A Case Study Of Geometri Literacy In Elementary School Through Ethnomathematics At Borobudur Temple Indonesia

Azamul Fadhly Noor Muhammad, Marsigit, Soeharto

Abstract: The aims of this research were to describe geometry literacy of lower grade elementary school through Ethnomathematics at Borobudur Temple, as well as to describe the result. This research was a descriptive qualitative research with Case Study type. Methods of data collection that were used were observation and interview. The subjects of the study were three students who were lower grade elementary students (grade 1, 2 and 3). In this study, data analysis performed was descriptive analysis. Data that was analyzed in the research was the result of interviews conducted by researchers on the subject of research. The results of the research showed that the lower grade elementary students had good literacy ability especially in the material of square, rectangle and triangle through ethnomathematics at Borobudur Temple.

Index Terms: Literacy, Geometry, elementary school, Ethnomathematics.

1. INTRODUCTION

The result of a research by PISA (Programme for International Student Assessment) in year 2015 and the result of a research by TIMSS ( Trends International Mathematics Science Study) in year 2015 placed Indonesia at a rank that is still far from expectations, that is still below average. This result created a severe mental blow for Indonesian people to immediately get introspection and improve themselves. This result is due to the lack of students 'math skills in solving reasoning problems, problem solving and students' literacy reasoning in mathematical symbols that is still low. One of the causes is that current mathematical learning tends to be conventional and less contextual. The regulation of The Ministry of Education and Culture No. 68 year 2013 supports innovative and contextual learning pattern. So that the learning process is expected to be interactive, fun, motivating, challenging, as well as leaving single learning pattern into becoming multidiscipline learning pattern. In determining the learning resources used in learning, it is necessary to hold the following rules. 1) Supporting local/regional curricula; 2) Developed by teachers with adequate competence; 3) In accordance with the development of age, emotional, material, abilities, learning styles and conditions of students; 4). Contains the value of beauty, social value and literacy [5]. The use of learning resources in the Kraton Yogyakarta location which is one of the tourism destinations, in general, must be interesting for students. In addition, the theory states that learning will develop when the teacher integrates student background [6] in this case is the cultural environment of their surroundin. The existence of these conditions creates a common thread that there should be an effort to improve students' mathematics skills with various alternatives and innovations [5]. One of the key is improving the learning process, especially by improving the portion of reasoning, problem solving, arguing and communicating through more contextual learning. Innovative mathematical learning can be done through a cultural approach or that is called as ethnomathematics. According to Shirley, current area of ethnomathematics, now that mathematics is growing and evolving in society and in accordance with local culture, can be used as a center of learning process and teaching methods, although it is still relatively new in the world of education [4]. Ethnomathematics requires dynamic interpretation. As what is contended by D'Ambrosio that "The term requires a dynamic interpretation because it describes concepts that are themselves neither rigid nor singular-namely, ethno and mathematics" [1].

So it can be concluded that ethnomatematics can be regarded as special ways by a particular group in performing mathematical activities. The mathematical activity here is an activity in which there is a process of extracting from real experience in daily life into mathematics or vice versa, including grouping activities, arithmetic, measuring, designing buildings or tools, creating patterns, calculating, determining location, playing, explaining, etc. Whereas the form of ethnomathematics is the result of the mathematical activities owned or developed in the group itself, including the concept of mathematics in the cultural heritage that are very popular such as relics of our ancestors like Borobudur temple, Prambanan Temple and Yogyakarta Palace. Marsigit suggests materially, mathematical objects can be concrete objects, drawings or models of cubes, colorful symbols of large or small numbers, square pools, pyramidal roofs, pyramids in Egypt, a triangle-shaped roof of a house, a circular wheel, and so on [3]. So materially, the mathematical object is located in the environment or around us. One of the examples of ethnomatematic elements residing in Borobudur Temple, Magelang Regency, Central Java Province, which has high cultural element value is building material which related to elementary geometry especially lower grade (grade 1, 2 and 3). Geometry learning material of first grade students of elementary school is limited to the introduction of solid figure and plane figure. Geometry learning materials of grade 2 of elementary school are simple plane figure, solid figure and their characteristics. Whereas the third grade of elementary school, geometry learning materials that are studied are elements and characteristics of plane figure [2]. OECD, PISA interprets mathematics literacy as follows: "Mathematical literacy is an individual’s capacity to formulate, employ, and

