Student's Mathematical Literacy: A Study from The Perspective of Ethnomathematics Context in North Sulawesi Indonesia

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Mathematical literacy skills are essential for students. This study analyzed students' mathematical literacy skills in solving mathematical literacy problems using an ethnomathematics context. The research subjects were students of class VIII SMP Negeri 2 Tondano, Minahasa Regency, North Sulawesi Province. This research uses the descriptive analysis method. The data was obtained through a test of mathematical literacy questions with an ethnomathematical context. The instruments used consisted of tests and interviews. The results showed that 87.5% of high-grade students could solve problems in formulating competence, while for middle-grade students, 67.6% of students and 31% of low-grade students. For employ competence, there are 71.5% high-grade students, 47.5% middle-grade students, and 3.3% low-grade students. Meanwhile, for interpreting competence, there are 55% of high-grade students, 13.3% of middle-grade students, and 1.3% of low-grade students. These results indicate that the mathematical literacy ability of students in answering mathematical literacy problem in an ethnomathematics context are relatively low.

Keywords: mathematical literacy, numeration, ethnomathematics

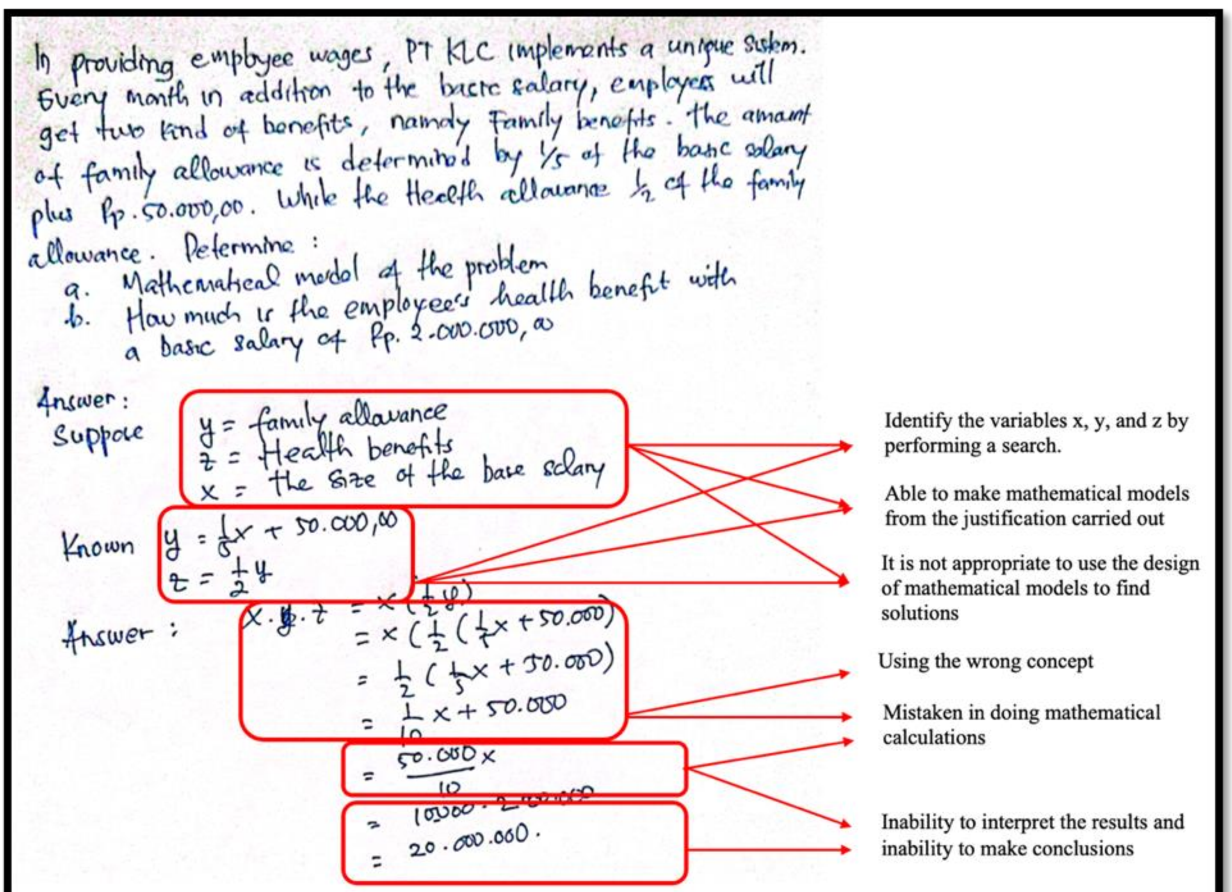
INTRODUCTION

Mathematical literacy ability is one of the most demanded abilities in the development of mathematics education today. This is because mathematical literacy skills are essential in helping students face challenges and problem-solving in everyday life (Stacey & Turner, 2015; Wardono, 2016; Janah et al., 2019;). Mathematical literacy can be defined as an individual's ability to formulate, work on, and interpret mathematics in various contexts, including mathematical reasoning, using concepts, procedures, and facts, in describing, explaining, and predicting phenomena (OECD, 2003; Mangelep, 2013).

One of the international studies in measuring mathematical literacy skills is the Program for International Students Assessment (PISA). PISA results show that Indonesian students' mathematical literacy skills are still low (Mangelep, 2018b; Janah et al., 2019). Indonesia is ranked 72 out of 78 countries with a score of 379, which is still below the average score of OECD countries (OECD, 2019). This result aligns with students' regional results, especially in North Sulawesi Province. Based on the results of the National Mathematical Literacy Contest (KLM), which is a junior high school mathematics competition that uses PISA-type mathematical literacy questions, it shows that the achievements of students from North Sulawesi have been in a low position and have been consistent for the last four years of participation (Mangelep, 2018a).

Based on the facts found in observations at SMP Negeri 2 Tondano, students' mathematical literacy skills are not optimal. It can be seen from the results of working on mathematical literacy problems in Figure 1:

FIGURE 1
STUDENT WORK RESULTS



