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Ethnomathematics: Geometry and Values from Architecture of the Radakng House in Sahapm Village

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ABSTRACT
Education and culture are something that cannot be separated in everyday life. Ethnomathematics is here to bridge between culture and education, especially learning mathematics. This study aims to describe matters relating to mathematics in the architecture of the Radakng house in Sahapm Village in order to obtain information in the development of ethnomathematical science towards mathematics learning. This type of research is qualitative research with an ethnographic approach. Data collection techniques used in this study are observation and documentation. The results showed that in the architecture of the Radakng house there are mathematical elements, namely, geometry consisting of rectangle, beam, square, parallelogram. The architectural form of the Radakng house in Sahapm Village, the Kanayat'n Dayak community, which is still maintained and inhabited by the community, has values that can be used in life. These values are moral, historical, and philosophical values, which can be felt, reflected, and applied in everyday life, such as values that teach communal life, togetherness, mutual cooperation, openness, mutual help, storage and family.

Keywords: *Architecture, Long House, Geometry, Local Values*

1. INTRODUCTION

Mathematics and culture are something that cannot be separated in everyday life. Culture is a typical way for humans to adapt to their environment, while mathematics is realized because of human activities. This is in line with Freudenthal's expression, "mathematics as a human activity" [1]. In line with the opinion is that mathematics is a form of culture [2]. The one thing that can bridge education and culture, especially mathematics education, is ethnomathematics. Without realizing it, people have carried out various activities using basic mathematical concepts and mathematical ideas [3].

In essence, mathematics is a symbolic technology that grows on skills or environmental activities that are cultural in nature. Based on this, a person's mathematics is influenced by their cultural background, because of what they see and feel. Culture will influence individual behavior and has a major role in the development of individual understanding, including learning that has actually been integrated with community life itself. One form of the product of a culture that we can see is architecture. In the form of architectural works, humans try to create various forms and pour them into various symbols and building concepts [2].

Ethnomathematics is a bridging relationship between mathematics and culture, ethnomathematics recognizes the existence of different ways of applying mathematics in people's lives or activities. Ethnomathematics is a research approach that examines the mathematical culture of a community group, which includes the history and philosophy of

the existence of certain mathematical concepts in the group, as well as its implications for learning mathematics [4]. In this case, the purpose of the study of ethnomathematics is to understand the belief system, thinking, and mathematical behavior of a group which can then be used as the basis for presenting meaningful mathematics learning for students. Learning mathematics in schools could be done better by exploring students' initial knowledge starting by linking formal mathematics with students' experiences in everyday life. According to Rosa and Orey [5], ethnomathematics is the application of mathematical skills, ideas, procedures, and practices that were applied in the past by members of certain cultural groups in different contexts, which are often used today in the current context.

The same thing was emphasized by Freudenthal, namely, learning must start from things that can be imagined by students, close to students, and related to students' lives [1]. Connecting culture and mathematics is an important step in recognizing the various ways of thinking that can lead to various forms of mathematics [3]. With the birth of ethnomathematics, one can see the existence of mathematics as a science that does not only take place in the classroom. Ethnomathematics presents mathematical concepts that are in accordance with the curriculum at school by linking culture and students' daily experiences [5]. It can also be interpreted that mathematical concepts can be explored and found in culture so that it is clearer that there is a link between culture and mathematics.

In Dayak culture, there are many ethnomathematics that are applied in everyday life and continue to develop without the Dayak people realizing it; one of the existing cultural products is Radakng Kampung Sahapm, a traditional house of the Dayak tribe who lives on the island of Borneo. This traditional house also has its own characteristics in the form of the building. The shape of the building is elongated and becomes the center of the Dayak settlement. The architecture of the Radakng house can be acculturated with mathematical concepts. The parts are an orderly arrangement of geometric shapes that have a mathematical aspect and there is ethnomathematics in it. Every culture has its own mathematics, because members of each particular culture have to create their own version of mathematics.

2. METHODS

This study is qualitative research with an ethnographic approach. Qualitative research methods are research methods carried out in natural conditions and are more widely used for research in the field of cultural anthropology [6]. The approach used in this research is an ethnographic approach, which is an approach that aims to investigate and obtain an in-depth description and analysis of a cultural group based on intensive fieldwork in a certain period of time. Data collection techniques use observation, interviews and documentation. The research subject is the architecture of the Radakng house in Sahapm Village.

3. RESEARCH RESULTS AND DISCUSSION

3.1 The architecture of the house of Radakng Kampung Sahapm

The Radakng house, located in Sahapm Village, is the only Radakng house in Landak Regency. The Dayak community in particular the Kanayat'n Dayak found in the village of Saham is part of the entire existing traditional community who live communally and live in the houses of the inflammation. Maintaining the tradition of rumah betang provides values that are believed by the Dayak community, namely, to always live together and side by side with others, love the peace of a harmonious community. The inflamed house of Kampung Sahapm, built in 1875, is in accordance with the statement of the traditional leader of Kampung Sahapm. At first the Betang House in Kampung Sahapm was built with only one room and now if you count from the right it is room number 7, which then connects to the left and right, and until now there are 33 rooms.

Figure 1. Radakng House Sahamp
Source: Department of Culture and Tourism (2020)

The inflamed houses in Kampung Sahapm include stilt houses whose architecture is still very

simple, namely, elongated linear stilt houses with a symmetrical pattern, and supported by an ancient technique of connecting wood construction without using nails. The roof of the Radakng house is saddle-shaped with a column structure, without ornaments. The architecture of this very traditional and simple building is associated with the social life system of the people who support the culture. The simpler and more orderly a form is, the easier it is to be accepted and understood.