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interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena. It assists individuals to recognize the role that mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged and reflective citizens” [6]. Mathematical literacy is the capacity of individuals to formulate, use, and interpret mathematics in the main context of numbers and fractions [9]. This includes mathematical reasoning and the use of concepts, procedures, facts and mathematical exercises to describe, explain, and illustrate phenomena. This leads individuals to recognize the role of mathematics in life and make good judgments and decision-making needed by constructive and reflective people. While geometry literacy of elementary school for lower grade not only on the mastery of the material but also to the use of reasoning, concepts, mathematical facts and tools in solving everyday problems [8]. In addition, arithmetic literacy also requires a person to communicate and explain the phenomena s/he faces with the concept of arithmetic in mathematics. NCTM has mathematical literacy vision that is understood as “an individual’s ability to explore, to conjecture, and to reason logically as well as to use variety of mathematical methods effectively to solve problems [7]. By becoming literate, their mathematical power should develop”. This understanding includes 4 main components of mathematical literacy in problem solving that is exploring, connecting, formulating and reasoning logically and using various mathematical methods. This key component is used to facilitate daily problem solving which at the same time develops the mathematical capabilities. Therefore, for the literacy of the geometry of lower grade elementary school focuses more on connecting and reasoning logically and using a variety of mathematical methods related to numbers and fractions. Mathematical literacy in geometric material, specifically in this study, is reviewed in the aspects of ability, namely understanding, application, and communication. It is based on the definition of mathematical literacy which refers to the individual’s ability to: a) know facts and concepts and interpret mathematics into various contexts (aspects of understanding); b) using concepts, facts, and procedures in formulating, presenting, and solving math problems (aspects of application); c) able to communicate explanation (argument) and problem solving (communication aspect). Based on some of the things that have been described, then we need to pay attention first the potential of the students, about the ability of any mathematical literacy that has been mastered and has not yet mastered. This initial step is considered important in order to create a targeted learning. Thus, it arises the desire of researchers to explore further how actually the ability of lower grade elementary school geometry literacy through ethnomathematics, especially in Borobudur Temple.

2 RESEARCH METHOD
This research method is case study research. The subjects were 30 students. 10 student from class I (S1), 10 student from class II (S2) and 10 student from class III (S3) SD. In the data collection used is the result of observation and interview.

The result of student interview is then analyzed descriptively from the three aspects of literacy in this research to facilitate in understanding the implementation of this research, the required research flow as in Figure 1.1. In Figure 1 can be described the steps of research are: 1) Introduction, in this step consists of determining the place that the requirements of ethnomathematics, in this study determined Borobudur Temple, 2) Make observation guides and interview guides, observation guides and interview guidelines that are made are just the outline of the question about what the researcher wants to know. Observation guidelines and interview guidelines that are made, do not pass the validation stage, 3) Implementation, this stage consists of data collection through observation, and interviews with 30 students consisting of 10 student from grade I, 10 student from grade II and 10 student from class III, 4) Verify the data, verify the results of data collection directly to the research, both verification of the results of observations and interviews, 5) Data analysis, analyzing the results of observations and interviews about the flat wake of Borobudur Temple, 6) Make a conclusion, analysis of data obtained from the results of interviews on the existing flat in the Borobudur Temple, 7) Data conclusion, At this stage do drawing conclusions on the results of data analysis has been done in the previous stage.