From the results above, students need help understanding the relationship between language, symbols, and mathematical modeling, so students are less precise in designing mathematical models to find solutions. As a result, students need to be corrected in mathematical calculations and are unable to interpret the results and make conclusions. From the results of the interviews, these students did not master the concept, so they made mistakes in solving them. At the same time, mathematical literacy skills demand integration between students' conceptual, reasoning, and creative abilities (Wati et al., 2016).

According to the research results of Domu & Mangelep (2019), the factors causing these students' low mathematical literacy skills are influenced by various factors, including the readiness of learning by the teacher. In addition, the unavailability of a learning environment designed according to the context of students' daily lives can affect students' learning motivation. In the classroom learning process, students are expected to understand the facts, concepts, principles, and procedures that exist and have specific skills by using appropriate approaches, models, and techniques according to the characteristics of the teaching materials developed.

In addition to the factors above, the habit of working on standard, abstract, traditional questions that are not connected to students' daily lives can be one of the factors for the low Indonesian PISA results (Mangelep & Kaunang, 2018). The traditional questions have different characteristics from the PISA questions, which require mathematical reasoning and higher-order thinking skills, so Indonesian students need help working on these questions. This is also inseparable from the availability of mathematical literacy questions that use the context of everyday life based on PISA standards (Anisah et al., 2011; Jailani et al., 2020; Mangelep & Kaunang, 2018; Noviarsyh Dasaprawira et al., 2019).

The use of cultural contexts that exist in society in learning can be used to stimulate students' mathematical literacy. Orey & Rosa (2014) state that local cultural elements cannot be separated in the learning carried out by teachers. Research result Dahm & De Angelis (2018) stated that using the mother tongue in the context of local culture in learning mathematics showed a positive and significant effect in increasing mathematical and language literacy skills. For example: if someone teaches mathematics in the Minahasa area of North Sulawesi, the teacher must combine Indonesian and the local Minahasa language so that students can understand the material presented. This is because students may need help understanding the material. After all, they need help understanding the terms in Indonesian conveyed by the teacher. In line with this, Brandt & Chernoff (2015) argues that in studying mathematics, it is necessary to integrate culture into learning, especially the cultural context that surrounds students. This indicates that culture-based mathematics learning needs to be integrated into mathematics learning.

