.6.7%) from unit A and 26 people (61%) from unit B had achieved scientific literacy and the remaining 18 people in unit A (47.3%) and 14 people from unit B (38.8%) had not reached literacy. Based on the results of research at primary education Universitas Muhammadiyah Tangerang, it shows that the scientific literacy ability of primary education students in the aspect of competence has not shown good and satisfactory results, so it needs to be improved [13].

The low of scientific literacy of prospective teacher students will have an impact on the learning success of students in the schools they will teach later. In addition, the low scientific literacy of prospective teacher students will have an impact on the occurrence of misconceptions in students so that cognitive, affective and psychomotor learning outcomes are low [14]. Student as a teacher candidates are required to have good knowledge so that later students can have better scientific literacy, especially in studying natural sciences and those related to basic science concepts, so teachers who teach must have good knowledge. The knowledge possessed by the teacher will be reflected in the implementation of learning carried out in the classroom. If the learning carried out is of high quality, then the learning process will be meaningful. This is because the teacher has the task of planning and implementing the learning process, assessing learning outcomes, guidance and training, conducting research and assessment, establishing communication with the wider community [15].

This study aims to determine the scientific literacy profile of students who are prospective elementary school teachers. The student's scientific literacy profiles can be used as a basis for mapping and subsequently become the basis for determining efforts to improve or increase student's scientific literacy. Various efforts to improve and increase student scientific literacy will be carried out as a form of participation in improving the quality of education.

## 2 Methods

This is a descriptive research with a quantitative approach. The purposes of this research is to analyze the scientific literacy of Primary Education's teacher candidates. The population of this research is all primary education's students for the academic year 2022/2023 that is studying IPA subject at Raden Rahmat Islamic University totaling 125 students. The sampling technique used is random sampling technique, which total sampling are 84 students. The instrument to determine scientific literacy ability was obtained from an essay test. The test contains 7 questions with a grid that has been developed based on scientific literacy indicators according to [17] which includes: 1) identifying valid scientific opinions; 2) effective literature search; 3) understanding the elements of research design and their impact on findings/conclusions; 4) make precise graphs of the data; 5) solve problems using quantitative skills, including basic statistics; 6) understand and interpret basic statistics; 7) perform inferences, predictions, and draw conclusions based on quantitative data.

Data analysis was carried out by calculating the percentage of correct answers for each respondent on each scientific literacy indicator. The rating scale used starts from 0–4 that converse to 0–100 with the criteria "very low" to "very good". The criteria for assessing scientific literacy are presented in Table 1. The validity test of the questions

**Table 1.** The Criteria of Scientific Literacy

| Interval | Criteria | Code |
|---|---|---|
| 85–100 | Very good | **VG** |
| 70–84 | good | **G** |
| 55–69 | enough | **E** |
| 50–54 | low | **L** |
| 0–49 | Very low | **VL** |

*(Source: Sudijono, 2006).*

is carried out by matching the developed items with scientific literacy indicators. Based on the results of the item validity test, it was found that there were 15 valid items out of a total of 20 items. Testing the reliability of the questions was carried out with the Quest program. The results of the reliability test developed have a very high reliability or level of reliability, with a number of 0.83.

## 3 Result and Disscussion

The scientific literacy's data of primary education's teacher candidates was collected using the integrated test of scientific literacy indicators proposed by [17]. This assessment was attended by 84 students. The scoring of scientific literacy is carried out based on the results of student answers with scoring criteria on a scale of 0–100 with the benchmark achievement score divided by the maximum score multiplied by 100, which served.

$$\mathrm{N} = \frac{a1}{an} \times 100 \tag{1}$$

N: Score
a1: achievement score
an: maximum score

Based on the results of the calculations and analysis carried out by the researchers, the data obtained from the average ratio of the scientific literacy scores of primary education's teacher candidates. Ratio data is indicated by numbers, as an indicator of the value of the object that has been measured. The results of the analysis of the scientific literacy of primary education's teacher candidates are presented in Table 2.