3 RESULT AND DISCUSSION
Data collection has been done on three students as research subject consisting of S1, S2, and S3 in the form of interview result.

3.1 Ethnomatematics in Borobudur Temple
From the results of ethnomathematics field observation at Borobudur temple on Saturday, 29 July 2019 obtained data in the form of documentary photographs about parts of Borobudur Temple associated with ethnomatematika, as follows table 1.
Table 1.
Ethnomathematics Objects at Borobudur Temple

<table>
<thead>
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<th>Objects at Borobudur Temple</th>
<th>Observation Result</th>
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| Students can observe that the walls of Borobudur temple consist of rectangular stone structures when viewed as a plane figure. | Can be used for:  
   1. Introducing and mentioning a form of plane figure to the students, such as the square and the rectangle.  
   2. Knowing the shape of square and rectangular plane figure shape. |

| Stupa on Borobudur temple if it is observed are perforated, the hole form a rectangular pattern. This can help in learning mathematics, especially about square plane figure. | Can be used for:  
   1. Introducing and mentioning the real plane figure shape to the students, the square and the circle.  
   2. Knowing the shape of the plane figure of square and circle. |

3.2 The Result of Geometry Literacy of Lower Grade Elementary School through Ethnomathematics at Borobudur Temple

Mathematical literacy in geometric material, specifically in this study, was reviewed in 3 aspects of ability, namely understanding, application, and communication. Researchers interviewed subjects consisting of S1, S2, and S3 with provided images of Borobudur Temple. From the results of interviews between researchers and S1, there were interesting findings when answering questions from the researcher, S1 seems to be hesitant in answering each question from the researcher. This was reasonable because the researcher and S1 barely knew each other at the time of the interview. However, from the interview result it was found out that S1 knows Borobudur Temple from The Teacher when it was explained in the classroom with short answer. Once confirmed to the teacher it turns out that students have been to Borobudur Temple when they were at playgroup and kindergarten. Maybe because S1 was too nervous then forgot to answer that s/he has visited Borobudur Temple. Additionally, S1 knew about Borobudur Temple from the school book. Nevertheless, when answering questions from the researcher, S1 said the word “Learning Book”. After that, the researcher asked questions related to “square, rectangle, and triangle” plane figure. The answer from S1 about the form of plane figure shown by the researcher was the second one that is square. It was less accurate because the required answer was rectangle. Besider, there was also inaccurate answer from S1 by pointing out with finger rectangle plane figure that was on the picture when was asked to show square plane figure. From that answer the teacher can take a lesson in introducing plane figure or solid figure to the first grade of elementary school should be drawn clearly and give real example of square and rectangle as well as their characteristics. So that the students understand that square is smaller than rectangle or that rectangle is longer than square. In the next questions, it was also found correct answer from S1 when pointing at triangle plane figure. It showed S1 has the ability to respond correctly to the questions related to triangle plane figure compared to square and rectangle plane figures. A shocking thing was gathered from the interview result with S1 that the teacher always gave them score of “100” to S1. Besides, when showing plane figures such as square, rectangle and triangle, the teacher only used the tools that were inside the classroom without bringing learning media as an effort to make the students accept the concept of plane figure through geometry literacy in elementary school level that was said by the teacher so that it can be well received by the students. After that, the teacher drew conclusions related to the introduction of square, rectangle and triangle plane figures, after that the teacher made reflection to ensure the students understanding about
