Ethnomathematic Analysis of Hand Crafts (Makassar Ethnic) on Mathematics Learning

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ABSTRACT

Ethnomathematics is a field of study that studies the relationship between mathematics and the culture, traditions and social context of a group or society. The aim of this research is to find out what mathematical elements are found in Makassar Ethnic woven handicrafts. The research method used is a qualitative method with an ethnographic approach. The data collection techniques used were interviews and literature reviews. In this research, the data analysis technique used is the triangulation technique which consists of data reduction, data presentation and drawing conclusions or verification. Some of the Makassar ethnic woven handicrafts, namely Tappere which has mathematical elements, namely the concept of geometry and the concept of flat shapes, Palo Dotta which has the shape of a cone without a base and a flat triangular shape, Bola Takraw which has the shape of a ball, Lobo which has the shape of a circle and half circle, and Pattapi which has shape like a circle. Therefore, it can be concluded that mathematical concepts can be found in various life contexts, one of which is woven handicrafts.

Keywords: *Ethnomathematics, Mathematics Learning, Woven Handicrafts*

1). INTRODUCTION

Human activities in everyday life are closely related to mathematics. Mathematics has a very important role in aspects of life, including science, technology and culture (Noto et al., 2018). Despite this, many students still believe that mathematics is difficult to understand (Khairunnisa et al., 2021). In fact, to understand Mathematics, someone should know the concept of how and for what Mathematics is studied. Mathematics itself is one of the subjects that must be studied at every level of education, one of which is in junior high school.

Learning mathematics at school is a process in which someone understands basic and complex concepts in mathematics. This is because learning mathematics is not just numbers and formulas, but also involves understanding patterns, relationships, logic and problem solving. Mathematics learning

is a process in which someone understands basic and complex concepts in mathematics (Evi, 2011). More than just numbers and formulas, it involves understanding patterns, relationships, logic, and problem solving (Laily, 2014). Learning mathematics is very important for everyday life because it can train logical and analytical thinking skills which are useful in solving problems.

Ethnomathematics is present as a solution to students' difficulties in representing mathematical material which is known to be abstract because it combines culture and mathematics. This is in line with Janu's opinion in (Amirah & Budiarto, 2022) who suggests that Ethnomathematics is a field of research that investigates the relationship between culture and mathematics in certain social groups. Ethnomathematics is a field of study that studies the relationship between mathematics and the culture, traditions and social context of a group or society. This concept recognizes that the way people learn, understand and use mathematics is not only influenced by the mathematical principles themselves, but also by their cultural, historical and environmental factors (Sarwoedi et al., 2018). Integration of ethnomathematics concludes that ethnomathematics has an important role in motivating and stimulating students, helping them overcome boredom, and providing new nuances in mathematics learning (Setiana et al., 2021). Learning mathematics is not just learning computational techniques and problem solving or understanding definitions, arguments and evidence (P. Sopamena and R. Yapono, 2016). Mathematics is considered something neutral and free from culture, Nur Prabawati in (Ibrahim, 2021). Items called ethnomathematics include mathematical concepts inherent in traditional games, handicrafts, artifacts, and cultural activities of certain communities (Sulaiman & Nasir, 2020). Ethnomathematics also aims to investigate how students understand, control, and apply the concept of well-being in solving mathematical problems and incorporating them into their environment.

Based on observations, the handicrafts found in South Sulawesi are handicrafts woven from bamboo, lontara leaves and rattan in Makassar City and Gowa Regency. These handicrafts woven from bamboo, lontara leaves and rattan consist of Tappere, Palo Dotta, Bola takraw, Lobo and Pattapi. Tappere can be associated with a flat shape because it is rectangular, Palo dotta can be related to the concept of a geometric shape, namely a cone without a base, Bola takraw can be associated with mathematics because a ball takraw is a three-dimensional shape that has curved side boundaries, Lobo is half shaped. circle and Pattapi are circular in shape, so they can be related to plane material. The use

of handicrafts woven from bamboo, lontara leaves and rattan is useful in daily life and traditional events, such as a place to store rice, rice, lemang, cakes and so on. The ethnomathematics contained in woven bamboo crafts can help improve learning, especially if used as a learning resource (Misliani, 2019). By using ethnomathematics in bamboo weaving crafts, students can gain an understanding of the existence of mathematics as part of culture.

