e-ISSN: 2549-5070
p-ISSN: 2549-8231

Journal of Medives : Journal of Mathematics Education IKIP Veteran Semarang
Volume 7, No. 2, 2023, pp. 287 - 297

https://doi.org/10.31331/medivesveteran.v7i2.2627

Ethnomathematics: Utilization and Introduction of Geometry Buildings Using Janur (Coconut Leaf)

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***Received**: May 2023. **Accepted**: June 2023. **Published**: July 2023.*

ABSTRACT

One area of mathematics that requires a good understanding and depiction of abstract concepts is geometry. Therefore it is necessary to apply realistic learning. One type of realistic learning is ethnomathematics. Ethnomathematics is a bridge between mathematics and culture by linking culture and students' everyday experiences. Traditional crafts that can be lifted are creations from coconut leaves (janur) which can be formed into various kinds of craft creations that contain geometric shapes. The type of research used in this research is descriptive qualitative research. Data collection was used through literature and interviews. The results of the research show that creations from coconut leaves (janur) can be geometric shapes that can be used as ethnomathematics objects. These forms include (1) coins that can be made into hexagons, (2) kerises that have elements of equilateral triangles, right triangles, and parallelograms, (3) diamond bricks that have elements of square geometry lengths and blocks, (4) balls (balans) which have square and cube geometry elements, (5) sinta diamonds which have rhombus geometry elements and rhombus upright prisms. Other geometric elements contained in the janur creations are congruence, angles, and symmetry.
***Keywords**: ethnomathematics, geometry, coconut leaves.*

How to Cite: Saputri, D., & Br Ginting, S. (2023). Ethnomathematics: Utilization and Introduction of Geometry Buildings Using Janur (Coconut Leaf). *Journal Of Medives : Journal Of Mathematics Education IKIP Veteran Semarang, 7*(2), 287 - 297.

INTRODUCTION

Humans have the potential to produce or create a new work by using the materials around them. This knowledge is passed down from generation to generation as a tradition (Efriani et al., 2019) .By producing work from his own hands, it will make these humans have skilled and innovative experience both in terms of producing goods or being creative in creating innovative ideas to help the learning process. North Nias Regency, which includes the Lahewa Village area and other coastal areas, has a variety of different cultures. Especially for coastal areas which are rich in coconut trees (Janur) have handicrafts in the form of woven and the like.

Woven is the process of crossing or netting materials that usually come from plants (Tocharman, 2009). Webbing can be divided into four types of webbing, namely: single cross woven, double cross woven, three-axis woven and four-axis woven. Weaving is one of the traditional crafts known in North Nias. Weaving is done in spare time, individually or in groups. The collection of raw materials is carried out by men and women. Processing and heavy work is done by men, while women do lighter work. The raw materials usually used for woven are pandan leaves, bamboo, rattan, banana leaf fronds, palm roots, palm leaves, and others. Woven goods produced such as mats, hats, baskets, baskets, food caps, fishing tools, hunting tools, and so on. However, what will be discussed is woven from coconut tree leaves, which produce goods in the form of roofs, rhombus wrappers, decorations for weddings and so on. It can be said that the woven is traditional because this craft has been passed down from generation to generation and still always retains the techniques, shapes and motifs that they have received from generation to generation. From the previous discussion, there are mathematical aspects related to woven crafts, namely tessellation/tiling.

Mathematics is the science of logic regarding shape, composition, quantity, and concepts related to each other in large numbers, but broadly speaking it can be divided into three fields, namely algebra, analysis, and geometry. (Djara et al., 2021) said that mathematics is a tool and supporting science for other branches of science to get solutions to various problems that arise. Mathematics is often considered a difficult subject and is disliked by students so that it can cause a decrease in learning motivation and this will lead to a decrease in student learning outcomes and achievement. Meanwhile, (Fauzi & Arisetyawan, 2020) said that learning difficulties were grouped into three types, (1) students' difficulties in using concepts, (2) students' difficulties in using principles, and (3) students' difficulties in solving verbal problems. In terms of concepts, one of the fields of mathematics that requires the ability to understand and draw good abstract concepts is geometry. Therefore, innovation is needed in the learning process, so that mathematical concepts will be firmly embedded in students.