Table 2 shows the value of students' scientific literacy skills on the sub-indicator of identifying valid scientific opinions of 44,05 with the "very low" category, conducting an effective literature search of 50,59 with the "low" category, understanding the elements research design and how it impacts the findings/conclusions is 45,83 with "very low" category, making graphs accurately from data of 51,19 with "low" category, solving problems using quantitative skills 36,01 "very low" category, understanding and interpreting the basic statistics of 52,08 with the "low" category, and making inferences, predictions and drawing conclusions based on quantitative data of 37,20 with the "very

**Table 2.** The Scientific Literacy Scores

| No | Indicator | Scor | Category |
|---|---|---|---|
| 1 | Identify valid scientific opinions | 44,05 | VL |
| 2 | Perform an effective literature search | 50,59 | L |
| 3 | Understand the elements of research design and how impact on findings/conclusions | 45,83 | VL |
| 4 | Precisely graphing from data | 51,19 | L |
| 5 | Solve problems using quantitative skills include basic statistic | 36,01 | VL |
| 6 | Understand and interpret basic statistics | 52,08 | L |
| 7 | Doing inference, prediction and drawing conclusions based on quantitative data | 37,02 | VL |

*Source: personal documentation*

low" category. Based on the research data obtained, the data on the scientific literacy of prospective elementary school teacher students is shown in the graph in Fig. 1.

The average scores in Table 2 and Fig. 1 shows that there is not much difference between one indicator and another. The average scientific literacy score of primary education's teacher candidates students obtained in this study was 45, 28%. The average score is included in the "very low" category. This implies that it is necessary to do learning that involves the scientific process, such as formulating scientific questions for each investigation, using the cognitive abilities possessed to explain natural phenomena as well as drawing conclusions based on facts obtained through the investigation process. One way to foster a culture of scientific literacy in students is to apply social science problem-based learning models and methods in the lecture process [18].

Based on the research data in Table 2 and Fig. 1, it can also be seen that the the highest score is found in the 6$^{th}$ indicator (Understand and interpret basic statistics) which score is 52, 08. The lowest score of values is found in 5th indicator (Solve problems using

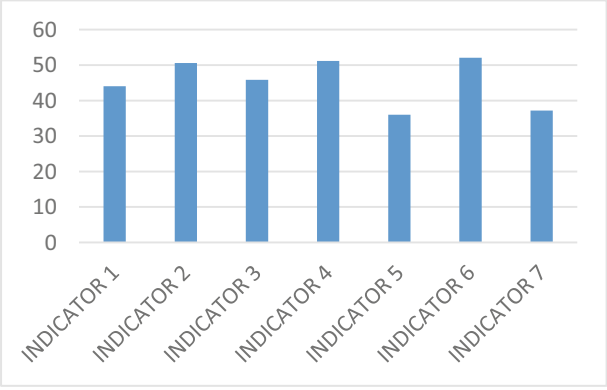


**Fig. 1.** The Scientific Literacy's Score in Each Indicator

quantitative skills include basic statistic) which score is 36, 01. This shows that the ability of a small number of students is still lacking in processing the data obtained in the form of tables, diagrams, or graphs. In addition, students' lack of ability to analyze data and draw conclusions precisely and distinguish between arguments based on scientific and non-scientific evidence [5]. This causes students' ability to use authentic and scientific evidence arising as a result of the development of science and technology to be low. As a result, students' ability to solve problems using quantitative data and basic statistics is very low.

The low scientific literacy of primary education students shows that there are still many contexts, content and processes in the basic concepts of science that have not been achieved. There are still many primary education students who do not understand more deeply about the concepts in biology, chemistry and physics, even though these concepts are very important in developing concepts that exist in science learning in elementary school [14].

