Mathematical literacy of prospective mathematics teachers in solving social arithmetic problems in the context of the wetland environment

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Abstract. Mathematical literacy is an individual's ability to formulate, use, and interpret mathematics in various contexts. However, the achievement of Indonesian students' mathematical literacy is low, according to the PISA study. Therefore, it is necessary to have a mapping of the mathematical literacy abilities of mathematics education students who are prepared as prospective mathematics teachers. The research describes the mathematical literacy of prospective mathematics teachers in solving social arithmetic problems in the context of the wetland environment. This research used the descriptive method. The participants were 87 students in the second year of mathematics education study program at Universitas Lambung Mangkurat. The students were tested with social arithmetic problems in the context of the wetland environment. The results showed that there are five categorizations of mathematical literacy of prospective mathematics teachers in solving social arithmetic problems in the context of a wetland environment. These categories are 6% of subjects did not solve problems, 3% of subjects only identified problems, 60% of subjects solved problems but did not fit the given context, 3% of subjects solved problems, but the procedure or the final answer is wrong, and 28% of subjects can solve the problem correctly both in the procedure and in the final answer. Based on these findings, prospective mathematics teachers need to be prepared to be familiar with problems related to the context of their environment to improve their mathematical literacy skills.

1. Introduction
Mathematical literacy is an individual's ability to formulate, use, and interpret mathematics in various contexts. This ability includes reasoning mathematically and using mathematical concepts, procedures, facts, and properties to describe, explain, and predict a phenomenon. This ability directs a person to recognize the role that mathematics plays in the world and to make reasoned judgments and decisions that are needed by constructive, engaged, and reflective citizens [1]. Mathematical literacy skills will encourage students to be able to think at a high level. A person with good mathematical literacy will use all critical and creative thinking to be able to formulate and interpret mathematics in various contexts [2].

A person has good mathematical literacy if he can analyze, reason, and communicate his mathematical knowledge and skills effectively, and can solve and interpret mathematical solutions [3]. Someone literate in mathematics does not only understand mathematics but is also able to use it in...
solving daily problems [4]. Therefore, it is clear that Mathematical Literacy aims to develop the ability and willingness to use mathematical thinking to understand various life-related situations [5].

The Organization for Economic Co-operation and Development (OECD) is an organization that measures the literacy of students aged around 15 in various countries through PISA. Based on the results of the 2018 PISA test, which involved 600,000 students as a sample, the average score of students in Indonesia was 379 and was below the participant average of 489. Moreover, the 2018 test results had decreased from 2015 when it reached a score an average of 386, although they were both below the average of the PISA participants’ test results. The average Indonesian student reaches level 1; that is, students can answer questions in a general and familiar context and all relevant information is available with clear instructions. They can identify information and complete routine procedures according to explicit instructions. They can act according to the stimuli given. Therefore, the preparation of mathematics teachers who can improve students’ mathematical literacy skills needs efforts.

Preparing prospective teachers who can improve student literacy skills needs to begin with mapping and analyzing the ability of prospective mathematics teachers. Several researchers have conducted the mapping of the ability of prospective mathematics teachers in Indonesia. In solving PISA problems, prospective mathematics teachers performed well in a problem interpretation process in individual and social contexts, but difficulties in the formulation and employment process [6]. In another study, the mathematical literacy abilities of prospective mathematics teachers are viewed from the process components whose results are low [7]. Some of these studies just used the PISA problem than directly use instruments related to the local wisdom of the subject, especially the context of the wetland environment.

Mathematical Literacy of the teachers around the world must be fluent and knowledgeable on a wide variety of topics. They must be able to understand everyday situations to make students aware of how these problems are handled in real life [8]. The majority of students of the Mathematics Education Study Program in Universitas Lambung Mangkurat come from South Kalimantan Province. The local wisdom in South Kalimantan is related to the wetland environment because most of South Kalimantan is in the form of swamps. On the other hand, the mathematical concepts that students learn can be combined with local wisdom around their environment [9].

Furthermore, [10] argues that mathematics taught in schools is expected to be inseparable from the concepts that exist in students' daily lives. In line with [11] statement, local wisdom on the wetland environment that is integrated into contextual mathematics learning is expected to be able to become meaningful learning because it is related to the community where students come from. Furthermore, by learning the wetland environment, students can become agents of change in responding to problems in their area. Therefore, this research aims to describe the mathematical literacy of prospective mathematics teachers in solving social arithmetic problems in the context of the wetland environment.