We can use an ethnomathematical view to build mathematics learning connected to the local cultural context. Ethnomathematics expresses the relationship between culture and mathematics (Balamurugan, 2015). Orey & Rosa (2012) define ethnomathematics as the relationship between mathematics, mathematical modeling, and cultural anthropology. The term "ethno" is described as the primary material that forms the characteristics of a particular group or ethnicity, which includes language, values, jargon, food, fashion, habits, physical appearance, etc.

Several studies related to integrating ethnomathematics into mathematics learning have shown positive results. Research results Ogunkunle et al., (2015) revealed that students who were taught by integrating ethnomathematics were able to increase their creativity and skills in learning. In addition, it was also found that there were significant differences between students who were taught with ethnomathematical integration and without integration regarding aspects of creative thinking (Ogunkunle et al., 2015). Abiam et al., (2016) also revealed that ethnomathematics-based learning, especially in geometry, is better than conventional learning in improving learning achievement. In addition, ethnomathematical integration also affects students' mathematical literacy skills (Farokhah et al., 2017). However, these studies are still focused on learning activities and have yet to examine the student's ability to solve math problems in an ethnomathematical context.

This article discusses students' mathematical literacy skills in solving math problems in an ethnomathematical context. This study is essential to understand the strategies, difficulties, and processes of students' mathematization to see to what extent the ethnomathematical context can stimulate students' mathematical literacy.

METHOD

This type of research is descriptive research with data acquisition using quantitative descriptive. The main concern in this study is the results of the Students' Mathematical Literacy Ability Test. The results of the student's work provide answers to this research's problems. This research was conducted in the odd semester of the 2021/2022 Academic Year at SMP Negeri 2 Tondano. The study involved 40 students divided into three groups based on their mathematical abilities (High, Medium, and Low). The research instrument used is a mathematical literacy ability test using the ethnomathematics context of North Sulawesi. Mathematical literacy ability tests are used to describe students' mathematical literacy abilities. Meanwhile, the interview instrument is used to see the compatibility between written answers and students' oral explanations in solving mathematical literacy problems in ethnomathematics contexts. The mathematical literacy problem used is as follows:

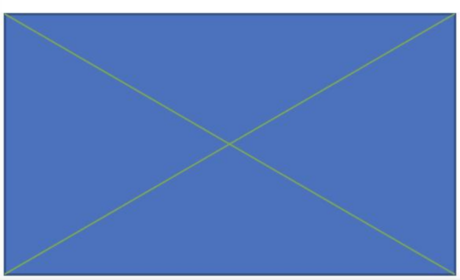
FIGURE 2
THE MATHEMATICAL LITERACY PROBLEMS WITH ETHNOMATHEMATICS CONTEXTS

UNIT 1: RICE FIELDS

Om Lutfi has a rectangular plot of rice fields (Local Language's: Kobong Peceh). Then he would divide the Kobong Peceh to his four children.

Image Source: Navel O. Mangelep Collection

Om Lutfi stated that he had divided his rectangular rice field into 4 parts as shown below. Ridho his son disagrees with Om Lutfi because he thinks the division is not the same. Do you agree with Ridho's opinion? Give the reason in the form of mathematical argumentation and then give examples of what kind of division is appropriate in your opinion? If you disagree, also give your reasons, then give examples of appropriate divisions in your opinion!



The instrument used in this research is a math problem with an ethnomathematical context. This instrument is based on three main domains of mathematical literacy in PISA: context, content, and process. The context used is related to ethnomathematics, while the process is seen in formulating, employing, and interpreting. The test given is an essay question of 5 numbers.