An alternative to overcome this problem is the application of realistic learning. According to (Herawaty, 2018) realistic learning itself is the use of reality and the environment that students have recognized so that learning can run smoothly and can achieve better learning goals. This is consistent with research that there is a strong correlation between the level of students' enjoyment of mathematics and realistic learning (Rahmawati & Muchlian, 2019). One type of realistic

learning is ethnomathematics.

(Sutrimo et al., 2023)., said that mathematics is a form of culture. Mathematics as a form of culture has actually been embedded in aspects of people's lives as a whole or as a whole wherever they are. The bridge or wedge between mathematics and culture is called ethnomathematics (Mar et al., 2021). Ethnomatematics is a lens for viewing mathematics as a cultural object (Puspadewi & Putra, 2014). Ethnomatematics can also be interpreted as a program that has the goal of learning how students can understand, articulate, process, and finally use mathematical ideas, concepts, and practices so that they can solve problems related to daily human activities (Afifuddin, 2022). Ethnomatematics presents mathematical concepts that are in accordance with the curriculum in schools by linking students' culture and everyday experiences (Rosa & Orey, 2011). According to (Imswatama & Zultiar, 2019), with ethnomathematics it can bridge the background knowledge that students already have with mathematics lessons at school. Thus, it is hoped that learning linked to culture can increase learning motivation and students' understanding of concepts as well as being an innovation in learning mathematics. In addition, by providing an understanding related to culture will also give cultural emphasis to students. This emphasis is intended so that students can get used to and in a sustainable manner apply the nation's cultural values in their lives (Oktavia & Suparni, 2021).

One of the traditional crafts that can be lifted is the creation of coconut leaves (janur). Creations from coconut leaves are commonly used in areas such as Nias and several other areas as a means of supporting the implementation of traditional ceremonies and weddings. In addition to traditional ceremonies and weddings, it turns out that janur can also be formed into various kinds of handicraft creations that contain geometric shapes.

Based on the description above regarding the relationship between mathematics and culture, this study aims to explore ethnomathematics in several coconut creations related to geometry. Geometry itself is material that is taught at various levels of education, such as the introduction of flat shapes in class V of elementary school (SD) semester 2, flat shapes (rectangles and triangles) in class VII Junior high school (SMP) semester 2, building flat sides in class VIII Junior high school (SMP) semester 2, and geometric shapes space in class IX (SMA) Senior High School semester 1. So much geometry material at several levels of education shows that this geometry material is very important. In addition, the absence of research related to the application of geometric shapes in coconut creations is also one of the considerations for conducting this research.

METHOD

In general, the research method is a scientific activity carried out to obtain valid data with specific goals and uses (Sugiyono, 2020). The type of research used in this study is descriptive qualitative research, because the data was extracted and obtained through interviews, literature studies and related searches on the internet, then the data is presented in the form of a description of the sentence. The subjects in this study were the people of North Nias Regency which were represented by a villager of a woven craftsmanship and a teacher located in a school in North Nias District. While the objects in this study are the mathematical elements in the

woven handicrafts of the people of North Nias Regency.

1. Method of collecting data

The data collection method used is as follows :

a. Literature review. Researchers collect information and data from written sources contained in various reference books, journals, papers and so on which are used as research material.

b. Interview. Researchers conducted question and answer with research subjects directly. The questions asked were about weaving in the people of North Nias Regency, as well as about tessellation learning in a school in North Nias Regency.

2. Data analysis method

Data obtained through interviews with 2 subjects. After the researcher has obtained the data, the next step is to sort the data and analyze the data in a qualitative descriptive way to find out the mathematical elements contained in the woven handicrafts and the possibility of using these mathematical elements to help the tessellation learning process.

