

# The Mathematical Literacy Skills of Muhammadiyah Elementary School Students in Sleman Regency

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**Abstract.** This study aims to describe the literacy skills of Muhammadiyah elementary school students in Sleman Regency, Yogyakarta. The population of this study was grade 4 students at Muhammadiyah elementary school in Sleman Regency. The samples of this study were 395 students taken from 16 Muhammadiyah elementary schools of each district in Sleman Regency using cluster random sampling technique. The data collection technique used mathematical literacy test instruments that had been tested for their validity and reliability. The results showed that the mathematical literacy skills of students at Muhammadiyah elementary schools in Sleman Regency were still in low. Mathematical literacy skills of Muhammadiyah Elementary School students in Sleman Regency in the domain of formulating mathematical situations were in the moderate category. It means the process domain by using concepts, facts, procedures, and mathematical reasoning as well as the process domain of interpreting, implementing, and evaluating mathematical results were in the low category.

**Keywords:** literacy, mathematics, elementary school, Muhammadiyah.

## INTRODUCTION

"Literacy for All," is a slogan of the United Nations Educational, Scientific, and Cultural Organization (UNESCO) - an international organization engaged in education. This slogan emphasizes the right of human beings to be "literate" as a requirement to live. Literacy makes individuals, families, and communities empowered to improve their quality of life. Furthermore, literacy has a multiplier effects, namely eradicating poverty, reducing child mortality, curbing population growth, achieving gender equality and ensuring sustainable development, peace, and democracy [1]. Moreover, the school literacy movement or GLS (Gerakan Literasi Nasional) has been programmed by the government since 2015 under the ministerial regulation (permen) No. 23, in respect to the growth of manners to children through language. In broader scope, the literacy refers to more than just reading and writing [2]. It also includes how someone communicates in society. Literacy also means social practices and relationships related to knowledge,

language, and culture. Nevertheless, student literacy in Indonesia generally still needs to be evaluated. This is based on the results of student's achievement in Indonesia, which is still lower than other developing countries.

The results of Program for International Student Assessment (PISA) in 2015 showed that Indonesia was in the 64th place out of 72 countries [3]. The literacy included in PISA assessment is not only merely literacy, but also includes scientific literacy, mathematical literacy, and financial literacy. The purpose of PISA mathematical literacy test is to measure how students apply their knowledge to solve a set of problems in various real contexts. To solve this set of problems, students must work on a number of math competency tests. Thus, knowledge and understanding of mathematical concepts is very important for students. However, the ability to activate mathematical literacy to solve problems encountered in everyday life is even more important. Based on the 2015 PISA results, 75.7% of Indonesian students only had math literacy skills below level 2 [3]. It indicates that Indonesian students can only solve routine questions, and simple calculations.

Although PISA is a program to test students, aged 15 years old on average, who have gone through basic education, the PISA result showed that learning in primary schools have yet to familiarize students with the mathematical literacy skills. It might happen because mathematical literacy skills cannot be obtained in such a short time. Students themselves must develop mathematical literacy skills, since they are in elementary school. The same thing is also explained by Faizah stating that literacy must be instilled through three stages, namely habituation, development, and continuous learning since elementary school [4].

The PISA framework for measuring mathematical literacy is divided into three constructs, namely content, context, and cognitive. Content aspect consists of domain quantity, uncertainty and data, change and relationship, and space and shape; context aspect consists of personal, societal, occupational, and scientific domains; while the cognitive aspect consists of six levels ranging from the lowest level to the highest level of knowledge [3].

Mapping items with constructs like this is also used in the development of test items in this study. The explanation of the 2012 PISA framework [3] regarding the construct of mathematical literacy is as follows. In the aspect of context, mathematical literacy is measured in the context of problems and challenges faced in a person's real world (personal) that relate to the daily lives of individuals and families; societal relating to the community, whether local, national or global where an individual lives his life; occupational related to the world of work; and scientific related to the use of mathematics in science and technology. In the aspect of the content mentioned above, there are four categories of mathematical content related to problems that arise. Category quantity is the quantification of the attributes of an object, linkages, situations, and entities that require an understanding of the diversity of representations of the quantification, as well as consideration of quantification-based interpretations and arguments. The uncertain and data category includes 2 (two) sets of issues, namely how to identify and summarize the meanings inherent in a set of data displayed in different ways; and how to understand the impact of variability inherent in a number of tangible processes. Uncertainty is part of scientific predictions, poll results, weather forecasts, and economic models. The category of change and relationship focuses on temporal and permanent relationships between objects and their environment, where changes occur in systems that are related and the elements in the system influence each other. The space and shape category covers a wide range of phenomena encountered anywhere, such as patterns, equipment of an object, position and orientation, representation of an object, coding of visual information.

