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EXPLORATION OF ETHNOMATHEMATICS IN SAUNG RANGGON OF CIKEDOKAN VILLAGE CIKARANG BARAT THROUGH GEOMETRY LEARNING

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ABSTRACT

The aims of this study were to (1) understand the concept of geometry with geometric material, (2) understand the concept of geometry with geometric material, (3) understand the concept of geometry with geometric transformation material, and (4) understand the development of numeration contained in the design. Saung Ranggon traditional house. This study is a qualitative research conducted using an ethnographic approach to explore and understand the concept of geometry through the use of geometric materials and geometric transformation materials, as well as the development of numeration within the design of the Saung Ranggon traditional house. The data collection techniques used in this study included interviews, observations, documentation techniques, and data analysis using triangulation techniques with the Spradley model consisting of domain analysis, taxonomic analysis, and component analysis. The results of this study are the geometric concepts contained in the design of the Saung Ranggon traditional house, namely, the concept of a flat shape (a rectangle that can be seen from the door, a square that can be seen from the side wall, a triangle that can be seen from the ventilation section, a trapezoid that can be seen from the back wall, a rhombus that can be seen from the fence section, and circles that can be seen from the old well), the concept of geometric shapes (tubes), the concept of transformation geometry (reflection on the $y = x$ axis, $y = -x$ axis, y axis), and numeration development are used to solve the cost problem.

Keywords: Traditional House, Ethnomathematics, Geometry Learning, Numeration Development

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PRELIMINARY

Indonesia possesses cultural diversity that characterizes it as a multi-ethnic nation. (Daiman & Iswahyudi, 2019). The diversity of culture in Indonesia is a combination of various kinds of traditional culture from Sabang to Merauke, was a particular feature of the uniqueness of the regions spread over the 37 provinces (Hartanti & Setiawan, 2019). Thus, the uniqueness of culture in Indonesia is reflected in movement, traditional food, customs,

clothing, musical instruments,and houses. As a result, culture, which is the work and creation of human feelings, shows that humans live their lives with reason and thoughts (Rahmawati & Muchlian, 2019). One important aspect of the cultural values passed down is reflected in the traditional house (Safitri & Priscilla, 2022).

Traditional houses can study culture in the field of education, namely, mathematics (Kurino & Rahman, 2022). The structures of traditional house buildings, such as roofs, window sills, and doors, are always related to the concept of geometry; therefore, mathematics has been a part of the culture for centuries (Yuniar et al., 2022). Thus, it can be concluded that mathematics is a part of everyday life. One alternative that can link culture with mathematics is ethnomathematics (Bito et al., 2021).

As an illustrative study, there are traditional houses in West Java, particularly in Bekasi, one of which is the Kranggan Stage Traditional House (Liaupati et al., 2022). This building is characteristic of the Sundanese style in West Java. The roof of this building is in the form of a triangular prism because there are two congruent triangular sides, and all other sides are parallelograms. Each building has an ethnomathematics meaning because buildings are inseparable from geometric material, and every building in Indonesia has a culture such as traditional houses and mosques (Ba'ru & Ranteallo, 2019). Ethnomathematics can also be considered a program that aims to investigate how students understand, articulate, process, and finally apply mathematical ideas, concepts, and methods to solve everyday problems (Ditasona, 2018). Meanwhile, ethnomathematics facilitates students in constructing mathematical concepts (Widada et al., 2019).

Previous research related to ethnomathematics in traditional houses found that there are geometric concepts in traditional house buildings, in particular, "Ethnomathematics Exploration of Geometry Concepts in Joglo Pati Houses" on geometric concepts such as lines, angles, flat shapes, Pythagorean theorem, geometric shapes, congruence, and geometric transformations (Kholisa, 2021). "Ethnomathematics and Geometry Exploration in "Rumoh Aceh" discovered mathematical concepts and geometric concepts (Azmi et al., 2021). "Ethnomathematics Exploration at the Joglo Sinom Limas Traditional House" found geometric concepts, namely points, lines, space, geometric transformations, symmetry, flat shapes, spatial shapes, congruence, and congruent (Susanto et al., 2022). "Ethnomathematics Exploration at Rumah Kebaya Betawi" found mathematical concepts regarding integers, equivalent ratios, angles, one-dimensional geometry, two-dimensional geometry, three-dimensional geometry, transformation geometry, congruence and congruence of flat shapes (Nisa et al., 2022).