2. Method

This research uses a qualitative approach with a descriptive exploratory method. Participants of this research were the Student of Mathematics Education Study Program of Faculty of Teacher Training and Education Universitas Lambung Mangkurat in the second year. The participants of this study were 87 students aged between 18 years 0 months to 20 years 7 months. The participants as the subjects were selected based on purposive sampling, namely students who took Junior high school mathematics learning courses which are the student level as the subject of the PISA survey. The main instrument in this research was a team of researcher, and the test was a problem related to social arithmetic contextual wetland environment as a supporting instrument. The problem in the test are as follows:

“The floating market is one of the local wisdom of South Kalimantan. Merchant peddles their wares using jukung. Jukung is a river transportation means for residents of Banjarmasin City in the past. However, sometimes the items he sells don't run out in one day. One day, a merchant brought 15 kg of oranges and bought them for Rp. 105,000.00 in total. On average, the oranges he sold were only 60%
of all the oranges he brought in one day. What is the price of 1 kg of oranges to be sold so that the seller can make a profit of at least 10% in a day?"

This instrument shows the social reality in South Kalimantan, namely economic activities in a floating market. The floating market is one of the local wisdom from South Kalimantan. The floating market is an economic activity for the people of South Kalimantan which has grown because the lives of many people are centred around the river flow, while the river is the primary transportation access for a long time. Another unique thing about economic activity in the floating market is that the sellers ride the jukung. Jukung is river transportation in South Kalimantan. Hence, the problem relates to the environmental Context of South Kalimantan's wetlands.

After the data were collected, the researchers analyzed the data. Because this study uses a qualitative approach, the data analysis techniques of this study include data collection, data condensation, data presentation, and conclude, according to Miles & Huberman [12]. The conclusion of the study describes the mathematical literacy of prospective mathematics teachers in solving social arithmetic problems in the context of the wetland environment.

3. Result and discussion
The results of the study were obtained from tests conducted on the subjects in this study, namely as many as 87 students. Furthermore, the results of the subject's answers are categorized based on the characteristics of the same answer. The results of this categorization are presented in Table 1.

| No | Characteristics                                                                 | Percentage |
|----|---------------------------------------------------------------------------------|------------|
| 1  | The Subject did not solve the problems                                           | 6%         |
| 2  | The Subject only identified the problems                                         | 3%         |
| 3  | The Subject has solved the problems but did not fit the given Context            | 60%        |
| 4  | The Subject has solved the problems, but the procedure or the final answer is   | 3%         |
|    | wrong                                                                           |            |
| 5  | The Subject can solve the problem correctly both in the procedure and in the final answer | 28%        |

Based on Table 1, it can be seen that the majority is in the category the Subject are solved problems but did not fit the given context. It will be discussed in depth in the following description.

3.1. The Subject did not Solve the Problems
Characteristics of the subject do not answer the problem is indicated by a blank answer sheet given to the subject. Even though it is in a small category, this phenomenon needs to be conveyed because there are several groups of students who have apathetic attitudes with the problem; namely, they feel that the problem does not need to be resolved in detail. Also, another cause of the subject not solving the problem is that they don't know where to start and how to solve the problem, so they prefer to leave with no answer.

3.2. The Subject Only Identified Problems
The next characteristic is that the subject was only identifying the problem. This is shown by writing the answers, as shown in Figure 1.
Figure 1. The subject only identified problems.

Figure 1 shows that the subject wrote what was known and asked about the problem. The subject did not continue to solve the given problem. They don't know the next step they need to took, so they could not find a solution to the problem.

3.3. The Subject has Solved Problems but did not Fit the Given context

The third characteristic of mathematical literacy in solving problems is that the subject reaches the stage of solving the problem, but the solution given does not arrive at the final correct answer. The third characteristic is presented in Figure 2.

Figure 2. The subject has solved problems but did not fit the given context.