Based on the results of research conducted (Puspitasari et al., 2020), the results of the handicrafts of the people of Sodo village, Paliyan subdistrict, namely Tompo, show elements of mathematics, namely the use of the principle of tessalation or tiling, woven motifs that have a flat geometric shape in the form of a square or rectangle with tiling. one type of figure for one.

This is in line with the opinion of (Ibrahim, 2021) that bamboo weaving crafts show that every object contains ethnomathematics, which includes a number of mathematical learning concepts that can be used at the elementary/MI and SMP/MTS levels. One of the concepts is as follows: a. Nyiru is shaped like a circle with a diameter and radius so it can be related to the idea of a circle as a flat shape; b. Due to its three-dimensional shape, mosquitoes can be associated with the idea of geometric figures, especially triangles and cones without bases; c. The hihid shape is related to the concept of a flat shape, namely a quadrilateral; d. The shape of Boboko can be related to the concept of flat buildings in the form of circles and cubes because the surface is circular and the base is square or cube shaped.

Then this was reinforced by research conducted by (Wulandari, 2021) on East Sumba ikat crafts which can be identified based on the motifs found, namely lines, angles, flat shapes such as triangles, parallelograms, rectangles and rhombuses, as well as geometric transformations including rotation , reflection, dilation. and translation. Based on several studies above, researchers are interested in conducting a literature study regarding ethnomathematics on handicraft products, so that researchers can apply it in mathematics learning.

Based on the background above, the aim of this research is to find out what mathematical elements are found in woven handicrafts (Tappere, Pattapi, Palo, Bola takraw, and Tudung serving). The existence of mathematics with cultural nuances. Researchers hope to make a huge contribution to making boring mathematics learning more interesting and making students enthusiastic about learning mathematics. Therefore, it is necessary to carry out research related to ethnomathematics

activities, with the title "Ethnomathematics Analysis of Handicrafts (Ethnic Makassar) on Mathematics Learning".

2). METHODS

The method used is a qualitative method with an ethnographic approach. Ethnography is used to describe, explain and analyze the cultural elements of a society or culture (Sari Permata et al., 2023). This research was conducted at Fort Ratterdam, Jl. Ujung Pandang, Makassar City, South Sulawesi and Balla Lompoa Museum, Jl K.H Wahid Hasyim No 39 Sungguminasa, kec. Somba Opu, Gowa Regency, South Sulawesi.

Secondary data is a tool that researchers use to collect data, such as interviews and literature reviews. This is referred to as secondary data because the data is collected through other people's presentations rather than primary sources (Creswell, 2017). Researchers conducted interviews to gain the necessary knowledge about the culture of woven bamboo, rattan and lontara leaf crafts.

Researchers went through several stages when conducting interviews. The first stage is to create questions. As a second step, the researcher has prepared several questions about handicrafts made from woven bamboo. Information is asked using questions that have been previously prepared by the researcher. Researchers interviewed experienced informants who are often directly involved with bamboo craft culture. The third stage is making information notes. Researchers store information in records of informants' responses to interview questions. Additionally, a literature review is part of the data collection process that involves understanding and analyzing data sources, which include books and scientific journals relevant to the research. The data analysis process consists of understanding the research being discussed, reading the abstract to see relevant research topics, and noting important points relevant to the research. The main aim of this research is the relationship between culture and mathematics used in mathematics learning.

In this research, the data analysis technique used is the triangulation technique, which was developed by Miller and Huberman, which consists of data reduction, data presentation, and drawing conclusions or verification. In the data reduction stage, the researcher selects data that is not needed and converts the images into writing. Next is the data presentation, where information is collected through interviews, field investigations, and documents found about handicrafts to describe the

mathematical elements contained therein, then draw conclusions by selecting the mathematical elements contained in handicrafts as learning in schools.

