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ETHNOMATHEMATICS OF 100-PILLARS LIMAS HOUSE AND ITS INTEGRATION IN MATHEMATICS LEARNING FOR JUNIOR HIGH SCHOOL

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Abstract

The purpose of this study is to explore ethnomathematicss elements in 100-Pillars Limas House and integrate it into mathematic learning. This research use ethnographic approach. The data are collected through interviews, observation, documentation, and test. The data obtained from observations and interviews are carried out by data analysis with the stages of data reduction, data display and verification. While the data obtained from the test will be analyzed by accumulating the test results of students who reach the KKM and then looking at the completeness of student learning outcomes. The results of this study indicate that: (1) there are several mathematical concepts, namely geometry and symmetry used in the construction of the 100-pillars Limas house structure and the philosophy that underlies each of the parts contained in the house. 2) its integration in learning mathematics is conducted to contextualize abstract mathematical objects so that the student will be easier to understanding mathematical concepts while introducing cultural elements to students. The learning outcomes of students after implementing ethnomathematicss-based learning shows that there are 88% of students who finished the integration of ethnomathematicss into mathematic learning in effective category.

Keywords: Exploration, ethnomathematics, integration in mathematics learning, 100 pillars limas house.

Abstrak

Tujuan penelitian ini adalah untuk mengeksplorasi unsur etnomatematika pada Rumah Limas 100 Tiang dan mengintegrasikannya ke dalam pembelajaran matematika. Jenis penelitian yang digunakan adalah eksploratif. Teknik pengumpulan data menggunakan wawancara, observasi, dan dokumentasi. Data yang diperoleh dari observasi dan wawancara dilakukan analisis data dengan tahapan reduksi data, penyajian data, dan penyajian data. Sedangkan data yang diperoleh dari tes akan dianalisis dengan tahapan mengakumulasikan hasil tes siswa yang mencapai KKM lalu dilihat ketuntasan hasil belajar siswa. Hasil penelitian ini menunjukkan bahwa terdapat: 1) terdapat beberapa konsep matematika yakni bangun ruang dan kesimetrisan yang digunakan dalam pembangunan struktur rumah limas 100 tiang dan filosofi yang mendasari setiap bagian-bagian yang terdapat pada rumah tersebut. 2) pengintegrasiannya dalam pembelajaran matematika dilakukan untuk mengkontekstualkan objek matematika yang bersifat abstrak agar lebih mudah memahami konsep matematika di samping itu juga bertujuan untuk mengenalkan unsur budaya pada siswa. Hasil belajar siswa setelah menerapkan pembelajaran berbasis etnomatematika menunjukkan bahwa terdapat 88,57% siswa yang tuntas dalam hal ini pengintegrasian etnomatematika dalam pembelajaran matematika dalam kategori efektif.

***Kata kunci**: Eksplorasi; etnomatematika; integrasi dalam pembelajaran matematika, rumah limas 100 tiang.*

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INTRODUCTION

Meaningfulness in mathematics learning is expected to be applied in the aspect of daily life of students, where in the students may associate mathematics with experience, social life, and local art and culture (Richardo, 2016). In line with it, Bishop (1994) stated that mathematics is a form of culture in learning mathematics with the basis of culture which is known and comprehended by the students in daily life. Culture and mathematics are interrelated which signify that, in community culture, there is mathematic element there in (Pratiwi, 2019).

Ethnomatemathics is a mathematics in a culture and human behavior in their environment. (D'Ambrosio, 1985). In line with it, Purniati, et al. (2021) stated that ethnomathematics might show to the students that culture may contribute to mathematics, therefore, the integration of culture in mathematic learning needs to conducted. It is supported by the research of Risdiyanti & Prahmana (2021) which says that ethnomathe-matics may be made as an innovation of learning mathematic with the aim that the students will love mathematics more through culture.

