Analysis of Mathematical Literacy of Elementary School Teacher Candidates Using Ethnomathematics-Based Story Questions

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Abstract. This study aims to: 1) analyze the Mathematical literacy of prospective elementary school teachers using ethnomathematics-based story questions and 2) determine the role of ethnomathematics-based story questions in improving mathematical literacy. The research methods used are descriptive qualitative approaches-the research at one private university in Surakarta's PGSD study program. The subjects used by students in the first semester of the 2022/2023 Academic Year were 32 students who took Geometry and Measurement courses. Sampling technique with *purposive sampling* analyses high, medium, and low-ability categories. Data collection techniques with interviews, documentation, and ethnomathematics-based story questions. The validity of the data uses triangulation of techniques and timing. Cycle model data analysis: 1) data reduction, 2) data presentation, and 3) conclusion drawing. The results; 1) the High category has Mathematical literacy ability at levels 4 to 6, the Medium category is at level 5, and the Low category is at levels 2 to 4. 2) the results of descriptive analysis state that ethnomathematics stories effectively increasing the Mathematical literacy of prospective elementary school teachers.

Key words: mathematical literacy; ethnomathematics

INTRODUCTION

There are 5 (five) mathematical abilities that must be mastered by a person who is undoubtedly helpful in his life; mathematical reasoning, representation, connections, communication, and problem-solving (National Council of Teacher Mathematics, 2020). According to NCTM (2020), the five aspects are related to mathematical literacy. Mathematical literacy will make it easier for a person to make the best decisions as part of solving the problems he faces in life. It is said that the ability to understand, apply, and explain to others how to solve problems in life is a mathematical literacy activity (Abidin, Y, Titi M., Hana Y., 2018; Maryani & Widjajanti, 2020). A person with good mathematical literacy will quickly adapt to modern society. However, in reality, there is data that shows that Indonesia's mathematical literacy is low, which is in the bottom ninth place out of 79 PISA participating countries in 2015. Education in Indonesia should be able to produce excellent students through teachers, exceptionally qualified and professional elementary school teachers (Faisal & Martin, 2019; Prabawati, 2018). Literacy activities, in general, include reading, writing, speaking, and listening or listening activities. These activities can relate to local wisdom activities in the surrounding environment.

Local wisdom is a social order of knowledge, norms, regulations, and skills of the community in a specific area to fulfil an ordinary life passed down from generation to generation (D. Hidayati, 2017; Jumriani et al., 2021). t is one determinant of the character of a nation that develops according to its time and cannot be separated from its owner's environment (Wagiran, 2012). Based on the literature review and utilization principles, the form of local wisdom used in improving mathematical literacy in this study is an as traditional food attached to Central Javanese culture, especially in Surakarta. It is in line with research (Sari et al., 2020) that traditional food can be used as an alternative learning resource in the discussion of geometry. Then research (Pathuddin et al., 2019) related to the ethnomathematics of traditional food in the Bugis region and (Huda, 2018) about market snacks in Yogyakarta. Some many philosophies or meanings can be learned as a provision for life, especially for prospective elementary school teachers, because a cultured person is a person with good understanding and reasoning in his life.

The results of observations on students of prospective elementary school teachers for one semester at private universities in Surakarta city found several problems, including the weak number of students in understanding math story problems and the shared knowledge of students with local wisdom around where they live. The main factor of concern is improving the quality of professional and competent elementary school teacher candidates in this era of Independent Learning.

Based on the problem of low levels of mathematical literacy and the need to improve the critical thinking of prospective elementary school teachers, it is necessary to take the first step to determine the students' Mathematical literacy abilities. It was used as preliminary research in carrying out learning to continue to focus on mathematical literacy activities to improve students' ability and reasoning skills based on PISA levels. According to PISA, in conducting a mathematical literacy assessment, there are 6 (six) levels (Hadayatilah, 2013), as follows.

Table 1. Level of Mathematical Literacy.

Level	Description
Level 1	Able to answer questions with general context based on all relevant information from the question and provide solutions accordingly
Level 2	Able to use simple and transparent procedures to solve problems and interpret them correctly
Level 3	Solving problems with procedures that are usually used or performed
Level 4	Able to choose a mathematical model that suits the context of the question to get the right solution
Level 5	Able to use mathematical models to solve given problems
Level 6	Able to solve problems using subsequent reasoning and generalize their findings and convey the solutions got to others

Meanwhile, the indicators of Mathematical literacy, according to PISA (V. R. Hidayati et al., 2020), are described in the following table.

