

# An Exploration of Ethnomathematics in Traditional Weapon Artifacts of Somba Opu Fort, South Sulawesi

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## ABSTRACT

This research was carried out with the aim of exploring and understanding the mathematical concepts contained in traditional weapons artifacts from historical heritage at Somba Opu Fort, South Sulawesi. The method used in this research is qualitative with an ethnographic approach. This research stage begins with conducting a study, preparing instruments, collecting data through observation and interviews, and data analysis. Data collection techniques in this research are observation, interviews and documentation. The main instrument in this research is the researcher himself, and the tools used are observation guidelines, interview guidelines and documentation. The results of the research show that there are mathematical concepts such as spatial shapes and flat shapes in traditional weapon artifacts that can make it easier for students to understand mathematics learning as well as get to know culture.

**Keywords:** Ethnomathematics, Traditional weapons artifacts, Mathematical concept

## 1). INTRODUCTION

Education in human life is a very important thing, because education can educate the nation's life, form a dignified nation, and produce superior generations. Education is present in the form of cultural socialization, interacting with local community values and maintaining reciprocal relationships that determine the processes of changing the socio-cultural order of society in order to develop the progress of civilization and the orientation of education shows clearly that the educational process is also a cultural process, because the educational process occurs in the context of culture. (Aminullah, 2017). Cultural progress can be developed through mathematics. Mathematics is not a universal domain of formal knowledge, but is a collection of symbolic representations and procedures that are culturally constructed in certain groups of society and when such thinking develops in learners, they incorporate representations and procedures into their cognitive systems and mathematical skills learned by learners at school are not logically constructed and based on abstract cognitive structures,

but rather as a combination of knowledge (Sarwoedi et al., 2017). (Sarwoedi et al., 2018).. If learning is adapted to the lives of students, it will certainly not be too difficult to adjust, especially in mathematics learning which has a high level of abstractness. (Abi, 2017). Therefore, mathematics can be used as a new input (culture) where activities involving numbers, geometric patterns, counting and so on are considered as applications of mathematical knowledge better known as ethnomathematics.

Mathematics and culture are two things that are closely related and cannot be separated in everyday life. Where, mathematics is one of the disciplines that can improve thinking skills, recognize shapes, structures, quantities, and interrelated concepts. (Arina, Mujiwati, & Kurnia 2020).. while culture is a habit in society that is passed down from generation to generation from previous people. Bishop said that mathematics is a form of culture and this explains that mathematics is a procedure and process for finding an appropriate concept and is obtained in relation to culture. (in Sanyoto, Slamet, & Agustito 2021). So the term ethnomathematics is known which is a combination of mathematics and culture. Ethnomathematics is a form of mathematics that is influenced or based on culture. In simple terms, ethnomathematics is defined as mathematics learning that is related to culture, this is associated with ethnomathematics objects and Hardiarti reveals that mathematical objects are cultural objects that contain a mathematical concept in a particular society, such mathematical objects as artifacts, traditional crafts, traditional games, and activities (activities) that are cultural in nature. (Sartika, Litik, & Argaarini 2023).. One of the areas that stores historical objects in Fort Somba Opu, Barombong District, Makassar City, South Sulawesi Province.

One of the historical relics at Fort Somba Opu are traditional weapons that, in addition to their artistic beauty and martial prowess, hold rich stories about cultural heritage and local knowledge systems. Behind their physical appearance, these weapons carry traces of mathematics embodied in their design, polymers, and practical use. The study of ethnomathematics is an interesting window to understand how the people of South Sulawesi not only use traditional weapons as a means of defense, but also as a manifestation of mathematics in everyday culture. This is in line with what Aflah and Handayani found that Ethnomathematics is an approach to learning mathematics that can be connected to an existing cultural group, so that from this culture it can be used as a source of learning mathematics. (Aflah & Andhany 2022). This study shows that ethnomathematics is not only relevant in the classroom or laboratory, but can also unlock the secrets of local wisdom contained in traditional weapons, becoming an introduction into the living and evolving world of mathematics.

Traditional weapons are not just tools of self-defense; they are manifestations of art, beauty and cultural identity. Intricate geometric designs, captivating symmetry, and striking polyrhythms give the impression that mathematics is not only lodged in the classroom, but also in every fiber of daily life. (Fitriati, 2016). Ethnomathematics explores proportional balance, effective angles of attack, and tactical strategies that can be key to success in weapon use. By taking a closer look at the traditional weapons of South Sulawesi, we can get a sense of how the local people craft their martial arts skills by utilizing mathematical concepts that may have unwittingly become an integral part of everyday life.