Judging from previous research, this study only focused on exploring traditional houses related to geometric materials. The difference between this research and previous research is in the aspect of numeration. The researcher will carry out an update by adding numeration aspects to the Saung Ranggon Cikedokan Traditional House with geometric materials.

Based on the results of the data, it can be concluded that the researcher will take the research object regarding traditional houses or traditional houses in the West Cikarang area, which are still maintained today, namely, the Ranggon Traditional House or Saung Ranggon. Saung Ranggon will be used as a research object that can be linked to culture and mathematics. So the researcher is interested in conducting research with the title "Exploration Of Ethnomathematics In Saung Ranggon Of Cikedokan Village Cikarang Barat Through Learning Geometry."

METHODS

This study used qualitative research (Rahmadani & Reflina, 2023). This study used utilized an ethnographic approach (Diniyati et al., 2022). The data collection techniques used in this study included interviews, observations, and documentation. In this study, researchers will conduct interviews using a semi-structured interview technique that is already in-depth to find more open issues, and researchers ask for opinions and ideas from informants (Herlina et al., 2018). In this study, the researcher who will be interviewed is the caretaker of Saung Ranggon Kuncen, Kuncen Mrs. Raden Nyi Sri Sumiati (Emak Encup Sumiati) (Nisa et al., 2022). Researchers use participatory observation techniques to observe the behavior of research subjects, in which they only visit research locations and remain passive observers (Septi, 2018). The technique of reviewing documents in this study is intended to record what is the information written in documents or archives related to the problem under study and then try to understand the intent or meaning. The purpose of this documentation method is to obtain secondary data on the Saung Ranggon traditional house. Data analysis uses triangulation techniques with the Spradley model, which consists of domain, taxonomic, and component analyses.

RESULT AND DISCUSSION

The traditional house that is the object of this research is Saung Ranggon's. Saung Ranggon traditional house is located on Jl. Cikedokan, RT.002/RW.08, Cikedokan, West Cikarang District, Bekasi Regency, West Java 17530.

Figure 1. Saung Ranggon

This traditional house was the hiding place of Prince Rangga from the VOC colonial era. In 1619, Prince Rangga, the son of Prince Jayakarta, fled after the defeat of Prince Jayakarta from the VOC. After this defeat, Prince Rangga looked for a place far from the reach of the VOC so that he would not be found. Therefore, a 7.6-meter by 7.2-meter house on stilts was built with a building height of approximately 2.5 meters. Then in 1821, Saung Ranggon was rediscovered by Mataram Abbas troops named Raden Abbas. The Saung Ranggon traditional house has been around since the Dutch colonial era in Indonesia, which is around the 16th century.

Two-dimentional figure

A flat shape is a flat plane composed of dots or lines that unite to form a 2-dimensional shape with circumference and area. The flat shape found in the Saung Ranggon traditional house includes the following features:

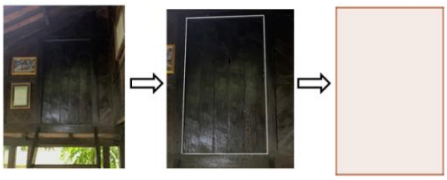


Figure 2. Rectangular

A flat shape is a flat plane composed of dots or lines that unite to form a 2-dimensional shape with circumference and area. The flat shape found in the Saung Ranggon traditional house includes the following features:

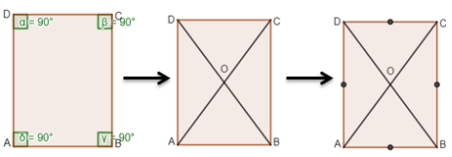


Figure 3. Rectangular Properties

Based on the analysis in Figure 3, there are the properties of the rectangle found in Figure 3 as follows:

1. Each corner is the same size $(\angle A = \angle B = \angle C = \angle D = 90°)$
2. The diagonals are the same length $(BD = AC)$
3. The diagonal bisect each other $(AO = OC = BO = OD)$
4. It has 2 axes of symmetry and 2nd degree rotational symmetry
5. $AB = DC$ and $AD = BC$ and $AB \,//\, DC$ and $AD \,//\, BC)$

Figure 4. Square

In addition to the rectangular shape, there is a sidewall in the form of a square flat wake. Based on this, researchers will analyze the results of the flat wake concept on the sidewalls of the Saung Ranggon traditional house.

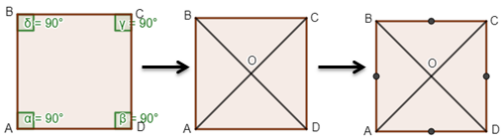


Figure 5. Square Properties

Based on the analysis in Figure 5, there are the properties of a square found in Figure 5 as follows:

1. Each corner is the same size $(\angle A = \angle B = \angle C = \angle D = 90°)$
2. The diagonals are the same length $(BD = AC)$
3. The diagonals are perpendicular to each other and bisect each other $(AO = OC = BO = OD)$
4. It has 4 axes of symmetry and 4 degrees of rotational symmetry
5. $AB = BC = CD = AD$ and $AB \,//\, CD$ and $BC \,//\, AD)$

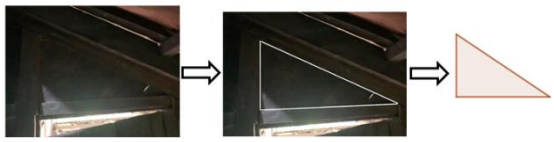


Figure 6. Right Triangle

In addition to the rectangular and square shapes, there is a triangular flat-shaped vent. Based on this, researchers will analyze the results of the flat wake concept in the ventilation section of the traditional Saung Ranggon house.

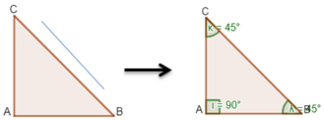


Figure 7. Properties Of a Right Triangle

Based on the analysis in Figure 7, there are the properties of the triangles found in Figure 7 as follows:

1. There is 1 slanted side and there is 1 elbow corner
2. It has two sides that are perpendicular to each other

Figure 8. Right Trapezoid

On the inside of the Saung Ranggon traditional house, there is a wall inside the traditional house in the form of a trapezoidal flat shape. Based on this, the researcher will analyze the results of the flat building concept on the inside of the walls of the Saung Ranggon traditional house.

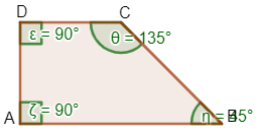


Figure 9. Properties Of a Right-angled Trapezoid

Based on the analysis in Figure 9, there are the properties of the triangles found in Figure 9 as follows:

1. There is a pair of opposite sides and $AB//DC$
2. There are two right angles $\angle A$ and $\angle D$

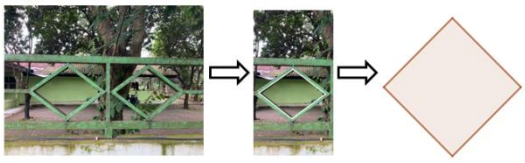


Figure 10. Rhombus

There is an outer fence with a flat rhombus shape. Based on this, the researcher will analyze the results of the concept of flat construction on the outside fence of the Saung Ranggon traditional house.