The first step of the modeling process is to understand the situation of the problem given and then construct it. In this process, problem solvers are required to construct the problem given into the situational model. Problem solvers need to understand the characteristics of the problem they face. The next step is to arrange the situation by determining the variables in the problem. Not only that, this step also requires a process of simplifying the situation by defining the problem correctly so that it can assist in the preparation of a real model of the problem situation. Defining the problem must be logical and in accordance with the context. After the problem is simplified, then a mathematical problem is made. As mentioned earlier, this is a process of converting real models/real problems into mathematical models. The mathematical model can contain operations or variables. The fourth step is to work mathematically. The results of this process are mathematical solutions, which will then be interpreted into the real world as real solutions. Although through the process of interpreting the solution has been obtained according to the context, the process has not stopped. The solution needs to be validated to see whether a re-modeling process is needed by looking at the suitability of the results with problems, data, and theory. After that, it is then continued at the last stage, namely presenting the final solution. The intended process of presentation is the process of bringing or translating a situational model into real situations and problems.

Mathematical literacy is a person's ability to formulate, use, and interpret mathematics in various contexts of everyday life problems efficiently.

Mathematics is intended to cover all concepts, procedures, facts and mathematical tools both in terms of calculations, numbers and spatial. In terms of process, this ability is not only limited to the ability to count, but also how to communicate, reason, and process other mathematical thinking. Daily problems are represented into mathematical problems to be solved. The process of solving this problem involves all objects in mathematics. After the solution is obtained, the solution is interpreted into the context or real situation.

Such a process will increase one's sensitivity to the usefulness of mathematics in solving everyday problems. This sensitivity will help him to solve problems effectively and efficiently. This does not only apply to complex work world problems, but also covers everyday problems. Thus, it is hoped that a society will be ready to face the challenges of this century. Given the importance of mathematical literacy skills, effort is needed in order to develop these abilities. Education in this case mathematics education has an important role in making it happen. As explained earlier, mathematics learning should provide students with opportunities or experiences to solve problems in various situations. In this way, students will activate their literacy skills while developing them.

Another fact that indicates that the mathematical skills of elementary school students in Indonesia still has to be improved is the result of the 2015 Trend in International Mathematics and Science Study (TIMSS) in the field of mathematics, where Indonesia was in 45th place out of 50 countries. The score achieved by Indonesian students below the average of international score was 397 while the average of international score was 500. TIMSS in 2015 is an international study that measures the ability of Grade 4 and 8 students in mathematics and science [5]. The results of observations in elementary schools from Nurkamilah, Nugraha, & Sunendar research found that the habit of literacy still focused on reading literacy [6]. The scope of other literacy has not been familiarized in schools, including mathematical literacy. It becomes one of the causes of the low mathematics literacy skills of students in Indonesia.

Based on Hayat & Yusuf [7], mathematical literacy in modern life is now generally defined as a unity of knowledge, understanding, and skills needed by humans to function effectively in modern life. Specifically, literacy contains competencies that are developed in previous education of mathematics, such as number and operations dealing with nominal money. They are also the skills to give reasoning and deal with mathematics, including modelling a problem or phenomenon in real life to an idea in mathematics and then solving it using mathematics (mathematization). Further, Hayat & Yusuf [7] said that realistic problems in mathematical skills matters more now. Other competencies that are also prioritized in modern mathematics are the connecting mathematical ideas to the context of modern life.

Mathematical literacy is the ability of students to formulate, apply, and interpret mathematics in various contexts, including the ability to give reasoning mathematically, and use concepts, fact procedures and tools to describe, explain or predict an event [3]. In simple terms, Ojose defines mathematical literacy as the

knowledge to know and use the basis of mathematics in everyday life [8].