Based on Figure 2, it can be seen that the subject has determined the average oranges sold in a day. The subject has also determined the purchase price of oranges per kilogram as the merchant's initial capital. Furthermore, the subject determines the total money earned when oranges are sold at a capital
price and as much as an average of Rp. 63,000.00. With these calculations, the overall profit is Rp. 6,300.00 or a profit of Rp. 700.00. Thus, the merchant must sell for Rp. 7,700.00. If the merchant sells oranges for Rp. 7,700.00 for 9 kg of oranges in a day, the total amount earned by the merchant is Rp. 69,300.00. When returned with the question being asked, the merchant's acquisition of Rp. 69,300.00 indicates that the merchant is not profitable, because the initial capital that must be issued is Rp. 105,000.00. This shows that the subject has tried to solve the problem but does not fit the context in question in the problem.

3.4. The Subject has Solved Problems, but the Procedure or the Final Answer is Wrong

The fourth characteristic is that the subject has solved the problem with the right procedure, but there is a final part that makes the answer given to be wrong. The illustration of the fourth characteristic is shown in Figure 3.

![Figure 3](image)

**Figure 3.** The subject has solved problems, but the procedure or the final answer is wrong.

At first, the subject wrote down what was known. Furthermore, the subject determines the total money that must be achieved for the merchant to get a profit of 10%, which is Rp. 115,500.00. In the end, the subject divides Rp. 115,500.00 by 15, even though it should be divided by 60% of 15. This shows that the path of completion is correct, but there is an error at the end of the solution so that the answer given is wrong.

3.5. The Subject can Solve the Problem Correctly

The fifth characteristic of the subject's mathematical literacy is that they have determined the correct answer through the right procedure. This is shown in Figure 4.
Figure 4. Subject resolve the problem with the right both procedure and answers.

Figure 4 shows that the subject has determined that the average orange sold in a day is 9 kg. Then the subject determines the money the merchant gets if he wants to get a 10% profit. To get the desired price, the subject divides the total profit by 10% that should be obtained, namely Rp. 115,500.00 with an average daily sales of 9 kg. Thus, the final result obtained is Rp. 12,833.33 or can be rounded up to Rp. 12,300.00 is the selling price of oranges per kilogram so that the merchant can get at least a 10% profit.

3.6. Discussion

The mapping of mathematical literacy skills needs to be done so that stakeholders can have data to carry out the following policy. By knowing the characteristics of mathematical literacy of prospective mathematics teachers in solving problems, educators can provide treatment to them to improve their mathematical literacy ability. Besides, it is important to integrate mathematical literacy in the mathematics curriculum in schools [13]. The integration of Mathematical Literacy into the curriculum can lead to the understanding that mathematical knowledge requires recontextualization which brings a shift in criteria to the objectives of learning mathematics in schools [14].

Table 1 shows the five characteristics of the mathematical literacy of prospective mathematics teachers in solving social arithmetic problems in the wetland environment context. Based on Table 1, it can be seen that the majority of participants in the characteristics of solving social arithmetic problems but not fit with the context. This shows that the mathematical literacy of the majority of participants is in the weak category because they cannot solve the problem correctly. This is in line with research conducted by [6], [7], [15]. The lack of students who can solve problems appropriately needs special attention in increasing an individual's mathematical literacy in solving problems of daily life, especially those around them.

It is necessary to familiarize students with the problems around them so that they are accustomed to using mathematical literacy in solving problems around their lives. The highest level of mathematical literacy is reached when individuals can effectively use mathematics in whatever situation they find in their life [16]. Furthermore, mathematical skills and mathematical literacy need to be integrated so that student achievement in learning mathematics is more optimal [17]. This habituation can be done by going directly to "the field" or through simulative learning media. Like the treatment in learning by realistic learning assisted by e-Schoology [18] and Virtual Mathematics Kits (VMK) as digital media. Other treatment can enhance the mathematical literacy ability in a learning scenario, such that the implementation of realistic mathematics education and the DAPIC problem-solving process [19] and applying the contextual teaching and learning [20].

4. Conclusion

There are five categories of prospective mathematics teacher literacy in solving the social arithmetic problem in the context of a wetland environment. Those categories are characterized by did not solve
problems, only identified problems, solved problems but did not fit the given context, solved problems but the procedure or the final answer is wrong and able to solve the problem correctly both in the procedure and in the final answer. Of the five categories, the majority of prospective mathematics teachers have solved problems but did not fit the given context. It is better if students are familiarized with problems that can improve mathematical literacy in-class activities. In-depth study related to the causes of student failure in solving problems in various contexts needs further investigation.

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