3. **Research implementation procedures Overall**

a. Identify the problem

At this stage, the researcher saw that there was a mathematical element in the woven crafts, because there were flat wake patterns there.

b. Analyze and Formulate Problems

After the problem is identified, the researcher conducts an analysis so that the problem can be formulated clearly. Obtained the formulation of the problem as follows:

- What are the mathematical concepts that can be found in woven handicrafts?
- Can the mathematical concepts found in woven art be used to deepen students' understanding of congruent plane shapes?

RESULTS AND DISCUSSION

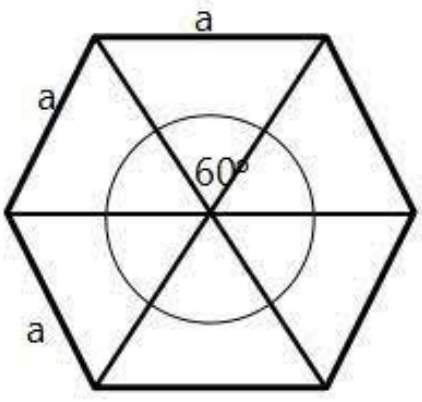
Coconut plants (Cococs nucifera L.) have an important role for people's lives in Indonesia, both in the economic, social and cultural sectors (Kriswiyanti, 2012). One part of the coconut plant is the leaf. Janur is a young coconut leaf that has a golden yellow color and is easily available all over the country. Janur is widely used in areas such as North Nias, one of which is for traditional ceremonies/religious ceremonies, making roofs for houses and ketupat skins. If you look at some creations from coconut leaves, you will find geometric shapes that can be used as ethnomathematics objects.

Various kinds of coconut creations Here are some examples of coconut creations which contain the mathematical concept of geometric shapes (flat shapes and geometric shapes).

1. Coins

Pigure 1. Coins

If the coins above are modeled geometrically, they will form a shape that has 6 sides. Next, the researcher analyzed the concept of the wake.



Pigure 2. Construct a coin model hexagon

Based on the analysis of the image above, it can be seen the concept of a regular hexagon flat shape. The properties that can be found in modeling coins are as follows: Has six sides of the same length, has six angles that are the same size, has six axes of symmetry, forms 6 triangles that are congruent with each forming an angle that is the same size, namely $\frac{360^{\circ}}{6} = 60^{\circ}$.

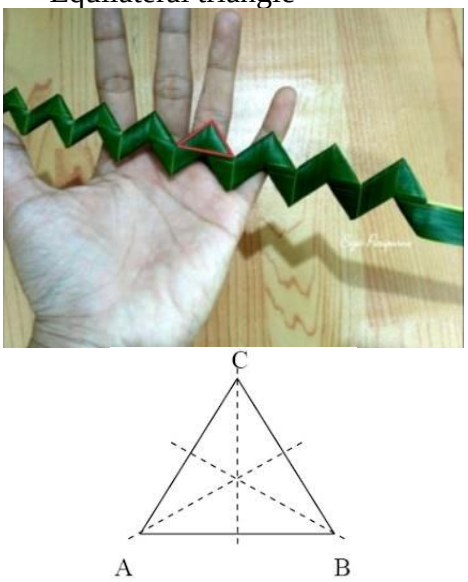
This material is studied in grade 5
Problems example:
In the picture, the hexagon-shaped leaf has 6 sides of the same length and the side length is 2 cm. Based on the side lengths, calculate the perimeter of the hexagon!
Is known : s = 2 cm . Asked : K(keliling/perimeter) ?
Answer :
Perimeter of the hexagon that is? : K = 6 × s