According to Zulkardi, the concept of mathematical literacy is closely related to mathematical processes or mathematical modelling. In mathematics literacy, there are three emphasized skills, namely formulate, employ, and interpret [9]. Formulating mathematics involves identifying opportunities to apply and employ mathematics in solving certain problems, providing mathematical structures and representations, identifying variables, and simplifying assumptions in solving problems [10].

PISA measures mathematical literacy skills which refer to three main domains, namely content domain, context domain, and process domain. In the process domain, the process is divided into three types, namely formulating the situation mathematically; applying concepts, facts, procedures, and mathematical reasoning; and interpreting, implementing, and evaluating mathematical results [10]. The importance of mastering mathematical literacy for students has been emphasized by some experts. Literacy in the context of mathematics according to Stacey and Turner, is the power to use mathematical thinking to solve everyday problems, thus, students are better prepared to face the challenges of life [11]. Mathematical literacy helps one to recognize the role of mathematics in the world and make judgments and decisions needed as a citizen [12]. According to Kamaliyah et al., mathematical literacy helps one to understand the role and benefits of mathematics in everyday life so that it can be employed to make good decisions [9].

In respect to the benefit and drawback potentials of mathematical literacy skills as mentioned, it is necessary to examine the mathematical literacy skills of elementary school students, especially at Muhammadiyah Elementary School in Sleman Regency. The findings of this study will be expected to provide an overview of the levels of mathematical literacy skills of Muhammadiyah elementary school students in Sleman Regency, whether they are categorized as very low, low, moderate, high, or very high. The purpose of this study is to determine the level of mathematical literacy skills of Muhammadiyah elementary school students in Sleman Regency in terms of the process domain and content domain.

**METHOD**

The type of the research is survey research. This research is a quantitative research used to find out a phenomenon of a group of individuals. The study was conducted in 16 Muhammadiyah elementary schools in Sleman Regency. The study was conducted in March to May 2018. The population of study was the 4<sup>th</sup> graders of Muhammadiyah elementary school in Sleman Regency with the total number of 2373 students.

The sample of study was determined using Krejcie and Morgan Table. Based on this table with 5% of significance level, the sample size for the population of the 4<sup>th</sup> graders of Muhammadiyah elementary school in Sleman Regency were 331 students, taken from the total population of 2373 students and rounded off it into 2400 students. It means that the minimum number of sample

was 331 students or more [13]. The sample of this study was 394 students. This sampling was adjusted to the number of students in each school who were selected as the subject of study. The sampling technique used was stratified random sampling and cluster random sampling.

The data were obtained from the test results of mathematical literacy skills. The test was given in the form of 5 items in the description of mathematical literacy. The quantitative data were in the form of mean scores of students' mathematical literacy. Then, the data were converted to determine the category of students' mathematical literacy skills using normative reference to standard deviations [14].

**RESULT**

The description of the results of the mathematical literacy skills test was employed on the 4<sup>th</sup> graders in 16 schools. The result showed that the mean mathematical literacy of Muhammadiyah elementary school students in Sleman Regency was 16.1, which was categorized in as low. The percentage of students who had mathematical literacy skills in the high and very high categories was still below 20%. Most students are still in the moderate, low and very low category.

Table I presents the distribution of students' mathematical literacy skills seen from the number of students in the very low, low, moderate, high and very high categories. It can be seen from the data in Table 3 that only 4 of 395 students or only 1% of students were in the very high category. Meanwhile, 43 students or 11% of students were in the high category, 138 students or 35% of students were in the moderate category, 162 students or 40% of students were in the low category, and 47 or 12% of students were in the very low category.

Table 1. The distribution of mathematical literacy skills of students for each category

Category	f	f relative (%)
Very high	4	1%
High	43	11%
Moderate	138	35%
Low	162	40%
Very low	47	12%

The mathematical literacy skills of Muhammadiyah elementary school students in Sleman Regency were also analyzed based on each domain, namely the process domain and content domain. The mean of mathematical literacy ability of students viewed from each aspect of the process domain are 10.8 (moderate) for formulating, 3.6 (low) for employing, and 3.3 (low) for interpreting. This is assumed to be one of the causes of the low mathematical literacy of Muhammadiyah elementary school students in Sleman Regency. Whereas, Stacey mentions that mathematical modelling is the key that is closely related to mathematical literacy [15].