RESULTS AND DISCUSSION

This research was carried out by analyzing the results of students' answers which were divided into 3 groups of students (classes), namely high class, medium class, and low class. This division is based on the student's answer score, the average value (x), and the standard deviation (SD) where the high class with a score of $>\bar{x}+SD$, the middle class $\bar{x}-SD<score<\bar{x}+SD$, and low grade with a score of $<\bar{x}+SD$ (Arikunto, 2010). The results of statistical calculations obtained 7 students in the high class (17.5%), 22 students in the medium class (55%), and 11 students in the low class (27.5%), and the average value of all students was 43, 25 and the standard deviation of 17.11. The average score of students is 43.25, with a minimum score of 15 and a maximum of 80. While the standard deviation is 17.77.

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In addition, students' abilities are also seen by their competence in mathematical literacy processes, namely formulating, employing, and interpreting. The following is the average value of student achievement in process competence.

FIGURE 3
THE AVERAGE VALUE OF STUDENT ACHIEVEMENT IN THE ASPECT OF PROCESS COMPETENCE

From Figure 3 above, the lower-grade students are almost entirely unable to work on mathematical literacy questions in the ethnomathematical context of interpreting competence. Problems in interpreting competence require students to think critically and reflectively, develop mathematical models, and find mathematical ideas from the problems given, so students need to develop appropriate problem-solving strategies. This causes students with low grades to have difficulty solving questions on this competency. Regarding employing competence, students in this class also need help. The average score of students at this stage is less than 1. Students need help connecting the given ethnomathematical context to mathematical modeling, so students do not produce mathematical models from the existing problems. Therefore, the mathematical literacy ability of students at this stage is low.

In middle-grade students, we found that the average score on formulating competence was almost the same as that of the students. Here it can be seen that the class students have no difficulty solving questions on formulating competence. It is also seen that the average score of students almost reaches the total score but almost has difficulty solving problems on employing and interpreting competencies. This is in line with the results of Stacey's research (2011), where in PISA Mathematics, Indonesian students also have difficulty solving questions on interpreting competence (only 0.1% of students). While in the employing competence there are 23.3% of students. This indicates that students' mathematical literacy skills are shallow, especially in employing and interpreting competencies.

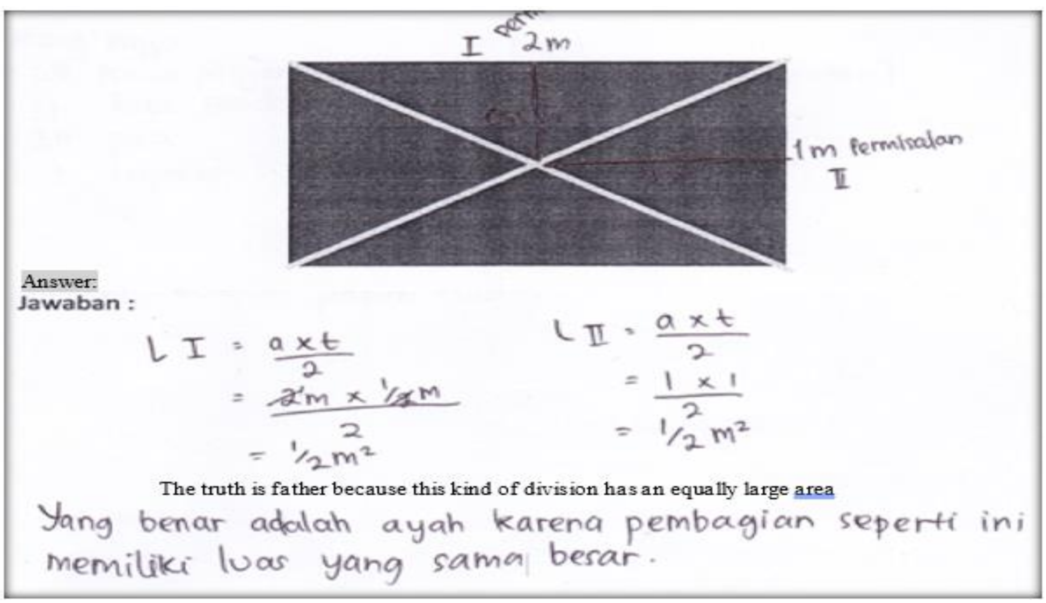
If made in percentage, students who can solve mathematical literacy questions for formulating competence are 87.5% high-grade students, 67.6% middle-grade students, and 31% low-grade students. As for employing competence, 71.5% are high-grade students, 47.5% are middle-grade students, and 3.3% low-grade students. Meanwhile, for interpreting competence, only 55% of high-grade students, 13.3% of middle-grade students, and 1.3% of low-grade students can solve problems on this interpreting competency.