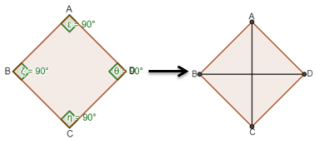


Figure 11. Rhombus Properties

Based on the analysis in picture 13, there are rhombus properties found in picture 13 as follows:

1. $(AB = BC = CD = DA)$ and $(\mathrm{AB}//DC$ and $BC \,//\, AD)$
2. It has two fold symmetries and a rotary symmetries
3. It has opposite angles that are equal and bisected by its diagonal $(\angle A = \angle C, \angle B = \angle D)$

Figure 12. Circle

In addition to the kites and ketupat shapes, an old well has existed since the founding of the Saung Ranggon traditional house. When viewed from above, the old well appears flat in the form of a circle. Circumference Formula (Alfina et al., 2021):

$$K = \pi \times d$$
$$K = 2 \times \pi \times r$$

Circle Area Formula

$$L = \pi r^2$$

Figure 13. Triangle and Trapezoid

Furthermore, the back of the Saung Ranggon traditional house appears flat from a combination of triangles and trapezoids. The combined area of a triangle and trapezoid is determined as follows (Putri & Ratu, 2018):

First find the area of the triangle with the formula :

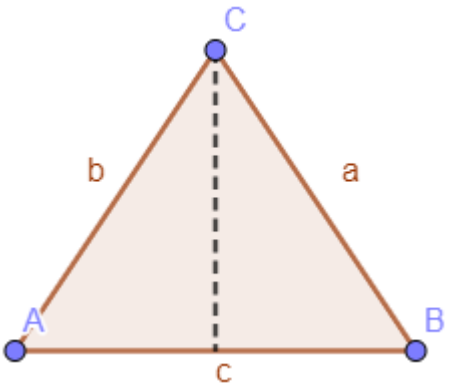
$$L\Delta = \frac{1}{2} \times a \times t$$

In addition, if the height of the trapezoid is not known, the Pythagorean formula can be used as follows:

$$c^2 = a^2 + b^2$$

If the height of the trapezoid is known, the area of the trapezoid can be calculated using the following formula:

$$L\Delta = \frac{1}{2} \times a \times t$$



In the picture beside, if the height of the trapezoid is not known then you can use the Pythagorean formula as follows:

$$a^2 + b^2 = c^2$$

$$DF^2 + AF^2 = DA^2$$

If the height of the trapezoid is known, then proceed with calculating the area of the trapezoid with the formula:

$$L_{trapezoid} = \frac{1}{2}(a + b)t$$

So, the combined area of the triangle and trapezoid is $L_{combined} = L\Delta + L_{trapezoid}$

The results obtained from the Saung Ranggon traditional house had flat materials in the form of rectangles, squares, triangles, trapezoids, rhombuses, and circles (Yuningsih et al., 2021).

Geometry

Building space is a part of the space that is limited by the set of points found on the entire surface of the building (side). Build the space found in the Saung Ranggon traditional house, including:

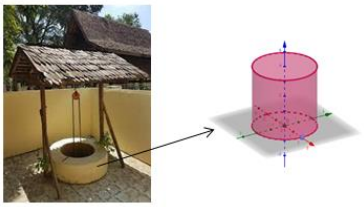


Figure 14. Tube

Outside the Saung Ranggon traditional house, there is an old well that has existed since the founding of this traditional house. Figure 5 shows the cylindrical shape. The formula for the surface area of the tube is as follows (Suharjana & Markaban, 2009):

Surface area $= 2\pi r(r + t)$
Tube Volume $= \pi r^2 t$

The results obtained from the Saung Ranggon traditional house contained building materials in the form of a tube (Sulistyani et al., 2019).

Geometry Transformation

Geometry transformation is a change in the position and size of an object (points, lines, curves, and planes) (Istiqomah, 2020). The geometric transformations found in the Saung Ranggon traditional house include the following:

Figure 15. Reflections On The Axis- y=-x

The inner roof of the Saung Ranggon traditional house has geometric transformation material in the form of reflections on the axis $y = -x$. We use formulas (x,y) → (x',y') with the description x'= -y and y'= -x.