3) RESULTS AND DISCUSSION

One of the results of human creativity is making something by hand according to needs and gaining experience using it (Komarudin. et al., 2014). People can acquire different skills through experience. Everyone can have chicken skills. However, motifs, weaving techniques, and the general quality of woven items are influenced by the hands of the weavers. Woven, also called knitting, is a type of craft art (Aprillianti & Yudianto, 2019).

Weaving Craft is the process of weaving two or more objects or woven materials together so that they do not separate. The high friction force generated by the tension generated by overlapping bamboo slats ensures that the woven material maintains its shape even under pressure (Anandhita, 2017). For centuries, people have been weaving, resulting in weaves with various patterns and motifs. Several existing angled directions and intersections are arranged back and forth to create webbing of varying densities, depending on the angle or distance chosen.

The woven crafts used in each region are different. Based on the results of observations made at Fort Ratterdam, Jl. Ujung Pandang, Makassar City, South Sulawesi and Balla Lompoa Museum, Jl K.H Wahid Hasyim No 39 Sungguminasa, kec. Somba Opu, Gowa Regency, South Sulawesi found several handicrafts, namely Tappere, Bola Takraw, Tudung Saji, and Palo. This can be seen in the following image:

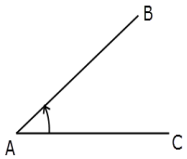
Figure 1. Balla Lompoa museum

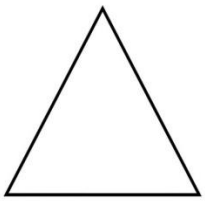
Figure 3. Handicrafts at the Balla Lompoa Museum

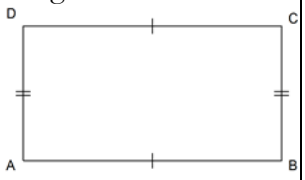
Figure 4. Handicrafts in Fort Ratterdam

Based on figure 3 and figure 4, handicrafts were found in the form of woven bamboo, pandan leaves and rattan originating from Makassar City and Gowa Regency. The following are the mathematical concepts contained in five types of handicrafts woven from bamboo, pandan leaves and rattan.

Table 1. Mathematical concepts contained in woven handicrafts

Image of tapper handicrafts	Mathematical concept	Questions and answers
	Line	1. Mother bought a rectangular batik cloth at the cloth character. Mother labeled each corner of the cloth, namely A, B, C, D. which are parallel lines of the fabric are…. **Answers:**  Parallel lines are: AB = AC and AD = DC
	Corner  	2. Ani visited the La Galigo mesuem to make observations. If Ani arrives at her destination at 03:05, determine the smallest angle produced by the clock hand at 03:05!

		Answer: Note the position of the short hour hand. If calculated from the initial position of the number 12, then we can calculate its current position using the following calculation: The position of the short hand on the clock 03: 05 = $3 \times 30^{\circ}$ Short needle position on $03.05 =$ $3 \times 30^{\circ} + 5/60 \times 30^{\circ}$ Short needle position on 03.05 = $90^{o} + 2{,}5^{o}$
	Triangle 	3. The Balla Lompoa Museum is one of the museums in the District. Gowa. There are many handicrafts in the museum, one of which is Tappere. There is a rectangular Tappere that will be cut diagonally into 2 parts so that it has the shape of a triangle with an area of 40 cm². If the base of the triangle is 10 cm, then the height of the triangle is... Answer : Sis: area: 40 cm² and base = 10 cm

		Dit: the height of the triangle? Solution: t = (2 × L) : a t = (2 × 40) : 10 t = 80 : 10 t = 8 cm
	Rectangle 	4. A base (Tappere) that people often use has a circumference of 40 cm, so the length of the side of the tappere is … a. 5 cm b. 10 cm c. 15 cm d. 20 cm **Solution:** s = K : 4 s = 40 : 4 s = 10 cm **Answer: b**
	Rectangle 	5. A mat in Balla Lompoa is rectangular measuring 32 m long and 24 m wide. Beads will be installed around the mat with a distance of 4m between the beads. how many beads are needed? Then calculate the area of the mat! Solution: Known:Diketahui : Rectangular mat p = 32 m, l = 24m. Beads will be placed around the mat with a distance of 4 m between the beads. Asked: Number of beads required and area of the mat? answer : Around $= 2 \times (p + l)$ $= 2(32m + 24)$ $= 112m$