2. Kerises

Pigure 3. Kerises

From the picture above, it can be seen that there are several models of flat shapes, namely:

a) Equilateral triangle

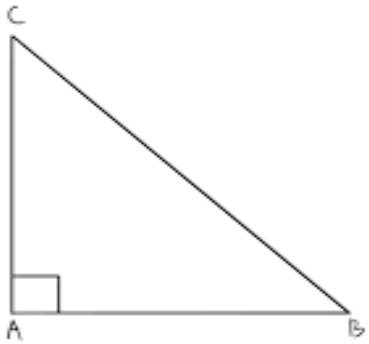


Pigure 4. Build an equilateral triangle modeling kerises

Based on the geometric modeling above, it can be seen that the concept of a plane shape is an equilateral triangle with the following properties: AB = BC = CA, Angle A = Angle B = Angle C, which is 60°, Has 3 fold symmetries and 3 rotational symmetries.
This material is studied in grade 6.
Problems example :
Sarah made a creation in the form of an equilateral triangle. The coconut mat has a length of 3 cm and a height of 4

cm. How wide is the bay?
Is known : a = 3 cm, t = 4 cm
Asked : Wide (Luas) = ... ?
Answer : Wide (Luas) = ½ x a x t

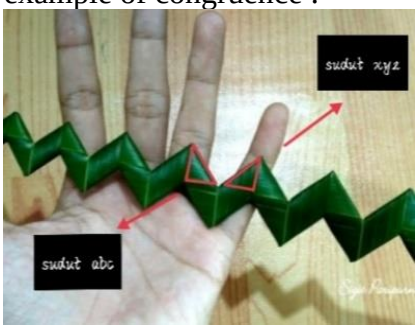
b) Right triangle



Pigure 5. Build a right-angled triangle modeling kerises

Based on the geometric modeling, the concept of a right-angled triangle is found with the following properties: One of the angles is 90° (right-angle), namely at angle A, the hypotenuse (hypotenuse) is in front of the right angle.

An example of congruence :

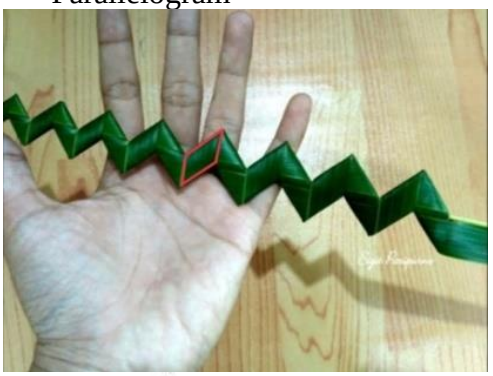


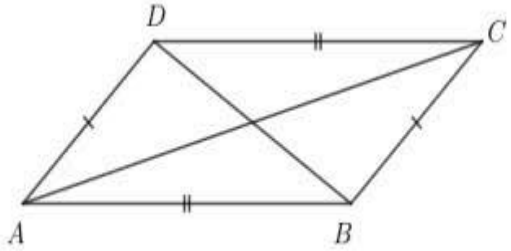
In the picture above it is known that triangle abc is congruent with triangle xyz. If ∠b= 35 then determine ∠y

Answer :

Since both are congruent then ∠y=∠b = 35°.

c) Parallelogram





Pigure 6. Build a parallelogram modeling kerises

Based on the modeling above, we get the concept of a parallelogram with the following properties: 2 opposite sides are the same length, namely AB = DC and BC = AD, has 4 angles where the successive angles add up to 180° (angle A+B = angle B+C = angle C+D = angle D+A = 180°) , Has no axis of symmetry, Has 2 diagonal lines, namely BD and AC.