Only very few students were in the high category. The results of the students' skills showed that most students find it difficult to translate the questions being raised. This might be caused by the characteristics of mathematical literacy problem adopted from PISA problems which contain contexts in each problem.

Meanwhile, students are used to solving questions by using routine characteristics. The result is not much different from the results of the USBN of Mathematics in 2018, which suffered a decrease of the mean score compared to the results in 2017, as the questions tested employed High Order Thinking Skills [16].

Besides being described according to the process domain, the data of mathematical literacy skills of students were also described based on the content domain as in the international PISA survey. Table 5 shows the result data of the research on mathematical literacy skills viewed from the content domain which includes geometry (space & shape) content, quantity (number), and statistics (data).

Table 2. Percentage of students' mathematical literacy abilities based on the content domain

Aspect	Mean	Category
Geometry	4,3	Low
Quantity	6,6	Moderate
Statistics	6,2	Moderate

The description of mathematical literacy skills of Muhammadiyah elementary school students in Sleman Regency viewed from the mistakes and successes done in solving mathematical literacy questions is as follows. In the content of quantity, it was observed: (1) students were able to translate the problem given; (2) students had the ability to choose one strategy from several possible strategies, it was seen from the number of ways used by the students; (4) students were able to carry out the determined procedures; (5) students were able to perform operations with mixed number; (6) students were able to find a solution preceded by drawing conclusions on their analysis.

On geometry content, students' skills were indicated by the results of their work which showed that: (1) students were able to find the concept of circumference and area, yet still having difficulties if the area is a combined area; (2) students were able to mention the steps of completion using sentences or sketches; (3) students were able to see the relationships between lines; (4) students were able to interpret problems and employ certain representations in the form of sketches.

In statistical content, it indicated that (1) students could read the diagram on the problem given; (2) some students were not able to make a diagram of the problem given; and (3) some students failed to understand the problem making their answers were irrelevant to the question given. Furthermore, the result data from the research on mathematical literacy skills were described based on skill levels as very low, low, moderate, high, and very high categories of content domains in one diagram. The details of the percentage viewed from content domain can be seen in Figure 1.

Based on Figure 1, it states that the students' skills to work on Geometry, Numbers (quantity), and Statistics problems were mostly in the moderate and low categories. Only few students were in the high and very high category. Seen from the time allocation, 60 minutes duration to work on 5 description questions is relatively

sufficient. Another fact that can be revealed is that students had difficulty in finding the starting point to solve problems. It was indicated through the observations of student work sheets.

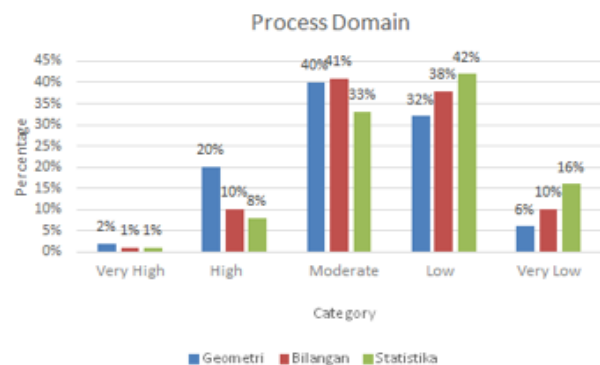


Figure 1. Bar Chart of the Percentage Distribution of Content Domains on Each Category

## CONCLUSION

Based on the results of the analysis and discussion, we can conclude that the mathematical literacy skills of Muhammadiyah elementary school students in Sleman Regency are categorized low. Mathematical literacy skills of Muhammadiyah elementary school students in Sleman Regency on the content domain of quantity (numbers) and statistics are in the moderate category, while the geometry content are very low. In the process domain of formulating mathematical situations, the students' skills are categorized into moderate, while the process domain which deals with concepts, facts, procedures, and mathematical reasoning is categorized low. In the domain of the process of interpreting, applying, and evaluating mathematical results, the students' skills are categorized into low category.

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