Ethnomathematics research on traditional South Sulawesi weapon artifacts can make a valuable contribution to our understanding of the complexity of culture and mathematics. Ethnomathematics opens the door to the understanding that it is not only the weapon itself that has value, but also the local mathematical knowledge reflected in every detail. (Aflah & Andhany, 2022). By detailing the design, polasari and mathematical symbolism of traditional weapons, we can gain insight into how this knowledge is applied in the making and use of weapons, and how it enriches the daily lives of the people of South Sulawesi.

This research focuses not only on weapons as physical artifacts, but also on the values and mathematical knowledge contained in South Sulawesi culture. The perfection of traditional weapon designs that have been passed down from generation to generation is not just visual beauty, but also a representation of the depth of local wisdom. Therefore, this research seeks to explore the wealth of local mathematical knowledge embedded in the traditional weapons of South Sulawesi, making them an important part of cultural heritage and a source of inspiration for the development of contextual mathematics education.

## **2) METHODS**

This research uses a type of qualitative research. Qualitative research method is a research approach that rests on the philosophy of postpositivism. This type of research is used to investigate the conditions of natural objects, where the researcher acts as the main instrument in collecting and analyzing data. (Sugiyono, 2018). The approach used in this research is an ethnographic approach. Research with an ethnographic approach requires direct presence in the field. This is in line with Guarango's view (2022) which states that ethnography is a form of qualitative research that involves analyzing the culture of a group through direct observation and interviews. This research was

conducted on October 13, 2023, at Fort Somba Opu, located at Gusung Sarombe Sapiria, Barombong sub-district, Makassar city, South Sulawesi. This research stage starts from literature review activities and initial observations and determining the research location. The second stage of the researcher began to compile the instrument, the researcher became the main instrument, using observation guidelines, interview guidelines, and documentation as tools. The instrument guidelines cover three aspects, namely historical, philosophical, and mathematical. The instruments used to collect data are observation sheets, interview guidelines, and documentation guidelines. The third stage is data collection activities in the field, namely through observation and interviews to the Somba Opu Fort. The fourth stage is data analysis activities. In this study, the data collection method involved observation, interviews, and documentation. Data analysis was conducted by applying the Miles and Huberman model data analysis technique, which involves data reduction, data presentation, and conclusion drawing.

### **3) RESULTS AND DISCUSSION**

Somba Opu Fort is located on a delta of the Je'ne Berang river in the Barombong sub-district of Gowa Regency. The fort was built on the orders of King Gowa IX Daeng Matanre Karaeng Mannuntungi Tumapa'risi Kallonna. At that time Somba Opu Fort was still made of clay. During the reign of the 11th King of Gowa Tunipallangga Ulaweng, Somba Opu Fort was strengthened by building Dewata/Bastion and bricks and armed with cannons. The improvement and construction of Somba Opu Fort continued to be strengthened until the eleventh king of Gowa, Sultan Alauddin, even after Sultan Hasanuddin took over the reign of the Kingdom of Gowa, the development of Somba Opu city grew rapidly and became the center of government power as well as one of the most famous commercial cities in Southeast Asia. Somba Opu Fort was destroyed by the Dutch Company in 1669 after a fierce battle between Sultan Hasanuddin and the Dutch in the Makassar War. The fall of Somba Opu Fort was also the destruction of the Gowa Kingdom Empire.

After being buried for approximately 3 centuries, in an effort to reveal the glory and greatness of Somba Opu City, research and restoration activities have been carried out which until now continue to be carried out by the South Sulawesi Provincial Historical and Antiquarian Heritage Sanctuary. Now the status of Somba Opu Fort has been used as one of the tourist areas known as Miniature South Sulawesi In this area, traditional houses from various ethnicities in South Sulawesi are also built. (Eni, 2019). To complement other necessities, several buildings were also built as a representation of the

regencies / cities in the South Sulawesi region. These buildings mainly function as a means of supporting activities on a provincial scale.



*(Source: Personal Documentation)*

### Traditional Weapons of Historical Heritage at Somba Opu Fort

After sleeping for more than 300 years, the discovery of Somba Opu Fort was finally reported by the community. In 1978, the Ujung Pandang Branch of the Institute of History and Anthropology conducted the first research on the history of Somba Opu Fort. A year later, the National Archaeological Research Center in collaboration with the South Sulawesi Historical and Antiquarian Heritage Sanctuary began the first archaeological excavation in the Somba Opu Fort area.

In 1989, the South Sulawesi Provincial Government designated the Somba Opu Fort area as the construction site for the Sulawesi Miniature Project. Excavations continued intensively to rescue important findings buried in the ground. At the same time, they reconstructed the fortress of the Gowa-Tallo Kingdom. The excavation produced a relatively large number of varied findings. Starting from the bricks that make up the fort, pottery and fragments, foreign ceramics and fragments, kupa

currency, jinggara currency, roof tiles, and inscribed and decorated bricks that have certain meanings. (Sitti Aminah, et al. 2020).

