Traditional House Architecture in Geopark Ciletuh Sukabumi as Mathematical Learning Materials In Basic Education

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Abstract. The purpose of this research is to describe a mathematical element in a traditional house in Geopark Ciletuh Sukabumi. The background of this research is there is a fact in the community which states that learning is only as a benchmark to achieve grades, not based on how the student understands and solves the problems given, whereas the use of learning one of them is as a solution to solve problems in daily life. Based on this, there is concern that students will not be able to apply mathematics to solve problems in everyday life. Therefore we need a new innovation in learning that links social life or culture with material in schools such as mathematics. One solution to that problem is about ethnomathematics. The type of this research is qualitative research. Data collection techniques used in this research are an interview, observation, and documentation, then the data obtained are analyzed by using data reduction, data presentation, verification, and conclusion. The results of this study show that in the architecture of traditional house there are mathematical elements such as geometry. The results of this study can be used as an innovation and learning materials in elementary school mathematics, so it will increase students knowledge related to the application of mathematics in everyday life. It is expected that ethnomathematics may become an innovation of learning mathematics in school.

Keywords: basic education, etnomathematics, traditional house architecture,

1 Introduction

Indonesia is a country that has many tribes and cultures. The tribe applies their respective cultures in their daily lives. Sundanese tribe is one of the tribes in West Java that has a variety of ethnic characteristics, and ethnomatematics is part of that ethnic group. Etnomatematics is the relationship between culture and mathematics [1].

At present most students consider mathematics to be an abstract science whose uses are difficult to find in everyday life. There is a fact in the community which states that learning is only as a benchmark to achieve grades, not based on how the student understands and solves the problems given, whereas the use of learning one of them is as a solution to solve problems in daily life. Based on this, there is concern that students will not be able to apply mathematics to solve problems in everyday life [2].Therefore we need a new innovation in learning that links social life or culture with material in schools such as mathematics.

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According to Tandiling [3], ethnomathematics is mathematics applied by certain cultural groups, labor groups/farmers, children from certain classes of society, professional classes and so on. If viewed from the standpoint of research, ethnomathematics can be defined as the cultural anthropology of mathematics from mathematics and mathematics education. According to D'Ambrosio [4], the mathematics taught at school is known as academic mathematics, while ethnomathematics is mathematics applied to identified cultural groups such as communities, tribes, labor groups, children of certain age groups, classes professionals, and so on. So that it can be said that ethnomathematics is mathematics that appears as a result of the influence of activities that exist in a culture-influenced environment.

Mathematics as a basic science needs to examine and examine the basics of arithmetic or computation applied in society to enrich the development of mathematics. With the birth of ethnomathematics, one can see the existence of mathematics as a science that does not only take place in the classroom. Culture is a typical way for humans to adapt themselves to the environment, while mathematics is realized because of human activities [5]. According to Rosa and Orey [6], ethnomathematics presents mathematical concepts that are in accordance with the curriculum in schools by relating the daily culture and experiences of students. whereas according to Arisetyawan et al [7] the reason that ethnomathematics is important for mathematics learning in schools is that ethnomathematics can bridge the background of students' knowledge with mathematics at school. Therefore, it is expected that mathematics learning associated with the local culture will increase motivation and understanding of students' concepts and can be one of the innovations in mathematics learning in schools.

The ethnomathematics in this study is a mathematical study of the architecture of the Sundanese tribal traditional house in the ciletuh sukabumi geopark region. The purpose of this study was to find out the mathematical elements contained in the traditional house which later could be used as material for learning mathematics in elementary schools.

2 Method

This type of research is qualitative research with an ethnographic approach. According to Sugiyono [8], qualitative research methods are methods of research carried out in natural conditions and are more widely used for research in the field of cultural anthropology. Data collection techniques used in this research are an interview, observation, and documentation, then the data obtained are analyzed by using data reduction, data presentation, verification, and conclusion.

3 Result and Discussion

3.1 Sundanese traditional house architecture

Sundanese tribe is a tribe that inhabits most of West Java [9] including the ciletuh geopark area of Sukabumi. This tribe has a distinctive culture like the tribes in general in Indonesia. One of them is in terms of traditional buildings. The basic concept of a typical Sundanese building is a stage-shaped building. The shape of the stage aims to avoid problems from the environment that could threaten its inhabitants. This can be illustrated in **Figure 1.**

Fig. 1. Examples of Sundanese traditional houses

Based on the shape of the roof, Sundanese traditional houses are divided into several features, while the types are as follows:

a. Jolopong is a house with a gable that has an elongated shape.
b. Perahu Kumurep is a house with a shield roof called the Perahu Kumurep by the Sundanese people because the shape of the roof is like an upside-down boat.
c. Julang Ngapak, is a house with the shape of a roof like the wings of a flying bird.
d. Badak Helay, is a house with the shape of a roof like a rhinoceros opening its mouth.
e. Tagog Anjing, is a house with a shape like a dog sitting.
f. Capit Gunting, is a house in the form of a roof with the top crossing each other in the form of scissors.