Table 2. Mathematical Literacy Indicators.

Aspects	Indicator
Formulating problems mathematically	A1: Identifying the Mathematical aspects that exist in a problem
	A2: Representing the problem mathematically
Using concepts, facts, procedures, and reasoning	B1: Develop and use strategies for solving problems
	B2: Using existing facts, concepts, and procedures to solve problems
Interpreting, applying, and evaluating the solutions got	C1: Interpreting answers got in real-world contexts

Source: (V. R. Hidayati et al., 2020)

Mathematical literacy activities observed in this study include planning problems, determining steps in solving problems and interpreting the results in real-life contexts.

METHODS

The research method used is descriptive with a qualitative approach, which describes the results of the research carried out as data in the form of numbers, speech, writing, and behaviour of the observed person. The research at one of the private universities in the city of Surakarta in the PGSD study program. The research subject was 32 students in the first semester of the 2022/2023 Academic Year. Sampling techniques with *purposive sampling* based on specific considerations (Sukestiyarno, 2020) to analyze the mathematical literacy ability in the High, Medium, and Low ability categories in depth. Data collection techniques with unstructured interviews are used to analyze the achievement of mathematical literacy levels of elementary school teacher candidates, documentation of test results, and ethnomathematics-based story question instruments to get data on mathematical literacy and analyze their improvement. The validity of the data uses triangulation of techniques and timing. Analyzed used a cycle model: 1) data reduction, 2) data presentation, and 3) conclusion

drawing (Miles, M.B, Huberman, A.M, & Saldana, 2014).

This study aims to describe the mathematical literacy of prospective elementary school teachers through the analysis of ethnomathematics-based test results using traditional foods in the city of Surakarta with indicators of mathematical literacy. (V. R. Hidayati et al., 2020). Research subjects were taken by one student each based on the results of an ethnomathematics-based mathematical literacy test with categories in the High ability category with a value range of 80 < a score of < 100, one student in the Medium category with a score range of 60 < a score of < 80, and 1 student with a low category between of 0 < a score of < 60. The selected subject is described in the following table.

Table 3. List of Mathematical Literacy Research Subjects with Ethnomathematics-based story problems

Student initials	Value	Ability Level
SP (S1)	86	High
FA (S2)	65	Medium
RE (S3)	54	Low

To find out the role of ethnomathematics-based stories in improving the mathematical literacy of prospective elementary school teachers. They were given periodically, at each meeting, by giving 1 question. The increase with see value from four meetings. Researchers used values from all three main research subjects with high, medium, and low categories to see the level of mathematical literacy and its improvement.

RESULTS AND DISCUSSION

Ethnomathematics-based story questions, before use, must declare valid and reliable in the trial class with the following explanation of the results.

Table 4. The results of the validity and reliability of ethnomathematics-based stories.

Question items	Correlation Coefficient (r_{count})	r_{table}	Information	R_{11}	Reliability
1	0.767				
2	0.675	0.349	VALID	0.736	Reliable with High category
3	0.631				
4	0.731				

Then, the test is given in 1 class of Geometry and Measurement courses in elementary schools, which are tested at the 1st to 4th meetings. It is to carry out besides knowing the Mathematical literacy profile of prospective elementary school teachers who also wanted to know the increase in using ethnomathematics-based story questions. Data from the analysis of interviews, tests, and the value of test results when applying ethnomathematics-based literacy questions. The explanation is as follows.

Analysis of question number 1

Lemper is a traditional food from Surakarta found in markets and by travelling merchants. One day, Sita found Lemper in a box of snacks from her neighbour's celebration measuring 45 x 15 x 3 cm. She gave it to her neighbours as a souvenir of 6 members. Each member has a length of 15 cm, a width of 5 cm, and a height of 3 cm. Calculate the volume of the six members and how members can be inserted into the snack box in full!

Mathematical Literacy in High Ability Subjects (S1)

In subjects with high abilities based on the results of observations in the first question with the ethnomathematics object "Lemper", students can identify and represent the problems in the problem in indicators A1 and A2. Students visually describe the shape of the lemper, which is likened to a block in geometry. Then, in the steps to answer B1 and B2, he listed the beam volume formula, namely Length x Width x Height, as the first step to solve the problem in the problem. At the end of the answer, he described visualization of a lemper image that could include in the box in full as a C1 activity. As an activity of checking the answers at the end, he wrote the word "So" every time it solved a problem. Following are the results of the analysis of the improvement of the answer results of S1 students

on ethnomathematics-based questions at the 1st to   fourth meetings.