3. The Ketupat Brick

a) Rectangle

Pigure 7. The ketupat brick seen from above

From the picture, it can be used as a model as below

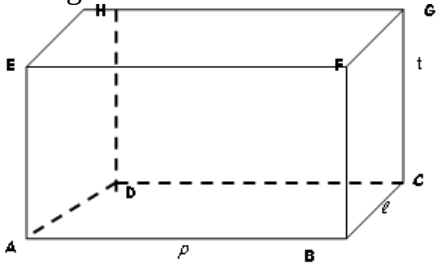
Pigure 8. Build a brick rhombus modeling rectangle

The model above is a rectangular flat wake concept with the following properties: Opposite sides are the same length (AB = DC and BC = AD), All four angles are 90°.
This material is studied in class 4.
Problems example:
It is known that a rectangular janur creation has a length of 8 cm and a width of 3 cm. How much area does the rectangle have?
Answer: L = p x l

b) Block

Pigure 9. Ketupat brick seen from the side

From the figure, the geometric modeling is obtained as shown below



Pigure 10. Build a brick rhombus modeling block

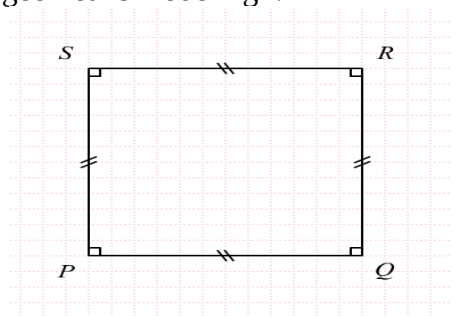
After being analyzed, we get the concept of a beam shape in the existing model. Then the following properties are known: Has 6 sides, Opposing sides are equal, Has 8 vertices, Has 12 edges that are not the same length, Has 4 diagonal spaces, Has 12 diagonal planes.
This material is studied in grade 5.
Problems example:
A block formed from coconut leaves has a length of 10 cm, a width of 8 cm, and a height of 5 cm. Calculate the volume of the block!
Answer:
V = p x l x t

4. Ball (Bal-balan)

a) Rectangle

Pigure 11. ball seen from above

From the picture it can be obtained geometric modeling :



Pigure 12. Build a modeling square out of balls

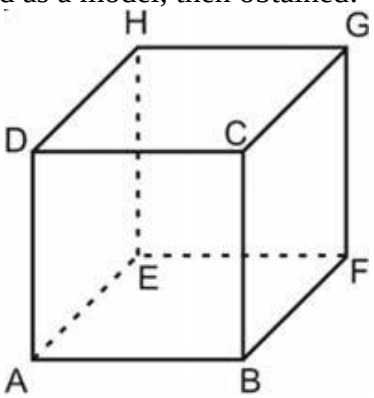
From the geometric modeling, the concept of a square shape is obtained, then after analysis, the following properties are obtained: All four sides are the same length, All four angles are

equal, namely 90°, Has 4 rotational symmetries and 4 fold symmetries.
Problems example :
If a square leaf has a side size of 4 cm. Calculate the area of the square!
Completion :
L = s × s

b) Cube

Pigure 13. The ball is seen from the side

If used as a model, then obtained:



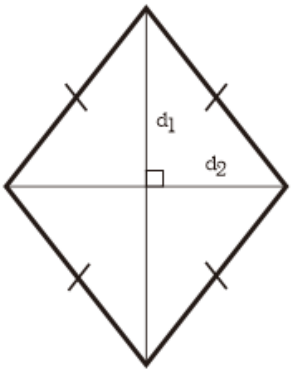
Pigure 14. Build a spherical modeling cube

The model above is a cubic geometric concept, then analyzed and obtained the properties: Has 6 equal sides in a square shape, Has 12 edges of the same length, Has 8 vertices, Has 4 diagonals of equal length, Has 12 diagonal planes
This material is studied in grade 7
Problems example:
Haris wants to form a cube-shaped box from coconut leaves. If the box has a side length of 5 cm, find the area of the leaf needed by Haris? Is known: r = 5 cm
Surface area of the cube = 6s2
Sita's ketupat

a) Belah ketupat

Pigure 15. Sita's ketupat seen from Above

Geometry modeling from the image above :



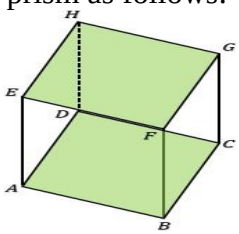
Pigure 16. Build a rhombus modeling the rhombus sinta