The following are student results in answering mathematical literacy questions in an ethnomathematical context (Figure 2, 5, 6). This problem asks students implicitly to be able to prove whether the two triangles have the same area or not. Here students need to identify congruent sides and angles or do an example to show that the two triangles have the same area. This problem requires students to be able to reflect on mathematical solutions by making mathematical explanations and arguments that support or reject them by meeting the requirements of mathematical completion.

Based on the question indicators on employability, here, students must be able to construct knowledge, provide explanations, and provide arguments in contextual problems given, in this case, the context of rice fields. The consequences that students must pass are that students must be able to understand the level and limits of mathematical solutions, which are a consequence of the mathematical model being used, where students must be able to provide logical arguments in proving whether the two triangular flat shapes above have the same area.

One of the strategies for solving the questions above was shown by SS1 students (Subject 1), namely by doing examples. SS1 tries to determine the value on the sides of the square and then finds the area of each triangle using the triangle area formula. Then it shows that the area of area I is equal to the area of area II, so SS1 concludes that the correct one is Uncle Buang.

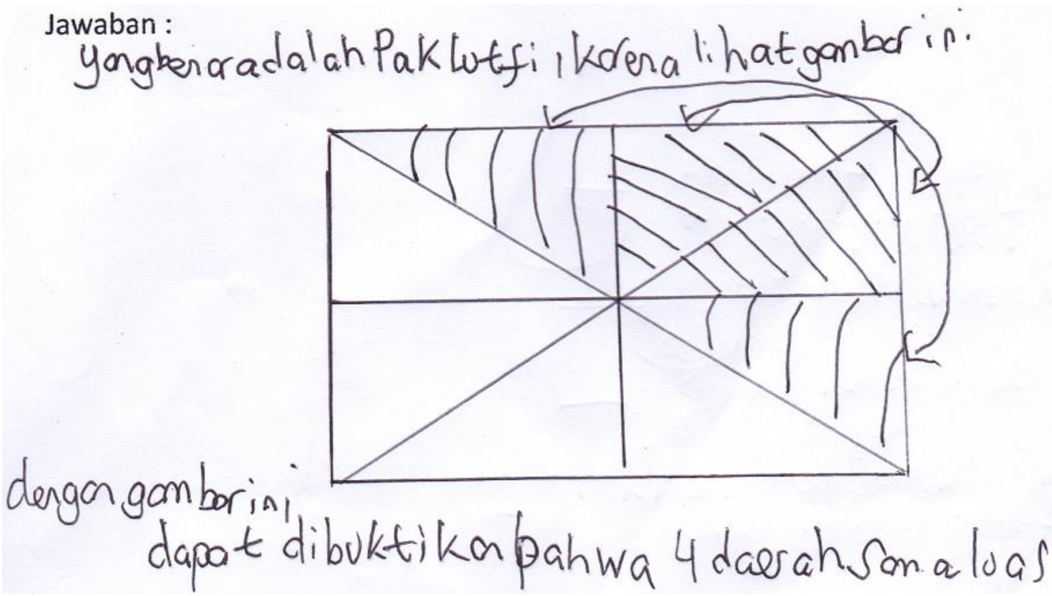
FIGURE 4
S1 STUDENT ANSWER STRATEGIES FOR UNIT 1 QUESTIONS



Based on the strategy adopted by SS1, SS1 has been able to argue using a simple mathematical model. SS1 uses direct proof by entering values, for example, with the existing triangle area formula. This shows that SS1 has been able to understand the relationship between the context and the given problem by using his understanding of the area of the triangle to interpret the solution to the given problem.

