

## Research Article

# View of Pre-Service Teacher Regarding Math and Science Literacy

Metta Liana, Mariyanti Elvi, Nur Asma Riani Siregar, and Susanti

Faculty of Teacher Training and Education, Universitas Maritim Raja Ali Haji, Jalan Raya Dompok, Kota Tanjungpinang, Indonesia

**ORCID**

Metta Liana: <https://orcid.org/0000-0001-9921-4153>

Mariyanti Elvi: <https://orcid.org/0000-0002-8484-1725>

Nur Asma Riani Siregar: <https://orcid.org/0000-0002-8894-772X>

Susanti: <https://orcid.org/0000-0002-8659-393X>

**Abstract.**

As future teacher candidates, pre-service teachers must have good mathematical and scientific literacy. Therefore, this study aims to describe the prospective of teacher students' mathematical literacy and scientific literacy. This type of research is a qualitative descriptive study with deep interview techniques. A total of 8 student-teacher candidates from the mathematics education, biology, and chemistry education study programs were selected to be interviewed. The results showed that students equipped with an understanding of mathematical literacy and scientific literacy in literacy-related programs and literacy lectures responded positively.

**Keywords:** teacher regarding, math literacy, science literacy

Corresponding Author: Metta Liana; email: [mettaliana@umrah.ac.id](mailto:mettaliana@umrah.ac.id)

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## 1. INTRODUCTION

In the face of such rapid development, each individual must independently be equipped with 21st-century life skills. The skills needed by individuals as a need and demand have shifted. Currently and in the future, the skills prioritized in dealing with changing times are no longer about physical abilities but relatively soft skills, including problem-solving, cognitive, and social skills. Several countries have adapted their education systems to meet changing needs to be adaptive and develop as technology advances. Likewise, Indonesia will adapt its education system by launching a new paradigm curriculum called "Kurikulum Merdeka", in early 2022. The curriculum encourages project-based learning for soft skills and character development. It focuses on essential materials so that learning practices will be more simplified and in-depth on achievement -essential competencies such as literacy and numeracy.

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Literacy and numeracy from an early age need to be grown through many learning approaches in schools or colleges as the learning environment in which they are raised [1]. Literacy as a global competency is a fundamental and essential component in supporting life skills in the 21st century. The basic literacy that every individual needs to possess includes language and academic literacy, numeracy literacy, scientific literacy, digital literacy, financial literacy, cultural literacy, and citizenship [2]. Mathematical literacy is defined as: An individual's capacity to reason mathematically and to formulate, employ, and interpret mathematics to solve problems in a variety of real-world contexts. It includes concepts, procedures, facts, and tools to describe, explain and predict phenomena. It assists individuals to know the role that mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged, and reflective 21<sup>st</sup>-century citizens [2].

Improved mathematical literacy can help students build connections between terminology, concepts, skills, and representations, which contribute to the development of mathematical literacy. In addition, mathematical literacy, often also called numeracy, is defined as the ability to use various kinds of numbers and symbols related to basic mathematics to solve practical problems in various contexts of everyday life. Alternatively, mathematical literacy can be related to the ability to analyze information displayed in various forms of graphs, tables, and charts and use the interpretation of analysis results to predict and make decisions [3]. Mathematical literacy is essential to reason systematically and critically in solving problems and making decisions in various contexts.

Scientific literacy can be defined as scientific knowledge and skills to be able to identify questions, acquire new knowledge, explain scientific phenomena, draw conclusions based on facts, understand the characteristics of science, awareness of how science and technology shape the natural, intellectual and cultural environment, willingness to be involved, and care about science-related issues [4]. Scientific literacy is one of the keys to facing various challenges in the 21<sup>st</sup> century. Where science-related issues that a person needs in making decisions can be identified and understood by a literate. Mastery and having basic science and technology concepts will be very helpful in solving life's problems. However, that does not mean everyone has to be a scientist. Having and mastering the basic concepts of science allows humans to play a role in making choices that impact life.