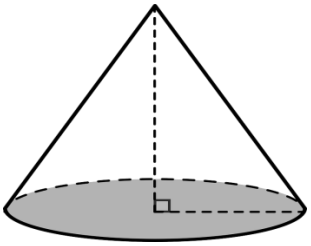
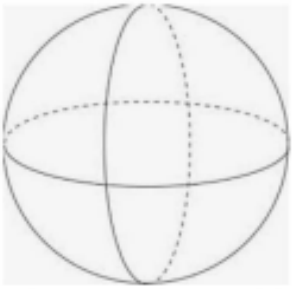
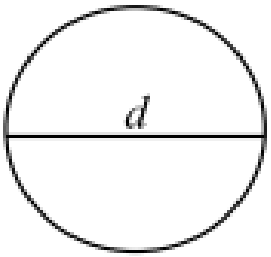
		$Garden\ area\ = p\ x\ l$ $32 \times 24 = 768$ Number of beads required: $112 : 4 =$ $28\ buah\ dan\ luas\ tikar =$ $768\ m^2$
Image of Palo Dotta handicrafts	**Ethnomathematics concept**	**Questions and answers**
	Cone 	1. A hand craftsman wants to make a Palo Dotta agricultural tool with a height of 20 cm. If the base radius is 15cm, what is the surface area of the palo dotta? **Answer:** **Known:** Tall palo dotta, h = 20 cm Fingers, r = 15 cm **Asked:** The surface area of Palo Dotta... **Solution:** $s = \sqrt{r^2 + h^2}$ $s = \sqrt{15^2 + 20^2}$ $s = \sqrt{625}$ $s = 25\ cm$ $L = \pi r \times s$ $L = \pi \times 15 \times 25$ $L = \frac{22}{7} \times 15 \times 25$ $L = 1.178{,}5\ cm^2$

Image of Takraw handicrafts	**Ethnomathematics concept**	**Questions and answers**
	Ball 	1. In area A, there is a tradition of making balls from woven bamboo for children's games. The ball has an average diameter of 10 cm. What is the volume of the ball? If each ball requires 1000 strands of bamboo woven, how many strands of woven total are needed to make 10 balls? **Answer** Known: Ball diameter = 10 cm ball radius, r = $\frac{d}{2} = \frac{10}{2} = 5\ cm$ Asked: Ball volume, v =…? Total strands of webbing =…? Solution: $v = \frac{4}{3} \times \pi \times r^3$ $v = \frac{4}{3} \times 3{,}14 \times 5^3$ $v = 523{,}6\ cm^3$ So, the volume of the ball is $523{,}6\ cm^3$

		Number of balls to be made = 10 Number of strands of webbing for one ball = 1000 Total strands of woven for 10 balls = 1000 strands/ball x 10 balls = 10,000 strands So, it takes 10,000 strands of woven bamboo to make 10 balls.
Images of Lobo handicrafts (serving hoods) & pattapi	**Ethnomathematics concept**	**Questions and answers**
 	Circle 	1. If a craftsman wants to make a basket that is 20 cm high, with a diameter of 30 cm. How much surface area of the top of the basket will be covered by the woven circle? **Jawaban** Known: Tall, t = 20 cm Diameter, $d = 30\ cm$ Circle radius, $r = \frac{d}{2} = \frac{30}{2} = 15\ cm$ Asked: Top surface area, LP =…? Solution: $LP = \pi r^2$ $\mathrm{LP} = 3{,}14 \times 15^2$ $LP = 706{,}86\ cm^2$

Based on the research results, five woven handicrafts were found with mathematical concepts contained in them. This will be discussed as follows:

a. Tappere'