From the modeling, we get the concept of a flat rhombus shape with the following properties: All four sides are the same length, The two diagonals are axes of symmetry (AC and BD), The two diagonals divide by 2 equal lengths and intersect perpendicularly, Has 4 rotational symmetries so that they can occupy the frame in 4 ways
This material is grade 7 lessons.
Problems example:
Ayu makes a ketupat whose base and top surface are in the form of a rhombus, which has a side length of 8 cm. What is the circumference of the

rhombus?
K = 4 x Side
b) Rhombus upright prism

Pigure 17. Sita's ketupat seen from the side

From the figure, the modeling is obtained, namely the geometric shape of a rhombus upright prism as follows:



Pigure 18. Construct a rhombus upright prism modeling the sinta rhombus model

From the modeling, the properties are: Has 6 sides, Has 8 vertices, Has 2 parallel and congruent sides, Has 12 edges.

HOW TO TEACH JANUR CREATIONS TO STUDENTS

Coconut creations can be used as props to teach flat shapes and geometric shapes. Educators can show coconut creations in front of students. Furthermore, students are asked to make observations related to the shapes that can be found. Then students are asked to discuss the properties of geometric shapes based on the observations made, such as how long the sides are, the size of the angles, rotational symmetry, folding symmetry, and so on. After that, the educator's task is to straighten out the concept if there are misconceptions in students.

The purpose of studying ethnomathematics in learning mathematics in the classroom is that the relationship between ethnomathematics and culture is easier to understand, so that students' and society's perceptions of mathematics can be more precise and easier to understand, because they are no longer considered something foreign. The application and benefits of mathematics for the lives of students and society can be optimized, so that more optimal benefits will also be obtained.

MATHEMATICAL ELEMENTS IN WICKER CRAFTS FROM JANUR

The flat shapes contained in woven leaves made by the people of North Nias district are parallelograms, which then three parallelograms form a hexagon and six parallelograms form a twelve-sided flat shape. So it can be said that the woven crafts of the people of North Nias district contain elements of mathematics. Because it contains elements of mathematics, of course the results of this woven craft can be used in learning in the classroom, especially as a learning resource.

Some of the mathematical elements in the woven patterns include congruence, angles, symmetry, and so on. Learning that incorporates ethnomathematics originating from woven crafts will add to students' insight into the existence of mathematics in one of the cultural elements they have, increase motivation in learning and facilitate students in associating the concepts learned with real-world situations.

CONCLUSION

Mathematics and culture are two things that are interconnected. This relationship is known as ethnomathematics. Mathematical concepts can be found in a culture, for example the traditional crafts of coconut leaves. Janur made in such a way, it

turns out that it can contain geometric shapes, both geometric shapes and plane shapes, which can be used to teach these concepts to students. Ethnomatematics in this woven craft can be used as a source of learning in learning, broaden students' insight into the existence of mathematics that exists in one of the cultural elements they have, increase motivation in learning and facilitate students in linking the concepts learned with real world situations. This is certainly a new and unique breakthrough so that it can also increase students' interest in learning. During the learning process, students can also be invited to make coconut creations because less and less people are able and willing to make these coconut creations. According to (Febriyanti et al., 2018) that the behavior of today's children has changed both intentionally and unintentionally following globalization. Therefore, the application of ethnomathematics in the form of visual aids for coconut creations can also help preserve regional culture which is increasingly being eroded by the flow of civilization for the younger generation. For researchers in the future, it can provide innovations such as replacing leaf leaves with other materials that are easy to find, such as ribbon. This is because during the process of making the teaching aids the researchers encountered obstacles in finding coconut leaves, because not all coconut trees have coconut leaves that can be used. In addition, the characteristics of the leaves that easily wither also cause the leaves to not be used for a long time, so that they must be renewed continuously..

ACKNOWLEDGMENT

The author would like to thanks for all participants who have been involved in the preparation of this journal.

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