Figure 16. Reflections On The Axis- y=x

Furthermore, there is also a side of the roof in the Saung Ranggon traditional house with geometric transformation material in the form of reflections on the axis $y = x$. Using formulas (x,y) → (x',y') with the descriptions x'= y and y'= x.

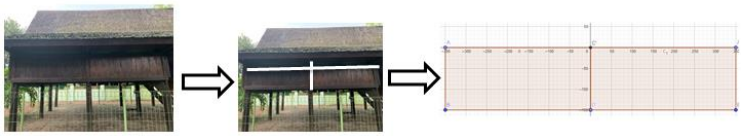


Figure 17. Reflections On The Axis- y

On the sidewall, there is a geometric transformation material in the form of a reflection (reflection) with in an axis y. If at point $A(-350,0), B(-350,-150), C(0,0),$

and $D(0,-150)$, then the result of reflection on the axis y is $A(350,0), B(350,-150)$, $C(0,0)$, and $D(0,-150)$ with formulas (x,y) → (-x,y).

Figure 18. Reflections OnTthe Axis y

On the back wall there was also a geometric transformation material in the form of reflections on the axis y. If at point $A(-150,0), B(-150,-150)$, $C(0,0)$, and $D(0,-150)$, then the result of reflection about the axis y is $A(150,0), B(150,-150)$, $C(0,0)$, and $D(0,-150)$ with formulas (x,y) → (-x,y).

The results obtained from the Saung Ranggon traditional house contained a geometric transformation material (reflection) (Susanto et al., 2022).

Numerical Development

back view side view front look

The roof of the Saung Ranggon traditional house is in the form of a Julang Ngapak, made of wooden shingles. The roof of the Saung Ranggon traditional house is in the shape of an inverted V. The roof of a traditional house consists of four identical rectangular parts. if a traditional house wants to renovate a roof that was originally made of wood shingles and change it to tile, how many tiles are needed to cover the roof of the Saung Ranggon traditional house? The size of the tiles that you want to install is according to the size $25cm \times 20cm$ and if one tile is valued at IDR 5,000, how much cost does it cost to renovate the roof?

Solution :

Size 1 is precarious = $25\text{cm} \times 20\text{cm}$

hat: Price 1 tile = IDR 5,000

roof length = $7{,}6\text{m}$

Roof width = $1{,}75\text{m}$

$\text{Area}_{\text{Roof}} = \text{p} \times \text{l}$

$\text{Area}_{\text{Roof}} = 7{,}6\text{m} \times 7\text{m}$

$\text{Area}_{\text{Roof}} = 53{,}2\text{m}^2$

$\text{Area}_{\text{Roof}} = 532000\text{cm}^2$

$\text{Area}_{\text{precarious}} = \text{p} \times \text{l}$

How many tiles are needed?

How much does it cost to renovate the roof?

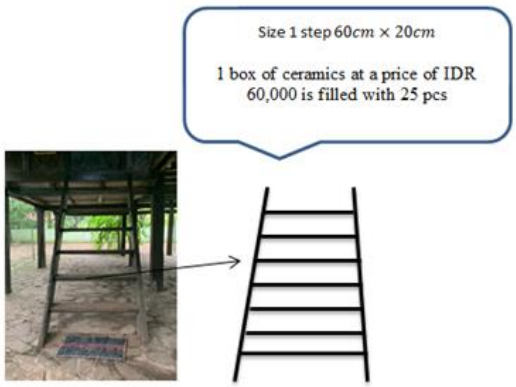
his:

$\text{Area}_{\text{precarious}} = 25\text{cm} \times 20\text{cm}$

$\text{Area}_{\text{precarious}} = 500\text{cm}^2$

many $= \frac{532000}{500} = 1064$ pieces

It is known that the required number of tiles in 1064 pieces. Next for how much it costs is 1064 x IDR 5,000 = IDR 5,320,000



Saung Ranggon has seven steps that lead to the house. The seven steps are made of wood. one rung measuring and . If you want to renovate the seven steps with tiles, how many tiles are needed to renovate the seven steps and how much money is needed to renovate the stairs? The size of the ceramic that you want to install with the size and 1 box of ceramics filled with 25 pcs for at a price of IDR 60,000.