Table 5. Student score results in the High ability category

Meeting-	Value	Criterion
1	76	Medium
2	80	Medium
3	85	High
4	90	High

Based on table 5, students or prospective elementary school teachers with the High category can meet all mathematical literacy indicators. Based on the results of an interview with S1, it states that when answering story questions, it is necessary to understand the problem carefully by reading times and finding the variables asked later, arranged into a mathematical model to make it easier to solve. However, there are some problems that he only works on stopping at making his mathematical models without being solved. S1 also understands the meaning of lemper as a symbol of fortune and humility. He knows the meaning of lemper from his grandparents and lives in the village. From the following analysis results, the level of mathematical literacy is 4 to 6.

Mathematical Literacy in Medium Ability Subjects (S2)

Subjects with moderate ability on indicators A1 and A2 can write what he knows, such as writing the word Lemper, cardboard snacks, and their size according to the questions, and writing in the questions. Then, S1 tried to translate into a mathematical model that could help him solve the problem and wrote several formulas related to the problem, such as the Length x Width x Height block formula (B1 and B2). After that, S2 did the questions according to the questions (C1). The following is an improvement in the answer results of S2 students from the first to the 4th meeting.

Table 6. Student score results in the Medium ability category.

Meeting-	Value	Criterion
1	48	Low
2	58	Low
3	67	Medium
4	80	High

From table 6, the result shows that students or prospective elementary school (S2) teachers have experienced a significant increase in each problem. He learned from the previous problem to solve the problem the next day. He felt the lecturer gave a test that could hone his abilities and was driven by high learning motivation. Then, for the meaning of lemper, it is not yet only to know its shape. Based on his level of mathematical literacy, he was to include in the level 5 category.

Mathematical Literacy in Low Ability Subjects (S3)

Analysis of S3 showed different results in the High and Medium categories. This elementary school student or teacher candidate can solve questions A1, A2, and B1 partially incomplete. However, there is also a question of whether he could get up to the B2 indicator and not continue. He still needed to relate concepts to one another in the geometric matter. So students need help to make their mathematical models. He still needs to work on associating and solving with mathematical models. The following are the results of the analysis of ethnomathematics-based question answers for S3 students at the 1st to fourth meetings.

Table 7. Student score results in the low ability category

Meeting-	Value	Criterion
1	30	Low
2	48	Low
3	55	Low
4	63	Medium

From table 7, S3 experienced an increase at the end of the question work, namely at the fourth meeting. Based on the interview results, he learned to understand the questions and use formulas in the story questions with his friend. For the meaning of Lemper itself, S3 is only the first to hear because it has only lived in Surakarta for two years, previously lived outside Java. Results of the work completed, S3 at the level of Mathematical literacy indicators, are included in levels 2 to 4.

From the description of the results above, S1 can meet the Mathematical literacy indicators well, and the ability to reason is well supported by starting from simple things to more complex mathematics (Cresswell & Speelman, 2020; Hasanah et al., 2019). S1 also visualizes a realistic approach when S1 solves problems (Saleh et al., 2018). Understanding the problem will make it easier for someone to compile a settlement procedure. So, be said that the mathematical literacy process requires critical thinking (Astuti, 2018; Tasekeb et al., 2019). In the S2 analysis, when doing question analysis, he understands the questions that are usually done faster. Thus, he will be easier to complete with routine procedures that are commonly used (Sukirwan et al., 2018). The level of students with moderate abilities exists at level 5, where at that level, a person can choose, compare, and evaluate problem-solving strategies and reflect (Darling-Hammond et al., 2020; Samsul & Djafar, 2018). Meanwhile, S3 has a low critical thinking ability so that which is the completion and levelling in mathematical literacy (Kusuma et al., 2022; Pratama, 2020), or low reasoning ability so that it cannot understand mathematical problems properly (Fakhriyana et al., 2018; Zaini & Retnawati, 2019).

CONCLUSION

Based on results and discussion, 1) Mathematical literacy levels are 4 to 6 in the High category, 5 in the Medium category, and 2 to 4 in the Medium category. 2) the results of descriptive analysis state that ethnomathematics stories effectively increase the Mathematical literacy of prospective elementary school teachers from four times doing these questions. Shows that stories related to aspects of local wisdom can be an alternative to presenting mathematical literacy. The recommendation from this study is that there is a social aspect that students use in solving problems. Where they first know the culture from their daily activities in the village, and this makes it easier for them to visualize it. So, the social aspect also affects mathematical literacy.

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