One of the methods for introduce culture to the students may be performed through pleasant mathematic learning, wherein the teachers must be creative in utilizing the source of learning which is usually found in the student culture (Sutarto et al., 2021). That learning process is suitable with the innovation curriculum of Indonesia, namely 2013 curriculum which emphasizes to the aspect of learning experience by means of identifying the element of local culture as the source of learning so that the students are active in learning and to create a meaningful learning experience (Nuraini, 2022). Therefore, RPP in the implementation of 2013 curriculum must accomadating the skill of 21st century (critical thinking, creativity, communication, collaboration), reinforcement of character education, and literacy in learning (Rindarti, 2018).

It is because by linking the mathematic concept and local culture, the students may assist student achievement in learning comprehensive through the material that being learned. One of them is by exploring ethnomathematics in 100 pillars Limas House which exists in the OKI territory, in Sugih Waras Village, to become a design of learning mathematic. The 100 pillars limas house is a limas house in the age of more than 100 years and still maintained up untill now. This house has 100 pillars and, even 104, because there are additional pillars in the kitchen and in the interior. There are Chinese and Arabic carvings at 100 Pillars Limas House in Sugih Waras Village (Maharanis et al., 2022).

This building has a distinctive attractiveness, such as golden color and there still antique relics inside of the house which is table guest and dressing table that are carved in 7 yellow color. The variety and form in 100 pillars Limas house have similarity with the structure of Palembang Limas house which generally constitute a form of cultural acculturation of cultural elements of Hindu- Buddha, Islam and local culture which were interpretade in a form of architectural symbolic meaning that reflect the beauty with bring out symbols as an expression of beauty. "Pangeran Rejed 100 pillars limas house" has an attractivity that designed by a traditional architect which has a quite unique value and the foundation consisted of 100 pillars that has a historical value (Maharanis, Sholeh, & Wandiyo, 2022).

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RESEARCH METHOD

This research applies ethno-graphic approach which is intended to explore mathematic idea (Shirley & Palhares, 2016). Ethno-graphic research also involve a design of learning activity from the previous exploration result (Prahmana & Istiandaru, 2021).

The data are collected through interview, observation, documentation, and test to explore the ethnomathematics element that exist in the 100 pillars Limas house. The type of interview is in-depth interview in order to dig deep every object to observed. The interview was performed to the 4th descendant of Pangeran Rejed Wiralaksana, a historian and cultural architect yet cultural conservative. Meanwhile, the test was conducted in order to see the student's learning result in ethnomathematics-based learning with the context of 100 Pillars Limas House to the students of Level VIII of Junior High School 17 Palembang.

Generally, the research proce-dure encompasses the exploration of 100 pillars limas house, learning design, and integration in the class. The results of interview, observation, and docu-mentation are analyzed by applying the theory of Miles & Huberman (1994) which encompass data reduction, data display, and conclusion drawing/ very-fication. The test results are analyzed by giving score and categorizing the learning completeness using the formula:

$$KB = \frac{NS}{N} x\ 100\%$$

Note:
KB : learning outcomes (%)
NS : the number of students who got ≥75
N : the number of students who took test

RESULT AND DISCUSSION

This research is focused on exploring ethnomathematicss element in the 100 Pillars Limas House and integrate it into mathematical learning.

Exploration of ethnomathematics Element

The 100 pillars limas house is an historical building which has built more than one century. This house has a unique structure, such as supporting pillars consisting of 100 pillars, has several storey rooms, Arabic-Chinese and mixed carvings, and each part has a distinctive philosophy of ancient people as its utility and benefit. All objects that existing in the 100 pillars Limas house has been explore for learning concept of mathematic. Based on the result of interview and observation, there is mathematical concept in the object of 100 pillars Limas house, which is geometry and symmetry.

3-D shapes has several sides. There are several concept of geometry in the 100 pillars Limas house, such as house pillars, tenggalung room, wing room, living room, botekan, foundation, and pillars in the form of tube. Based on its philosophy, the structure of pillars has different height according to the level in each room. Each room has different height in order to differentiate the guest who come according to the social status of the guest. The existence of cast system in such era causing that each guest who come to the house is placed at in different rooms. One of the rooms in "100 pillars limas house" can be seen in Figure 1.