To store various findings from the excavation of the Somba Opu Fort, the South Sulawesi Provincial Government established a museum, named Karaeng Pattingalloang Museum. In addition to being a cultural center and tourism facility to support the Sulawesi Miniature Park at Somba Opu Fort. The naming of the museum was inspired by a scholar and statesman named Pattingalloang. The scholarship that exceeded the Bugis-Makassar people of his time, made Karaeng Pattingalloang a symbol of the knowledge of a statesman of the Gowa-Tallo Kingdom.(Muhaeminah, 2014). So that is the reason, why in Karaeng Pattingalloang Museum there are many findings of Somba Opu Fort. Besides information about Karaeng Pattingalloang of course.

Based on the results of research conducted at Somba Opu Fort, it can be seen that in the shape and structure of existing artifacts such as spearheads, javelin points, cannons and cannonballs there are mathematical concepts that can be applied. Through exploration, observation, documentation, and interviews conducted by researchers, it can be identified that some artifacts illustrate the concept of flat and spatial shapes.


The historical artifacts located in Somba Opu that are associated with the concept of ethnomatics are as follows;


- Cannons and Bullets

Cannon is a bullet launcher to shoot targets which usually uses the method of exploding gunpowder as the launching force. (Batara, 2021). Cannons have various caliber sizes, ranges, firing angles, and firepower. More than one type of cannon is generally used in battle. Cannons were widely used during the royal era and also during wars against invaders who came to the archipelago, one of which was in Gowa Regency, South Sulawesi.

The cannon in Somba Opu Fort is made of metal/iron in the shape of a long blackish brown sphere, and has a shooting range of about one thousand (1000) meters, equipped with bullet balls made of iron and bronze. This cannon was used as a long-range war tool to protect the kingdom during the war against the Dutch during the colonial era. (Murniah, n.d.). Now this cannon has been made as one of the cultural relics in South Sulawesi.

The Ethnomathematical concept of the cannon and its bullets is the concept of flat shapes, namely the wheel of the cannon which is shaped like a circle and the spaces, namely the cannon in the form of a tube and the bullets which are shaped like a ball.

<p><b>Images of Traditional Weapon Artifacts Cannon and Cannon Bullets</b></p>	<p><b>Ethnomatics Concept</b></p>	<p><b>Questions and Answers</b></p>
	<p>The ethnomathematical concept of the cannon and its bullets is the concept of flat shapes, namely the wheel of the cannon which is shaped like a circle and the space, namely the cannon in the form of a tube and the bullet which is shaped like a ball.</p>	<p>1. One of the historical relics found in Fort Somba Opu is a cannon which one part resembles the shape of a tube, if the height of the tube is 1.5 m and the radius of the base and roof is 4 cm. Determine the volume of the cannon!</p> <p>Answer: Dik: <math>r = 7 \text{ cm}</math>, <math>t = 1.5 \text{ m} = 150 \text{ cm}</math></p> <p>Dit: <math>V = \dots?</math> Solution: <math>V = \pi \times r^2 \times t = 22/7 \times 7^2 \times 150 = 23,100 \text{ cm}^3</math></p> <p>So, the volume of the cannon is <math>23,100 \text{ cm}^3</math>.</p> <p>2. Calculate the area of a cannon wheel that resembles a circle, if its diameter is 30 cm!</p> <p>Answer:</p>

		<p>Dik: <math>d = 30 \text{ cm}</math>, <math>r = 15 \text{ cm}</math></p> <p>Dit: <math>L = \dots?</math> Solution: <math>L = \pi \times r^2 = 3.14 \times 15^2 = 3.14 \times 225 = 706.5 \text{ cm}^2</math></p> <p>So, the area of the cannon wheel is <math>706.5 \text{ cm}^2</math>.</p> <p>3. The cannon shells in Somba Opu Fort are spherical, if the radius is <math>4 \text{ cm}</math>, calculate the volume of the cannon shells! Answer:</p> <p>Def: <math>r = 4 \text{ cm}</math></p> <p>Dit: <math>V = \dots?</math> Solution: <math>V = \frac{4}{3} \times \pi \times r^3 = \frac{4}{3} \times 3.14 \times 4^3 = \frac{4}{3} \times 3.14 \times 64 = 66.99 \text{ cm}^3</math></p> <p>So, the volume of the cannonball is <math>66.99 \text{ cm}^3</math>.</p>
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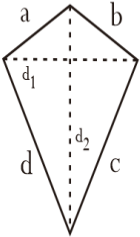
- Spearhead

Spear is a type of weapon that is found throughout the world, used for hunting and war. Spear is a tool of war that is widely used by ancient kingdoms including in South Sulawesi, in addition to pointed bamboo. The spear is a combination of art with metallurgical technology (casting, mixing and forging) of very complex metals (Zainal & Raden, 2014). In making it relatively easier than making swords and other weapons. In the history of spears have been made since ancient times which became



a tool for hunting, spearheads from sharpened or smoothed stones, then subsequent developments were replaced with strong and durable metal / iron.