Mathematical literacy and scientific literacy in learning are inseparable and interrelated parts. Some findings state that students with high math scores tend to achieve high science scores [5]. The ability in reading, math, and science of children at 15 can

be measured through the PISA (Program for International Student Assessment) test. The PISA test is a triennial international assessment organized by the Organization for Economic Cooperation and Development (OECD). Indonesia has participated in the PISA test since 2000. Approximately 70 countries participate in the PISA test every time it is held. The results are one of the sources of reference for forming education policies in various countries. The following shows the results of the PISA test for Indonesia.

Figure 2. Trends in performance in reading, mathematics and science

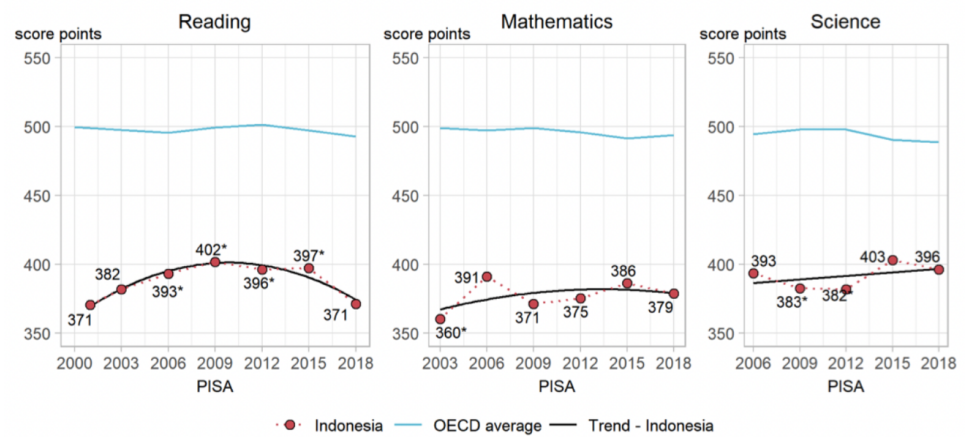


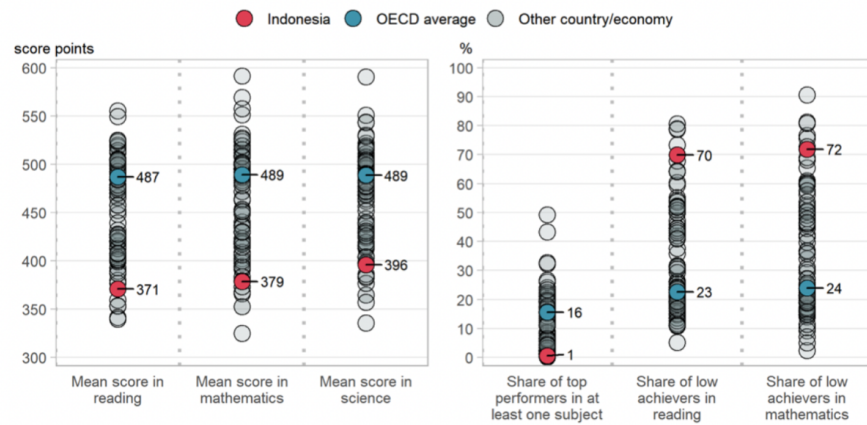
Figure 1: Trend in performance in reading, mathematics, and science.

From the graph in Figure 1 Indonesia’s PISA scores have fluctuated since they were first enrolled in 2000, but in general, there was no increase between 2000 and 2018. Like the mathematics scores of Indonesian students in 2015 and 2018 with math scores of 386 and 379 respectively, there is only a difference in score of 7 points. Likewise, science scores were at 403 and 396 in 2015 and 2018, with a difference of 7 points. To see Indonesia’s position in obtaining PISA results compared to other countries, see Figure 2.

Figure 2 shows that Indonesia’s PISA score is about 100 points lower than the OECD country average for reading, math, and science skills. The OECD country’s average score is 500. In the PISA system, a score of 40 is equivalent to one year of learning. Indonesian children’s scores are 100 points below the average, indicating that their reading, math, and science literacy is 2.5 years behind 15-year-olds in OECD countries. Figures 1 and 2 show that Indonesia is still in the lowest position for mathematical and scientific literacy achievement compared to other countries. For several test periods, it does not show significant changes.