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Figure 1. Tenggalung Room in the form of trapezoidal prism

As seen Figure I, this room is in the form of prism with the basis of elbow trapezoid. In the wall, there is hinge so that it may be opened and lifted to onto the hook which exists on the upper part of *tenggalung* room. In the past, this room is used as women's zone, as the weaving place and as seclusion place.

Figure 2. Living room of 100 pillars house

In Figure 2, living house is in the form of cuboid. This room is this place of elderly, personal in nature, may only be entered by the persons with high position in the community or community. There is an 'amben' for conducting discussion.

The concept of symmetry is seen in several objects in the 100 pillars Limas house, such as plafond, wall fence, wall craving, and two-doors window. The symmetry which principally constitute a transformation which is applied in a flat two-dimensional figure as the media. The plafond has different size, encompassing the part of long reed (intact) and short reel in order to differential the place existing in main room, *jogan* and *gegajah*. The short reed rests on the long reed, the longest size is 1/2 fathom of adult person. The size if long reed isnine fathoms which is seen in Figure 3.

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Figure 3. Plafond of 100 pillars house

Based on figure 3, the concept of symmetry existing in the plafond is seen in the arrangement of stem which is used with appropriate size along the support and must not be cut or connected in the length of 9 fathoms of adult person. The wall fence is the barrier between terrace and women's zone (*tenggalung* room) and as the resting place of wall of *gegajah* room which can be opened up. The concept of symmetry in the wall fence can be seen in each arrangement of fence which cover the *tenggalung* room. The wall carving is in the form of symmetry as combination of jasmine flower, cape flower, chrysolite which are flanked by bamboo. The existing carve is chiseled and painted. The motive of *simbar*/ tendril symbolize the description of water community/water ripple, while the motive of jar is the symbol of imperial gift. In the room, there are also dragon carving in the form of specific abstract of Palembang which is usually found in Limas house. The carving is made of gold foil in new wood, painted with gold paint can be seen in Figure 4.

Figure 4. Carving wall of 100 pillars house

Integration in Mathematic Learning

Based on the result of exploration, the mathematics concept that usually used in the learning geometry of flat faces 3D-shapes. This learning is starting from concrete matter which can be imagined by the students by using the context of 100 pillars limas house in the material of flat side geometry. It is in line with the research of Hidayat et al. (2022) which reveal the occurrence of misconception because the initial capability of students is still poor and the learning concept has not been directed to the matter known by them. It is also in line with the research of Nova & Putra (2022) which put forwards that the finding, knowledge or mathematics concept need various patterns which may bridge the concept comprehension of the students. To enrich the mathematic concept, the students must be empowered through the integration of mathematics content and culture

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which are in accordance with the life experience of the students so that it may directs to the success of mathematic learning. Therefore, the ethnomathatics role may contextualize an abstract mathematics object. The learning is designed for 5 activities, which is:

Activity 1: Identity the form of 2D-shapes

The front look of 100 pillars Limas house is formed from several two-dimensional figure, such as square, rectangle, trapezoid, etc. The learning activity is in Figure 5. From figure 5, the students have to identified the name of 2D-shapes that they found from in front of 100 pillars Limas house. Then the student was directed to draw that 2D-shapes.

Activity 2: Identified the pattern and determine the area of floor from pillars arrangement

The uniqueness of limas house is that it has 100 pillars and each floor in the room has a different height and the height difference is the same. The learning activities are in Figure 6.

Figure 5. Activity 1

Figure 6. Activity 2

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From Figure 6, students are directed to ask about the uniqueness of the arrangement of the pillars of the house, then the researcher asks students to identify whether there is a pattern found from the arrangement of the pillars, and then students are directed to ask to determine the floor surface area of the house when viewed from the arrangement of the pillars and the distance between the pillars was known.