3.2 Mathematical Elements in the House of Radakng Kampung Sahapm

The long house stands on wooden beams as high as ± 2 m, with a building length of ± 183 m, while the width is not the same depending on the space requirements and the ability of each occupant's family. The walls of the house are made of purchased wooden planks. If we look at the Betang Sahapm house, it can be divided into 4 parts based on the types of space used by the occupants. The form of use of this type of space is generally almost the same and is found in almost every Betang house. The type of space consists of stairs, terrace (pante), porch (sami), core room (chamber), kitchen and dango padi. The mathematical element found in the architecture of Rumah Radakng contains the concept of geometry. It has elements of plane and space figures including rectangle, beam, square, and parallelogram.

3.2.1 Pante

This part of the pante (terrace) is located at the very front of Radakng's house after climbing the stairs. Pante is an open room with a floor made of boards or battens that are arranged slightly loosely so that rainwater does not stagnate and fall directly to the ground. This room can also function for drying agricultural and plantation produces. Pante is also used by the children living in the Radakng as a playground. This pante is elongated but each room has a pante with a size of 550 cm × 440 cm, or the width of the pante is the same as the size of the room it has. The local value from the part pante is communal life, togetherness, sharing and mutual cooperation. Bale-bale is a relaxing place for residents to unwind when returning from the fields, as well as a place to gather during the day to spend free time while sharing experiences. Bale-bale also serves to receive guests who visit the Radakng house.

Figure 2. Pante
Source: Department of Culture and Tourism (2020)

Figure 3. Bale-bale
Source: Poltak Johansen 1993

The mathematical element in pante is a rectangle. Mathematical formulas can be applied to the calculation of the pante size in the inflammatory house.

Rectangle Area: L=pxl	perimeter of rectangle:
L= 550 cm x 440 cm	K=2x(p+l)
L=242000 cm2.	K=2x(550cm + 440cm)
	K= 1540 cm.

3.2.2 Sami’

Sami 'is a living room that is elongated and without a partition along the Betang or Radakng house. Judging from the existing construction on the pillars in the foyer, it can be seen that the beams make up the sami'.

Figure 4. Sami’

Source: Department of Culture and Tourism (2020)

Local values that can be applied in sami' architecture are togetherness and community life. The mathematical element in the sami' architecture is the beam. If we look at the pillars on the sami', they form a beam. The arrangement of pillars supporting the sami' forms a long row of beams along the length of the sami' house, with each block of the house having a beam formed on the existing posts on the sami'.

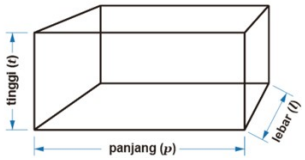

Figure 5. Beam

Volume	Surface area
$V = p \times l \times t$	$L = 2 \times (p.l + p.t + l.t)$

3.2.3 Jandela

There are Jandela or windows in every room of the Radakng house which is between the pante and sami' dividing rooms. Each cubicle has exactly one window and there is no cover on the window which symbolizes openness to the people who live in Radakng's house. Local value from this is openness and community life.

Figure 6. Jandela

The component mathematics we can connected from jandela is rectangle.

Perimeter of square	Square Area
K=4s.	$S = s^2$

3.2.4 Dango Padi

Another part of the Radakng house, although separated from the main building of the Radakng house, is the building where the harvest is storage, namely, the rice barn, or in the Dayak Kanayat'n language, it is called dango. The dango building is generally located in front of the Radakng house, although there are also those who make it behind it. This building stands alone apart from the Radakng house.

Figure 7. Dango Padi

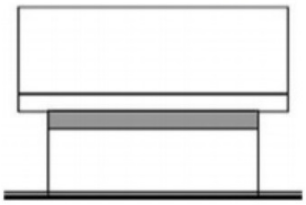

Figure 8. Sketch of Dango Padi

The value of this part is mutual help, storage and kinship. The mathematical elements of dango are parallelogram and beam.

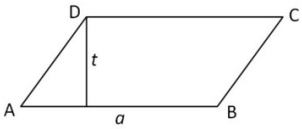

Figure 9. Parallelogram

Perimeter of the parallelogram:	Area of parallelogram:
K= 2 (length x width)	L: base x height

4. CONCLUSION

Indonesian ethnomathematics does not only stop at exploring and experimenting with culture in learning mathematics in several schools, but in the future, we can introduce it to the mathematics education curriculum in Indonesia. A learning approach involving the real things from the surrounding can be a good choice for teaching lessons. Through culture and local wisdom, a person will feel close and easy to understand mathematics. The exploration carried out on the architecture of the Radakng Sahamp house shows that there are

geometric aspects that can be applied in learning mathematics, namely, rectangles, beams, squares, and parallelograms. Not only does it contain mathematical content, the architecture of the Radakng house also has moral, historical, and philosophical values in every form of building that can be felt, reflected, and applied in everyday life, such as, values in community life, communal life, togetherness, sharing, mutual assistance. cooperation, storage and openness. Domestic life that upholds the aspects of togetherness, mutual cooperation and mutual respect can be taught to children. A thorough study of the architecture of the house including Sahamp to find the concept of geometry can be used as a starting point in teaching and learning mathematics activities at Landak Regency. It can be applied to improve understanding of geometry for students living in rural and urban areas.

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