FIGURE 5
S2 STUDENTS' ANSWERS TO UNIT 1 QUESTIONS

Answer: The correct one is Mr. Lutfi.

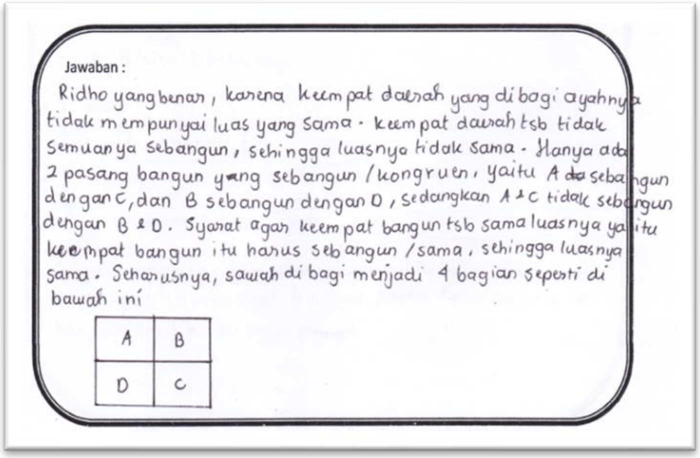


With this picture it can be proved that the 4 areas are equally large

Unlike SS1, SS2 uses a different strategy in solving this problem (figure 4). SS2 has answered this question correctly but needs to provide a complete explanation. SS2 tries to divide the rectangle by using one vertical line and one horizontal line through the center of the square. Then show the similarities between the triangles that are formed. Even though they did not write down the mathematical rules for why the two triangles can be said to be the same, based on the researcher's interviews with the students, it appears that the students have proven it.

From the results of SS3's answer above (figure 5), SS3 cannot explain the similarity of the areas of triangles A and B or triangles A and D. Here, SS3 only concludes visually by saying that the areas are not the same because the shapes are not congruent. The statement was not based on a mathematical argument, even though the question had been asked to explain it by providing a mathematical argument.

FIGURE 6
S3 STUDENTS' ANSWERS TO UNIT 1 QUESTIONS


Jawaban :
Ridho yang benar, karena keempat daerah yang di bagi ayahnya tidak mempunyai luas yang sama. keempat daerah tsb tidak semuanya sebangun, sehingga luasnya tidak sama. Hanya ada 2 pasang bangun yang sebangun/kongruen, yaitu A sebangun dengan C, dan B sebangun dengan D, sedangkan A & C tidak sebangun dengan B & D. Syarat agar keempat bangun tsb sama luasnya yaitu keempat bangun itu harus sebangun/sama, sehingga luasnya sama. Seharusnya, sawah di bagi menjadi 4 bagian seperti di bawah ini

Answer:
Ridho is right, because the four regions that his father divided did not have the same area. The four areas are not all as close as they are so the area is not the same. There are only 2 pairs of constructs that are constructed/congruent, namely A is built with C, and B is in conjunction with D. The condition for the four builds to be equal in area is that the four builds must be the same/ same. The rice field should be divided into 4 parts as shown below:

CONCLUSION

This study's results have shown that students' mathematical literacy ability in answering mathematical literacy questions in a mathematical context is relatively low. In percentage terms, only 87.5% of high-grade students, 67.6% of middle-grade students, and 31% of lower-grade students can answer questions on formulating competence. As for employing competence, there are only 71.5% high-grade students, 47.5% middle-grade students, and 3.3% low-grade students. Meanwhile, for interpreting competence, only 55% of high-grade students, 13.3% of middle-grade students, and 1.3% of lower-grade students can solve mathematical literacy problems in this competency.

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