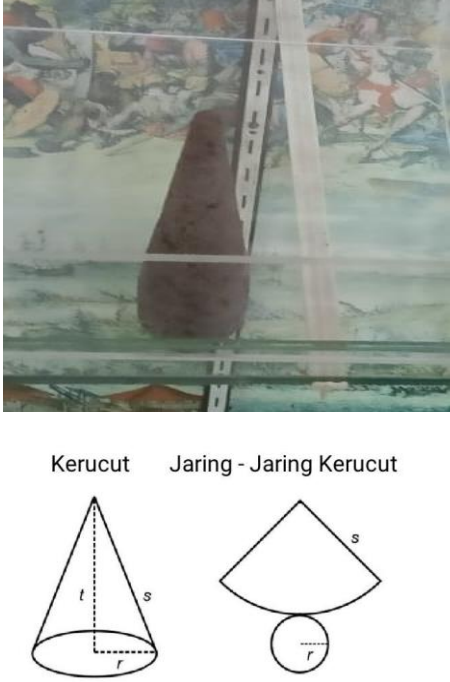
The iron spear in Fort Somba Opu is the result of the excavation of the Fort Rotterdam area by the South Sulawesi Cultural Heritage Preservation Center in 1993 which functions as a sharp weapon. With its sharpness, it can be used in hunting, fishing, or other activities involving the capture of animals or natural resources. (Mailili & Nurmayanti 2023). The ethnomathematical concept of the spearhead is its shape which resembles a rhombus and kite.

Spearhead Traditional Weapon Artifact Picture	Ethnomatics Concept	Questions and Answers
 	<p>The ethnomathematical concept of the spearhead is its shape which resembles a rhombus, kite and cone which has a long handle made of wood. However, the focus here is only the kite which is a rectangle whose one diagonal cuts perpendicular to the other diagonal axis.</p>	<p>One of the tools used for hunting in ancient times was a spear. If the spearhead is kite-shaped. Calculate its area and perimeter, if the length of each diagonal is 10 cm and 15 cm!</p> <p>Answer: Dik: <math>d_1 = 10 \text{ cm}</math>, <math>d_2 = 15 \text{ cm}</math> Dit: a) <math>L = \dots?</math> b) <math>K = \dots?</math> Answer: <math>L = \frac{1}{2} \times d_1 \times d_2 = \frac{1}{2} \times 10 \times 15 = 75</math> <math>K = 2 \times (a + b) = 2 \times (10 + 15) = 2 \times 25 = 50</math> So, the area and perimeter of the spear are <math>75 \text{ cm}^2</math> and <math>75 \text{ cm}</math>.</p>

- Javelin Eye

The javelin eye is a lightweight iron spear designed to be thrown with a certain technique, namely by throwing (towards the target), therefore in terms of the shape of the eye and the handle is made balanced.(Pratiwi et al., 2023). In the past, it was used as a long-distance sharp weapon in warfare or for hunting animals in order to meet the needs of human life for food. In further development, javelin throwing has been used as one of the sports in the modern Olympics since 1908 for male athletes and 1932 for female athletes.

The javelin in Fort Somba Opu was found during the excavation of ancient cannon shells in Fort Rotterdam by the South Sulawesi Cultural Heritage Preservation Center in 1993. It is thought that the javelin and other findings are related to the wars between the kingdoms of South Sulawesi in defense of their ancestral lands, and are also suspected to be the results of the wreckage of weapons of freedom fighters during the struggle for independence between 1945 - 1950 and weapons of the Dutch army (Rahman et al., 1993, Amalin 2023). The ethnomathematical concept of the javelin is the cone.

Image of Traditional Weapon Artifact of Javelin Eye	Ethnomatics Concept	Questions and Answers
	<p>The ethnomathematical concept of the javelin eye is a cone. A cone that can be formed from a right triangle rotated by 360, where the right triangle is the center of the rotation.</p>	<p>One of the sharp (traditional) weapons from South Sulawesi is a javelin that resembles a cone shape. Calculate its volume, if its radius is 2 cm and its height is 9 cm!                  Answer:                  Def: <math>r = 2</math> cm, <math>t = 9</math> cm                  Dit: <math>V = \dots?</math>                  Answer: <math>V = 1/2 (\pi r^2 \times t) = 1/2 (3.14 \times 2^2 \times 9) = 1/2 (113, 4) = 56.52</math>                  So, the volume of the javelin is <math>56.52 \text{ cm}^3</math>.</p>

#### 4). CONCLUSIONS

Based on the discussion, it can be concluded that the results of the study show that there are several traditional weapons related to mathematics without learning about mathematical concepts in everyday life using ethnomathematics.

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