There have been many studies investigating the causes of students’ low mathematical literacy and scientific literacy, including the lack of availability of textbooks containing practice questions that facilitate mathematical literacy. 50.7% of the seventh semester

Figure 1. Snapshot of performance in reading, mathematics and science



Note: Only countries and economies with available data are shown.  
Source: OECD, PISA 2018 Database, Tables I.1 and I.10.1.

Figure 2: Snapshot performance in reading, mathematics, and science.

of 2013 Curriculum 2013 junior high school mathematics textbooks published by the Ministry of Education and Culture in the second semester of 2017 revision are around 50.7% not similar to PISA [6]. The number of questions that are not following the PISA assessment aspect is more than the number of questions following the PISA assessment aspect [6]. Most of the questions presented are without context. As a result, students are not accustomed to working on problems with contexts that involve real-world activities [7].

Learning resources are needed that facilitate student literacy. Internal and external factors determine the success of students' scientific literacy in learning. Factors that influence the level of scientific literacy of students namely interest in science, learning motivation, teacher strategies in learning, and school facilities. One of the parties who can help students have good scientific literacy is the teacher. Teachers can optimize the growth of students' scientific literacy by designing learning methodologies, learning material, learning facilities, learning media, and favorable learning activities. The preparation of students in terms of knowledge, skills, literacy attitudes, digital science, and technology is one of the teacher's efforts in training them cognitively [8].

It can be concluded that the teacher has the most crucial role in guiding students to understand mathematics and science. Examining what is more important, teachers' knowledge of the subject matter or their knowledge of how to teach it, implies that while content knowledge is fundamental, pedagogic knowledge is also essential [9]. This study aims to describe the perspectives of pre-service teacher who are generation Z related to mathematical literacy and scientific literacy in learning and other real-world activities.

## 2. RESEARCH METHOD

This type of research is a qualitative descriptive study with deep interview techniques. This study aimed to describe the perspectives of pre-service teachers regarding mathematical literacy and scientific literacy in learning and activities in the real world. The subjects in this study were pre-service teacher consisting of 4 pre-service teachers from the mathematics education study program, two pre-service teachers from the chemistry education study program, and two pre-service teachers from the biology education study program at a university in Tanjung pinang, Riau Islands Province. The selected pre-service teacher has taken literacy courses and participated in the “Kampus Mengajar” program organized by the Ministry of Education, Culture, Research, and Technology. Kampus Mengajar program is a program that invites students to help develop learning, significantly improve literacy and numeracy competencies, adapt technology, and actualize students’ interests and potentials according to their respective fields of study [10]. Data analysis technique with three stages, namely data reduction, data display, and drawing conclusions/verification.

## 3. RESULT AND DISCUSSION

The results of interviews related to the perspectives of pre-service teacher related to mathematical literacy and scientific literacy are grouped into four parts:

### 3.1. The Understanding of Pre-Service Teacher Regarding the Concepts of

#### Mathematical Literacy and Scientific Literacy

From the results of interviews related to mathematical literacy, four informants explained mathematical literacy well. Two informants understand that mathematical literacy is not only able to count but can reason logically and critically in solving problems in everyday life. In comparison, the other two informants defined mathematical literacy as the ability of each individual to communicate and explain the phenomena they face in everyday life with mathematical concepts. The understanding of mathematical literacy by these four informants is in line with Ojase’s opinion; Stecy & Tuner states that mathematical literacy is the knowledge to use basic mathematics in everyday life to be ready to face life’s challenges well and effectively [11, 12].

For scientific literacy, four informants can also explain the concept of scientific literacy well. One informant defined scientific literacy as an individual's ability to relate science to everyday life to make it more meaningful. Meanwhile, three other informants have almost the same understanding regarding scientific literacy. According to them, scientific literacy is knowledge or understanding of scientific concepts and scientific processes that are needed in making decisions in everyday life. These four informants' understanding of scientific literacy is consistent with Wulandari's; OECD definition, which states that scientific literacy is individuals' scientific ability to use their knowledge in the process of identifying problems, obtaining new knowledge, explaining scientific phenomena, and drawing conclusions based on evidence related to scientific issues [4, 13].