Tappere (Mat) is made from pandan leaves and has a red cloth edge. In the past, tappere was used as a seat for royal guests (Purnamasari & Makmur, 2022). Pandan leaves first appeared in the Stone Age and were beneficial for the people who planted them. These slats are then closed or crossed to produce a woven mat that is a work of art. Women worked as weavers in their spare time at that time. At that time, woven mats were used both for traditional purposes and daily needs, such as sleeping mats. Woven mats are used as sleeping mats and for traditional ceremonies (Isnaini, 2019). Apart from that, the people of Makassar can gain economic benefits from selling mats. The basic problem is that the sleeping mats made by the Makassar people are a requirement for traditional ceremonies. When weaving mats, people often use a standard motif in the form of shedding pandan leaves one by one (Putma & Rusdi, 2022). Geometric elements such as points, lines, angles, triangles, squares, rhombuses and rectangles, as well as arithmetic series and value comparisons, are included in the mathematical concepts contained in the woven mats of the city of Makassar. This shows how woven mats can be used to teach mathematics.

Figure 5. Tappere illustration

b. Takraw balls

Takraw balss made from rattan are prehistoric tools (Sipahutar & Reflina, 2023). We know that a ball is a three-dimensional shape with curved sides. If we look at Figure 6, we get the following geometric concepts:

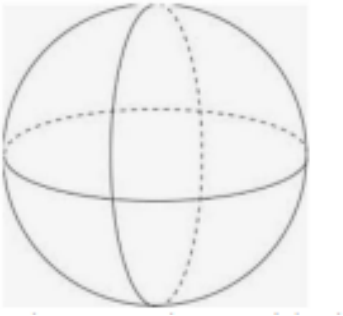


Figure 6. Illustration of a ball

Spherical buildings have the following characteristics, as shown in the figure above, which is an illustration of a sphere:

1. There is only one curved side plane
2. There are no diagonals, corners, or edges
3. There is only one central point; And
4. Has fingers.

c. Lobo (Tudung Saji)

Lobo crafts or serving hoods are crafts used to cover food. This serving hood is made by the people of Makassar using woven bamboo, and some even use woven pandan leaves (Fauzi & Setiawan, 2020). One household appliance that functions to cover food is a serving hood. The food hood is used every day. After returning home from home work and school, mothers and teenage children usually work on food hood crafts. To help with household needs, this food hood can improve the household economy. The maker of this serving hood still uses traditional methods, namely selecting the best leaves, drying them in the sun until dry, and then selecting the best leaves again (Syafa'at et al., 2021). The weaving process is carried out manually by refining pandan leaves and tying them to bamboo until finished (Fithri et al., 2021). Serving hoods have a conical, semicircular or rectangular shape. The frame material can be bamboo, iron, or cardboard, and stain or velvet cloth is used as a

cover. Depending on the leaves used, serving hoods can range from small to large. If viewed from Figure 7, the geometric concept is obtained as follows:

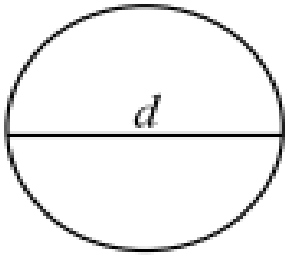


Figure 7. Illustration of a circular serving hood

From the results of the exploration and observation of the image of the serving hood above, we can dig up information that the mathematical concept contained in this craft is the concept of building space. As shown in the illustration above, the mathematical concept in the food hood is a circle. Implementation of the concepts of congruence, similarity and dilation. Formation of a flat circular shape consisting of three types of circle sizes, starting from small, medium to large circles. The manufacturing process can also be used as a lesson in determining the area and circumference of a flat circular shape.