It is seen that all aspects of scientific literacy achieved are in the low and very low categories. This means that there needs to be improvement efforts made in learning activities in order to improve aspects of scientific literacy for prospective teacher students. The low scientific literacy can be caused by several factors. Learning environment and climate affect variations in scientific literacy scores. Likewise, the state of infrastructure, human resources has a very significant influence on student literacy achievement. [19] Also revealed that the low scientific literacy of Indonesian students is closely related to the gap between science learning applied in schools and the demands of PISA. The low scientific literacy ability of students can be caused by conventional science learning habits and ignoring the importance of reading and writing science skills as competencies that must be possessed by students [20]. Students are used to only filling in the tables that have been provided by the teacher, so that students' ability to interpret graphs/tables is also limited [21].

Another factor that cause the low scientific literacy of students including a learning process that is not supportive in developing students' literacy skills, subjects that has not been taught, and there is no habituation for students to do questions in the form of discourse [22]. Meanwhile, the assessment of scientific literacy using test questions that begin with the exposure of several phenomena aims to encourage students to better recognize phenomena that are often observed in everyday life through reading ([23]. Students tend to do questions that emphasize rote memorization more often and they very rarely find questions in the form of discourse or questions that build students' analytical skills [24].

However, 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 applications for life. As prospective teachers, primary education students must also have high scientific literacy. Science literacy of primary education students is very influential on learning in schools. If the scientific literacy of primary education students is low, it is feared that the learning that will be carried out in schools is not good, so that the ability of students to understand the material is also low and only oriented to the final grade. Scientific literacy is related to various aspects of life in society, related to the

activities of people of all ages, both young and old. [25] Suggests that scientific literacy is related to people of all ages, so it needs to be improved to achieve higher literacy.

The primary education's students must have good scientific literacy because the teacher's role is very important in carrying out learning activities. The teacher's very important role makes it one of the important components that determine the success of students' learning. Prospective student of Elementary school teachers are required to master various skills, including scientific literacy, as a provision in an effort to prepare the 21st century generation that is able to be competitive and solve various challenges in the future [26].

Based on the results of the scientific literacy analysis of primary education in Raden Rahmat Islamic University, 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 [27], in order for scientific literacy to improve properly, teachers are encouraged to start introducing and teaching material using various strategies that have the aspect of scientific literacy, including teaching the material through a constructivism approach with experiments that can stimulate higher-order thinking and are contextual. Constructivism learning allows learners to build their own knowledge based on activities and direct observations and experiences as a result of learners acquiring their knowledge in the form of insights that change the initial knowledge base through new ways of organizing previously learned information [28]. Learners build knowledge by connecting new information with initial concepts [29].

The guided inquiry learning model is a model with a constructive approach that allows students to be actively involved in the learning process so that learning is not teacher-centered anymore. Learning with guided inquiry can determine the level of scientific literacy because in the application of this learning there are stages that are the basis for achieving aspects of scientific literacy [30]. The achievement of scientific literacy is indirectly supported and accommodated by guided inquiry during the learning process [27]. Active participation of learners in the learning process through discovery, involves activities of reflection, thinking, experimenting, and exploring [28]. One form of learning with guided inquiry that can be applied to facilitate scientific literacy is Process Oriented Guided Inquiry Learning (POGIL).

## 4 Conclusion

Based on the data obtained, it can be concluded that the scientific literacy of primary education students is still low. This can be seen from average of scientific literacy score of primary education's teacher candidates students obtained in this study was 45, 28%. The average score is included in the "very low" category. The value of students' scientific literacy skills on the sub-indicator of identifying valid scientific opinions of 44,05 with the "very low" category, conducting an effective literature search of 50,59 with the "low" category, understanding the elements research design and how it impacts the findings/conclusions is 45,83 with "very low" category, making graphs accurately from data of 51,19 with "low" category, solving problems using quantitative skills 36,01 "very low" category, understanding and interpreting the basic statistics of 52,08 with the

"low" category, and making inferences, predictions and drawing conclusions based on quantitative data of 37,20 with the "very low" category.

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