### **3.2. The Understanding of Pre-Service Teacher Related to The Problems of**

#### **Mathematical Literacy and Scientific Literacy of Indonesian Students**

From the results of interviews with the eight informants, the informants generally explained that the mathematical literacy and scientific literacy of Indonesian children were low. Information related to the low scientific literacy and mathematical literacy of Indonesian students was known by informants from the PISA test results conducted by the OECD. Indonesia is ranked in the 60s out of 70 participating countries for reading, arithmetic and science skills. Informants also obtained information regarding students' low level of scientific literacy and mathematical literacy from reading research articles related to scientific literacy and mathematical literacy during literacy lectures. In addition, informants get experience when they go to the field on "Kampus Mengajar" programs, some students cannot read or count fluently, the link between learning mathematics and science to everyday life is still minimal.

### **3.3. The Views of Pre-Service Teacher Regarding the Importance of**

#### **Future Teacher Candidates Having a Literate Nature**

From the interviews with the eight informants, the informants agreed that it is very important to have a good understanding of mathematical literacy and scientific literacy as pre-service teacher. Informants explained that they understood mathematical and scientific literacy from the "Kampus Mengajar" program and the lectures they attended. Previously, they stated that they did not have sufficient understanding of mathematical

and scientific literacy. According to the informants, teachers have an important role in building their students' scientific and mathematical literacy. So, the teacher must equip himself to be literate related to mathematics and science. Human resources required in the 21<sup>st</sup> century have at least four main competencies, namely literacy, inventive thinking, effective communication, and high productivity [14].

### 3.4. The Opinion of Pre-Service Teacher Regarding the Efforts of future Teacher Candidates

to be able to Improve Students' Mathematical Literacy and Scientific Literacy

The first informant argues that in the future they want to bring meaningful science learning by bringing students directly involved with science projects that are close to everyday life to create meaningful learning. For example, the rain cycle lesson begins by inviting students to participate in a project to make simple artificial rain to arouse students' enthusiasm. The second and third informants believed that in the future they will compile math and science questions that can measure mathematical literacy and scientific literacy, such as PISA test questions and use them in learning. The fourth, fifth, and sixth informants think that in the future they want to be proficient in using technology and present mathematics and science content to students in the form of uploaded videos, creating contextual learning media, which can be accessed anywhere and anytime. The seventh and eighth informants said that they would further improve their understanding of mathematical literacy and scientific literacy in the future. Because as future teacher candidates, they admit that they are not used to solving scientific literacy questions and math literacy problems.

Based on the informant's opinion, there are many things in the future that pre-service teacher can get used to to improve students' mathematical literacy and scientific literacy, including: Pre-service teacher present project-based learning that puts forward a scientific approach. Learning using a scientific approach known as a scientific-based approach has the stages of observing, asking questions, gathering information, associating or reasoning and communicating knowledge to contribute to students in providing direct experience in science learning which can improve scientific literacy [15]. Pre-service teachers take advantage of developing technology to facilitate students to have good mathematical literacy and scientific literacy. Digital literacy skills are also a must to support mathematical literacy [16]. Building knowledge is a human activity that technology can facilitate, realizing that students must shift in seeing technology as a motivating or entertaining item by starting to see technology as a tool to complete



certain learning goals [17]. There is a positive relationship between mathematical literacy and scientific literacy with digital technology devices in learning because it gives a feeling of comfort and enthusiasm in learning [9]. However, using technology for students still needs supervision if excessive can cause negative effects.

## 4. CONCLUSION

This research shows that pre-service teacher understands that as future teacher candidates, they must have good mathematical and scientific literacy to improve their students' mathematical and scientific literacy in the future. Pre-service teachers possess this understanding after being provided with provisions related to mathematical literacy and scientific literacy from "Kampus Mengajar" programs and literacy lectures that are followed. It is hoped that there will be regular programs or literacy courses specifically for pre-service teacher in the future.

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