Activity 3: Determine the surface area of the side walls and their application

With different heights for each space, the researcher directs students to analyze the pillars from each space and determine their surface area as shown in Figure 7. From Figure 7, students are directed to determine the surface area of the side walls of each room of the house and direct students to analyze the height of each room from the pattern of differences in height. Then the researcher directed students to solve contextual problems related to the surface area of the wall as shown in Figure 8. From figure 8, students are directed to determine the number of cans of wood paint needed to paint the side walls.

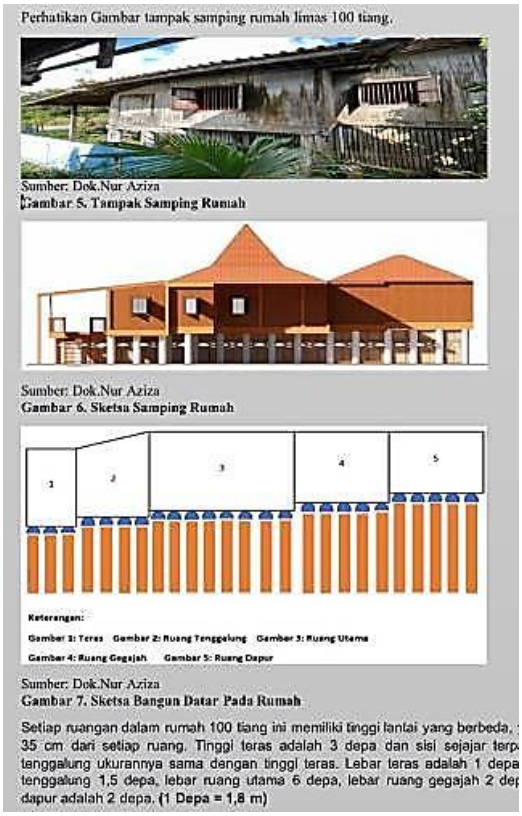

Figure 7. Activity 3 problem 1

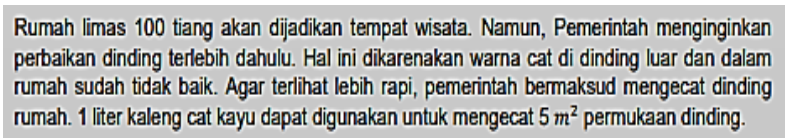

Figure 8. Activity 3 problem 2

Activity 4: Determine the surface area of the front wall and its application

The front wall of this 100 pillar Limas house has 5 walls that can be opened. Students are directed to analyze the length and width of the wall as shown in Figure 9.

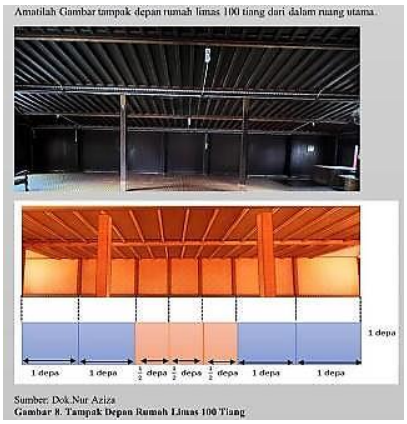

Figure 9. Activity 4

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From Figure 9, students are directed to determine the surface area of the front wall of a Limas house with 100 pillars. Then the researcher directed students to solve contextual problems related to the surface area of the front wall, namely the minimum number of cans of wood paint needed to cover the entire front wall.

Activity 5: Determine the volume of the room

Another uniqueness of this 100 pillar Limas house is that it has a room in the shape of a trapezoidal prism. Therefore the researcher directs students to first analyze the names of the mathematical shapes in that space as shown in Figure 10.

Figure 10. Activity 5

From Figure 10, students first identify the mathematical spatial structure in that space. then students are directed to determine the volume of the geometric shape with the height of the room known, the length of the parallel side is known, and the height of the base is known.