the introduction of square, rectangle and triangle plane figures so that they can be received and understood by the students. From the interview result between the researcher and S2, the researcher found some uniqueness that S2 firstly knew Borobudur Temple from the television before visited Borobudur Temple in the kindergarten. Besides, the student also got information about Borobudur Temple from the teacher and the school book. The next question that was asked by the researcher to S2 was about the implementation of ethnomathematics in Borobudur Temple about the ordered pictures of “square, rectangle, and triangle”. The answers given by S2 in order was “square, rectangle and triangle”. There were two mathematical concepts that were understood by S2, such as square and rectangle. S2 correctly answered the questions that were shown by the researcher that were the pictures of rectangle and S2 answered it with the answer of rectangle. But it was different from the first answer, where the researcher gave a question of a picture of square but S2 answered with “square”. It showed that S2 did not always give stable answer in naming square. It became an attention for all of us especially as teachers in giving the concept of plane figures has to use the same naming in every explanation. So that the students are avoided from inconsistent in answering questions or giving answer as what the researcher asked. The next question, the researcher asked questions about where did S2 know about the shapes of square, rectangle and triangle plane figures. S2 answered briefly “from the teacher”. Especially in the classroom and was shown through learning media brough by the teacher when explaining the material of plane figures to the students. When the researcher asked whether the teacher asked S2 to draw a picture of square, rectangle and triangle, the student answered “Yes, I drew in the note book”. But the teacher did not show how to draw that plane figure. According to the explanations from S2, he was only asked to draw the shape of square, rectangle, and triangle in the drawing book after it was demonstrated by the teacher in the board. To be more precise, the teacher should guide the students in drawing the shapes of plane figures to the students, so that the students can difference between square, rectangle, and triangle plane figures. The interview result between the researcher and S3, it was found that S3 got the information about Borobudur Temple from the teacher when visiting Borobudur in the kindergarten. That was during study tour of the students, parents, and teachers. Beside knowing about Borobudur Temple from the teacher, S3 answered from the school book, finds and from television. After that, the researcher asked questions related to the shoes of square, rectangle and triangle. The interesting thing occurred when S3 was asked to show the buildings in Borobudur Temple that were in form of square, rectangle and triangle. S3 pointed out with pencil and directed it to the picture of square but he answered it with “square”, after that he pointed on the picture of rectangle and the word that came out was “long square” and the last he pointed out the picture of triangle and said “triangle square, eh I mean triangle”. It was a quite shocking finding, because S3 was in the third grade but the concept of plane figure is still strongly built. It was proven by the answer from S3 that pointed on the picture of square but he answered with four square. In the material of plane square there is no naming such as “four square”, there are only square or rectangle. It was one of the findings from the students’ answer that have not yet understood about the concept of plane figure. S3 was unable to match between square, square, and rectangle. Where what the student meant to mention square, but s/he mentioner if four square. From the next question, teacher gave the examples on the board through provided learning media. However, S3 have not yet understood the concept of plane figure especially in terms of naming. There was a possibility that S3 possessed different learning style from his/her other friends. Additionally, the researcher asked questions about the way how to measure the circumfere of square, rectangle and triangle. S3 was able to mention the formula of square circumfere correctly, that is “for times side “4xside”", the circumfere of rectangle is “two times length plus width (2 x (p + l ))", and the circumfere of triangle is “three times side (3 x Sisi)”. In terms answer, S3 was correct, but the initial formula was not yet mentioned by S3. Such as the formula of square circumfere that is side plus side plus side plus side (K =s+s+s+s=4xs), and next the formula of triangle circumfere is side plus side plus side (K Δ=s+s+s=3xs). Students have to know that initial formula so that the students’ understanding on the way how to count the circumfere of that plane figure easier.

4 CONCLUSION

Based on the analysis and discussion it can be concluded that the geometry literacy of lower grade elementary school through ethnomathematics at Borobudur Temple with the subjects of S1, S2 and S3 is already good. However, there is a need for a deeper understanding of the naming of each of the plane figure. In addition, this is also a homework for all of us, especially researchers as an element of practitioners in the world of education who must convey the material of plane figures that are in the Borobudur Temple to be more easily understood and remembered by lower grade elementary students.

ACKNOWLEDGMENT

The authors wish to thank the Postgraduate of Yogyakarta State University that facilited for the research. Also thanks to all participants student of primary school that supporting this research.

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