The shape of the foundation of the Sundanese tribal traditional house is quite unique, namely, the building column is only placed on a flat rock that has been formed in nature, the purpose is to avoid cracking during an earthquake. While the shape of the stage floor aims for air circulation from under the floor to run well, it aims to reduce the humidity on the floor of the building. The floor of the Sundanese traditional house is made of "pelupuh" (bamboo which has been cleaved). The purpose of making the floor of the napkin is so that the air entering through under the house can enter the room. Walls, doors, and windows are made of woven bamboo which aims to allow air to enter the cracks of the bamboo webbing. This results in the temperature in the room not being hot. The roof of the Sundanese traditional house made of palm fiber serves to protect residents in it. The reason for choosing palm fiber as a roofing material is because palm fiber is a material that can absorb heat well so it does not cause a hot atmosphere in the house. "Tritisan" on the front of the house has a length of about 2 meters so that the walls of the building are not exposed to direct sunlight so that the walls that function as insulation do not heat and the room inside remains cold.

3.2 Mathematical elements of Sundanese traditional houses

In the Sundanese traditional house without realizing it there is an element of mathematics that can be applied as learning material in the classroom, including two dimentional figure. According to Hardi [10] two dimentional figure is a two-dimensional construct that only has a length and width, which is limited by a straight or curved line. The form of Sundanese traditional house building can be used as a medium of learning mathematics in schools, namely in the material about the introduction of the flat wake, flatness and application of the concept of the flat wake to solve problems in everyday life. By using this media, students are expected to have more knowledge about the flat builds in their neighborhoods. This is in

accordance with the opinion of Zebua [11] the results of research in the field of ethno-mathematics can be used as a contextual problem in mathematics education to support understanding of geometry.

a. Rectangle

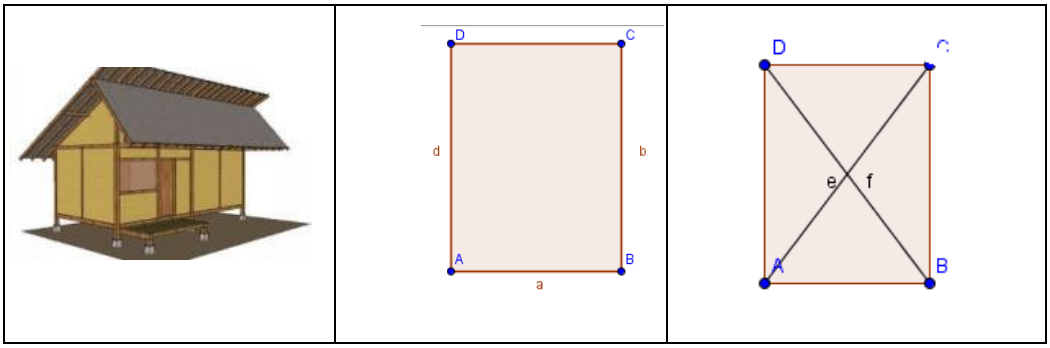

Fig. 2. Geometry analysis

In **Figure 2**, the side parts can be modeled as rectangles. In the picture, it is known that the modeling is in the form of a flat shape that has four sides. Furthermore, if further analyzed, there are several properties found between them.

1. $AB \neq CB, dan\ AD \neq CD$
2. $m\angle A = m\angle B = m\angle C = m\angle D = 90^0$
3. $AC = BD$
4. It has 2 rotary symmetries and 2 folding symmetries.

Based on the analysis of the properties of flat building it can be concluded that there are rectangular elements in the Sundanese traditional house. With students doing the analysis of the properties of a flat figure by using models that are found in their cultural environment, it will help students in understanding it. This is consistent with the opinion of Maryati [12] that the results of the learning process using cultural contexts are important in the learning process.

b. Parallelogram

Fig. 3. The roof of Sundanese traditional house

In **Figure 3**, it is known that the roof modeling of traditional Sundanese houses is in the form of a flat building that has four sides. Furthermore, if further analysis there are traits that indicate that the build is a multi-level flat building. The analysis of the properties is as follows:

1. $AB \neq CD;\ BC\ \neq AD$
2. $\angle A = \angle D;\ \angle B = \angle C$
3. Number of angles facing the magnitude 180^0

Based on the analysis of the characteristics of the flat building, it can be concluded that there are elements of parallelogram on the Sundanese traditional house. This is in accordance with Siswoyo [13] opinion that the characteristics of the parallelogram are parallel facing sides and equal lengths, angles facing the same size, diagonal angles divide the area into equals, the diagonals divide by two equal lengths.

c. Triangle

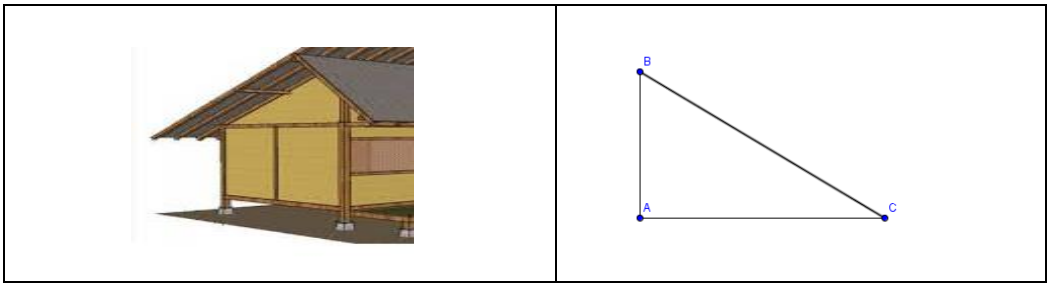

Fig. 4. The upper wall of the Sundanese traditional house

In **Figure 4**, it is known that the modeling of the upper wall of the Sundanese traditional house is in the form of a building that has three sides. If in further analysis there are properties that indicate that the build is a triangle.