Implementation was carried out on 35 grade 8 students of Junior High School 17 Palembang. This ethno-mathematics-based learning uses the context of a 100-pillars Limas house. Students are divided into groups and carry out all activities.

After all students carry out all activities, a test is carried out to see the learning outcomes. Student learning outcomes can be seen in Figure 11.

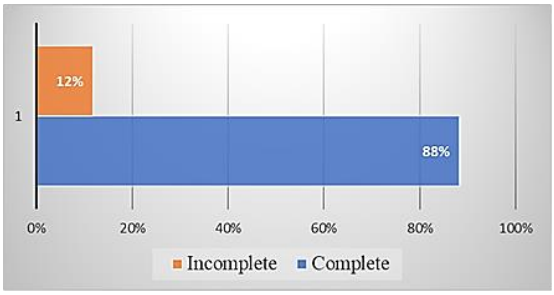

Figure 11. Completeness of student's learning result

Based on the test results, there were 88% of students who passed. If interpreted using the table of effectiveness criteria, the student learning outcomes after integrating ethnomathematicss in learning mathematics are included in the effective category.

Adam et al (2003) stated that integrating mathematical principles and methods from culture in the curriculum can help students to draw on their own mathematical experiences to better understand mathematical principles. From the results that have been explained that learning flat side shapes using ethnomathematicss of a 100-pillars Limas house, is able to make students construct the concept of the surface area itself. So, students are able to understand contextually that area is the part of the surface that is bounded by the lines that surround it.

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Ethnomatematics offers a broader view of mathematics which includes ideas, procedures, processes, methods, and practices that are rooted in different cultures and lead to increased cognitive processes, learning abilities, and attitudes towards meaningful mathematics learning (Rosa & Orey, 2016). From the results of the study it appears that students are able to recognize the fathom unit, which was a unit of measurement in ancient times before people were familiar with the standard unit of length used today. Students can also convert it in meters or centimeters. This made students familiar with the measuring system used by people at that time when building a Limas house with 100 pillars. This is in accordance with ethnomathematicss principles which aim to reposition mathematics to be anchored in culture and accommodate various perspectives for students to become critical, democratic, and tolerant thinkers (D'Ambrosio, 2016).

From the results of the implementation, it was found that students were very enthusiastic in learning geometry using ethnomathematicss of a 100-pillars Limas house. Students also actively collaborate with their group mates to solve problems together. Students are also active in asking the teacher on any problems they do not understand. This is in accordance with the objectives of the 2013 curriculum which expects aspects of learning experience to emerge by identifying elements of local culture as learning resources so that students are active in learning and create meaningful learning experiences (Nuraini, 2022).

As an activity in learning, culture can be used to investigate the principles of mathematics as part of a transformational approach to bring mathematics closer to people's lives and used to help students learn mathematics at school (Prahmana, 2021). From the results of the study it was found that students were able to solve everyday problems using ethnomathematics of a 100-pillars Limas house. Students can determine the number of cans of paint needed to cover all surfaces of the walls of a house by using the concept of surface area. Therefore, in reality mathematics cannot be separated from culture because mathematics is a socio-cultural construction and a cultural phenomenon, so that mathematics has a very important role to meet the needs of human life in the sense of solving and solving a problem in everyday life (Muzakkir, 2021).

CONCLUSION AND SUGGESTION

The results of the exploration of ethnomathematics elements in the 100-pillars Limas house show several mathematical concepts such as 3D-shapes and symmetry. The spatial concept can be seen in the pillars of the house, the tenggalung room, the wing room, the living room, the rooms, the botekan, the footprints, and the cylindrical pillars. In addition, the symmetrical material can be seen in the ceiling, the tenggalung fence, wall carvings, and the two-door window found in the 100-pillars Limas house.

Its integration in learning mathematics is done to contextualize abstract mathematical objects so that it is easier to understand mathematical concepts while also aiming to introduce cultural elements to students. Student learning outcomes after implementing ethnomathematics-based learning show that there are 88% of students who complete the integration of ethnomathematics in learning mathematics in the effective category.

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