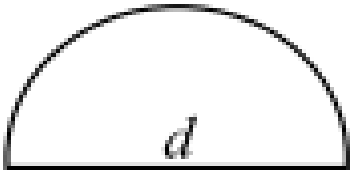


Figure 8. Illustration of a semi-circular food hood

The shape of the space presented in the food hood craft in the picture is a semicircle. The people of Makassar create these food hood crafts with various diameters and shapes. Apart from the semi-circular shape, craftsmen also create shapes with half-block shapes. Based on the manufacturing process, it can also be used as a lesson in determining the area and perimeter of a flat circular shape (Pririzki et al., 2020).

d. Pattapi

A post-harvest agricultural tool called pattapi is used to cook or clean rice from the grain shell after grinding. In Indonesian, pattapi is called nyiru or tampah. Usually pattapi is made by weaving strips of bamboo skin into a circle. A typical pattapi diameter is between 60 and 80 cm. When using, place the rice to be cleaned or sprinkled on the surface and swing the pattapi up and down (Akbar, 2021). To help the rice husks and other remains of the pounding process to separate from the rice and gather together so that they are easy to pick up, the rice on the surface of the Pattapi is also periodically shifted in a circular motion to the left. If you pay attention to the shape of the pattapi bamboo craft, it contains mathematical elements, namely the geometric concept of flat shapes, namely circles.

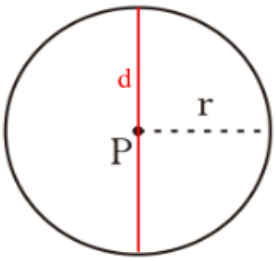


Figure 9. Pattapi illustration

Based on the analysis in Fig. The characteristics of the circle found in the Pattapi shape are as follows:

1. Only has one side
2. Has no corner points
3. The distance between any point and any side is always the same

The concept and nature of the circle contained in the traditional Bugis agricultural tool, namely the pattapi, has relevance to mathematics learning material on the subject of flat planes taught at elementary school level.

e. Palo Dotta

Palo Dotta, as it is called in the Bugis language, is a tool used by farmers in the rice fields to weed, plant, cultivate and harvest. Palo Dotta in Indonesian is called with the phrase "caping hat", and today most caping hats are worn by women. The aim is to protect the face from sunburn in the cool atmosphere of the rice fields (Busrah, 2023). Judging from Figure 9, it can be seen that Palo Dotta contains a mathematical concept, namely a conical shape. If you create a geometric modeling image, it will take the following form:

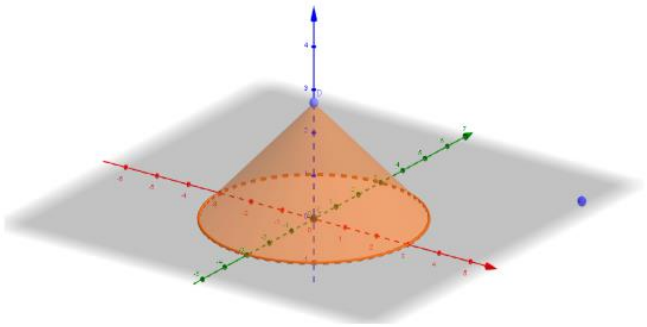


Figure 10. Geometric modeling of Palo Dotta

Sumber: Busrah, 2023

As shown in the image above, a cone is one of the geometric concepts that is formed, namely a cone. A cone is a type of spatial structure, with its boundaries determined by the area of the curved cone and circle. The characteristics of cones are as follows:

1. Consists of one curved side and a circular base
2. Has one curved rib; And
3. Has only one highest point

4). CONCLUSIONS

The results of the analysis of woven handicrafts that have been carried out can be concluded that there is ethnomathematics in each object studied which contains several mathematical learning concepts, including Tappere which has mathematical elements, namely the concept of geometry and the concept of flat shapes. The Takraw ball is spherical, has one curved side plane, no diagonals, corners, or edges, one central point; and has fingers. Lobo, shaped like a circle and a semi-circle when seen from different points of view. Pattapi has a circular shape, has a diameter and radius so that the shape of pattapi can be related to the concept of a flat shape, namely a circle. Palo Dotta has a three-

dimensional shape so that the shape of palo dotta can be related to the concept of a geometric shape, namely a cone without a base and a flat shape, namely a triangle.

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