3.3 Ethnomatematics concept that can be developed in mathematics learning in elementary schools

Mathematical elements contained in Sundanese traditional house architecture can be used as teachers as a medium for learning mathematics, for example in the material introducing flat shapes, congruence, building space, transformation and so on, so it will make it easier for students to carry out abstractions about geometry. This is in accordance with the benefits of learning media that according to Widyantini and Sigit [14], with learning media students can get a variety of real experiences so that learning material is easily understood and can encourage students to remember what they have learned. In addition, according to Fajriyah [15], ethnomathematics is an innovation in supporting mathematical literacy. The application of culture-based mathematics learning to mathematics learning activities is feasible [16]. By applying culture-based mathematics learning can make mathematics learning more meaningful and contextual that is closely related to the local cultural context. In addition, cultural-based mathematics learning will be an interesting, fun and innovative learning alternative because it allows the contextual meaning based on the experience of students as members of a cultural community so that they are expected to be able to support the literacy movement. The examples of application are as follows:

Look at the picture on the side!

1. What is the name of the building?
2. What is the function of the building?
3. From the picture what geometry is built into the building?
4. If the wall width is 1.3 meters and the wall length is 2.1 meters what is the wall area of the building?

Look at the picture on the side!
The triangle in building A and the triangle in building B are congruent. With a ratio of A: B is 3: 2. If the height of the triangle in building A is 2.8 meters, what is the height of the triangle in building B?

Fig. 5. An example of applying ethnomathematics

The **Figure 5** is an example of the development of ethnomathematics in mathematics learning in the classroom. From the figure, students are trained to observe directly the cultural phenomena that surround them, in this case, is observing some traditional buildings in the area. Then students are required to sketch the geometry. After students prepare a sketch, students are required to solve the problem using mathematical concepts. This can be illustrated by the following sketch in **Figure 6**.

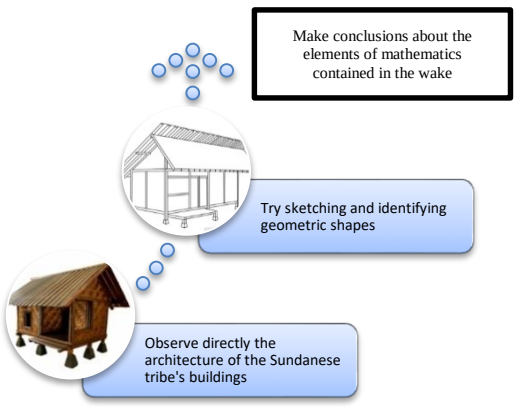

Fig. 6. The flow of the scientific method

By applying this learning, students will be trained to think scientifically. So that through the scientific method, the concept of student knowledge is formed based on scientific facts beginning with making observations. This is in accordance with the opinion of Richardo [17] who said that facts or phenomena are scientific objects that are used to build knowledge that involves elements of logic and experience. The teacher can develop more and adapt it to learning materials and circumstances in the environment. So that teachers not only convey information about course material but also about culture. Besides the application of culture-based learning in the classroom also has several advantages, this is as stated by Samo etc [18], that The application of contextual learning by integrating the local culture has several advantages such as; 1) to introduce the mathematics that exists in the culture., 2) to learn mathematics as their life activities, 3) to give introduction of culture into the right steps to encourage students to love their culture and preserve it, 4) to develop students‟ ability to think to solve the cultural context problem.

Therefore learning mathematics associated with cultural values is expected to be used as an innovation in learning mathematics. This is in accordance with the opinion of Surat [19] that learning mathematics based on culture will be an alternative learning that is interesting, fun and innovative because it allows contextual meaning based on experience. students as members of the cultural community.

Ethnomatematic application in learning is expected to develop intellectual, social, emotional, and political learning by providing cultural references and local wisdom. This is consistent with the opinion of Rosa and Oray [20] In this context, the implementation of an ethnomathematical perspective in the school mathematics curriculum helps to develop students' intellectual, social, emotional, and political learning by using their own unique cultural referents to impart their knowledge, skills, and attitudes.

4 Conclusion

From the results of this study, it can be concluded that there are mathematical elements of the architecture of Sundanese traditional house buildings that can be applied in mathematics learning including triangles and rectangles. The implementation of ethnomathematics in mathematics learning in the classroom is expected to increase motivation, scientific thinking skills and increase students' insight related to culture and local wisdom in their environment.

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