Solution :

1 rung measuring

hat: $60\text{cm} \times 20\text{cm}$

The ceramic you want to install is sized $20\text{cm} \times 20\text{cm}$

1 ceramic box filled with 25 pcs at a price of IDR 60,000.

his: How many ceramics are needed?

a). 1 rung measuring $60cm \times 20cm$

1 sized ceramic $20\text{cm} \times 20\text{cm}$

$\frac{60\text{cm} \times 20\text{cm}}{20\text{cm} \times 20\text{cm}} = 3$ pieces of ceramic

1 rung measuring $60cm \times 15cm$

$\frac{60cm \times 15cm}{20cm \times 20cm} = 2{,}25\ pieces\ of\ ceramic$

So that in 1 step of size $60cm \times 20cm$ requires 3 pieces of ceramic

And so, in seven steps requires

$= 7 \times 3 = 21$ pieces of ceramic

So that in 1 step of size $60cm \times 15cm$ requires

How much does it cost to renovate the stairs?

$2{,}25$ pieces of ceramic

And so, in seven steps requires

$= 7 \times 2{,}25 = 15{,}75\ pieces\ of\ ceramic$

So,

$21 + 15{,}75 = 36{,}75\ pieces\ of\ ceramic$

b). How much does it cost?

It is known that 7 steps require $36{,}75$ tiles. In 1 box of ceramics there are 25 pcs, so 2 box of ceramics is needed at a price of IDR 120,000

So, the required cost is IDR 120,000

Based on the results of the research conducted, the Saung Ranggon Traditional House is a cultural heritage building in Bekasi. The Saung Ranggon Traditional House can be applied in learning mathematics with geometric materials in the form of flat shapes, spatial shapes, and geometric transformations, as well as in the development of numeracy, which can be seen from the shape of the Saung Ranggon Traditional House building, in which there is an ethnomathematics theory. The results of the exploration carried out on the Saung Ranggon Traditional House show the geometric concepts contained in the design of the Saung Ranggon traditional house, namely, the concept of a flat shape (a rectangle that can be seen from the door, a square that can be seen from the side wall, a triangle that can be seen from the ventilation section, the trapezoid that can be seen from the back wall, the rhombus, and the circle), the geometrical concept of transformation (reflection of the $y = x$ axes, $y = -x$ axes, and y axes), and the development of numeration are used to solve the cost problem.

Figure 19. Group photo with Mrs. Raden Nyi Sri Sumiati (Emak Encup Sumiati's)

The following is a photo documentation of one of the administrators of the Saung Ranggon Traditional House. He is a kuncen interpreter (administrator) at Saung Ranggon Traditional House.

CONCLUSION

Based on the research data and discussion, it can be concluded that parts of the Saung Ranggon traditional house have ethnomathematics forms. The shape of the ethnomathematics section is as follows: (1) there is a geometric material in the form of a rectangle that can be seen from the door of Saung Ranggon, which can be seen from the shape of a square, the ventilation section is triangular, the inner wall is a trapezoid, the fence is shaped like kites and rhombuses, and the circular part of the old well. (2) There is a geometric material in the form of a tube, which can be observed from the old well. (3) Transformation geometry materials exist in the form of reflections (reflection), which can be seen from the roof in the Saung Ranggon section, as well as axes that can be seen from the sidewalls and rear walls. (4) Numeration development was used to solve cost problems.

ACKNOWLEDGMENT

In this research, I would like to thank Mrs. Raden Nyi Sri Sumiati (Emak Encup Sumiati) for giving permission and helping me in making data about the house. Saung Ranggon customs and people that I cannot name individually. Thank you.

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