

PINISI ETHNOMATHEMATICS: PHILOSOPHICAL VALUES AND APPLICATION OF MATHEMATICAL CONCEPTS IN PINISI SHIPBUILDING IN ARA VILLAGE, BONTOLAHARI DISTRICT, BULUKUMBA REGENCY

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Abstract

This research discusses the application of mathematical concepts and philosophical value of the pinisi ship which specifically explored the geometrical shape and transformation aspect. This is a qualitative study using an ethnographic approach. In addition, data collection techniques were collected through observation, interviews, and documentation. The informants are Punggawa and Sawi. This study uses the Miles and Huberman data analysis technique, consisting of data reduction, data display, and conclusions drawing. The result of this study reveals that on the Pinisi ship there are several mathematical shapes such as triangles, trapezoids, rectangles, and cylinders. Meanwhile, geometric transformation can be found in tambugu, soloro, anjong, tiang agung (great masts), tanpasere sails, and other components. Generally, the shape and geometric transformations can be associated with the philosophical meaning of the Pinisi ship. In this case, it is closely related to religious symbols and the human body.

Keywords: Ethnomathematics; Pinisi; Philosophical

1. INTRODUCTION

Pinisi is an embodiment of the maritime power of the Bugis Makassar tribe. South Sulawesi's Pinisi ship, also known as the archipelago's indigenous sailing craft, has a deep philosophical meaning in its unique construction (UNESCO, 2017). According to the sawerigading myth, the forces of nature gave trust and expertise to three specific regions,

namely, the villages of Ara and Tanah Lemo who were experts in shipbuilding, while the people of Bira were proficient in seafaring (Setiawan, 2021; Ramadhani, 2017). The most distinctive feature of the Pinisi ship is the gaff-ketch rig, two masts, and seven sails. At first, water transportation in Southern Sulawesi was simply in the form of the "*Lesung Boat*" which resembles a raft. Then due to the influence of Europe, developed at the end of the 19th century and created larger vessels called Pinisi. According to Mattulada (Ramadhani, 2017), The development of sailboats used by the Bugis-Makassar community can be seen through Padewakang, Pajala, Lambo, Palari, and Pinisi. Later, in the 1970s, the Pinisi ship began to improve with engines. This structure is an evolving craft.

For a long time, the Pinisi ship has been designed in such a way with great care and accuracy by shipwrights. In every stage of manufacturing, it is always accompanied by rituals according to the indigenous beliefs. In the early stages of making Pinisi, the keel cutting ceremony (*annakbang kalabiseang*) is carried out to cut quality wood such as Ulin and Bitti. It is also important to consider the good day in logging which is usually the 5th and 7th day of the current month. Then the process of cutting and assembling is executed which is accompanied by the Ceremony of Connecting the keel of the ship (*annatta'*). then after the ship has been finished, they will do the ceremony of rejecting misfortune (*Appasili*). Followed by the ritual of giving the navel (*Ammosi*). Finally, there is the *Anyorong Lopi* Ritual which is the beginning of the ship sailing on the vast ocean for the first time (Setiawan, 2021; Ramadhani, 2017).

Structurally, the Pinisi ship has many components consisting of two masts, seven sails, and hulls. Between the front mast and the *anjong* (triangle in front as a counterweight), there are three sails of the ship attached at the front end in the form of a triangle. The three triangles are named, *cocoro pantara* (the front sail), *cocoro tangnga* (the middle sail), and the last one is called *tarengke*. There are also two large trapezoidal sails on both of the main masts of the ship, the middle sail attached to the front mast is called *sombala bakka* (the large sail) and the rear sail is called *sombala riboko* (the back sail). While above the two masts there are two triangular-shaped sails called *tampasere* (Setiawan, 2021; Ramadhani, 2017). Whereas, for the hull, there is a technique for the arrangement of the "*Tata Tallu*" board. In this arrangement, the *tambugu* with the *roang* takes a major role in marking each length and location of the board Liebner, H. (2016). That way each board has a specific name, position, and pattern. Although, technology and knowledge in the past were not as advanced as now. Unwittingly the mathematics concept specifically shapes, and geometry has been applied in the process of making.

The implementation of mathematical thinking in real life can be seen in any diverse culture. According to Sumarto (2019), culture means a concept that draws interest and relates to the way a group of people lives, learns, thinks, feels, believes, and does what is appropriate in terms of behavior, practice, and social phenomena which describes the identity and image of society. Mathematics is a study derived from experience and cannot be detached from human civilization Utami, R. N. F., Muhtadi, D., et al. (2020). In fact, mathematics can be perceived as a cultural product and has given implications for a certain culture (Utami, R. N. F., Muhtadi, D., et al. 2020; Prediger, S. 2003)

Therefore, this is where ethnomathematics contributes as an essential fundamental connector between them. D'Ambrosio, U. (1985), explains ethnomathematics as the application of mathematics to a culture that can be identified as a community, such as ethnic groups, tribes, religious believers, certain age groups, etc. Principally, ethnomathematics is a bridge that links mathematics and cultural groups as a whole Utami, R., N., F., Muhtadi, D.,

et al. (2020). Thus, the ethnomathematics concept can also be seen in the Pinisi ship from Bulukumba, South Sulawesi. It is a distinctive cultural heritage of Indonesia that needs to be preserved and learned more deeply [1]. As a result, the researchers aim to discover the philosophical and cultural meaning of the Pinisi ship. It is also an effort to have a better understanding of mathematics in a contextual situation and generate new knowledge regarding the ethnomathematical concept of the Pinisi ship.

2. METHOD AND EXPERIMENT DETAILS

2.1 Type and Approach of Research Methodology

The research method used in this study is a qualitative method with an ethnographic approach. Through qualitative research, researchers can construct and interpret the mathematical aspects and cultural or philosophical meanings of Pinisi in depth by analyzing processes, individual understandings, events, interactions, and the essence of the Pinisi ship (Somantri, G.R., 2005; Firmansyah, M., Masrun, M., & Yudha S, I. D. K., 2021). Furthermore, ethnography plays a role in researching and describing the way of life of social and cultural groups by studying daily behavior in order to find patterns that can help in identifying aspects of making pinisi ships (Sugiyanto, C., & Winardi, R. D., 2019). The Pinisi ship itself is the result of a descending culture hence by using an ethnographic approach, it is anticipated that researchers can obtain the roots of knowledge from this heritage.

2.2 Location of Research

This research is located in Ara Village, Bontobahari District, Bulukumba Regency, South Sulawesi Province. Ara village has distinct local wisdom, it is the place where Pinisi shipbuilding evolves. Accordingly, it becomes the proper location to conduct research.

2.3 Research Subject

Subjects in this study were determined through incidental sampling and purposive sampling. Incidental sampling is necessary to collect data from several shipbuilders encountered accidentally or unexpectedly (Etikan. I, Bala. K., 2017). The researchers use incidental sampling because of the large-scale population of shipwrights which can be easily found at the location site. Meanwhile, purposive sampling was carried out by selecting and targeting the knowledgeable specialist of Pinisi shipbuilders, namely *pungkaha/panrita lopi* (Etikan. I, Bala. K., 2017). They have been determined and qualified as the representative sample based on the terms, demands, and objectives of the study. Therefore, the samples used are *sawi* (craftsman/shipbuilder), *pungkaha* (ship expert/head craftsman) or *panrita lopi*, and others who are representatives (Ramadhani, A., S., 2017).

2.4 Data Collection Method

2.4.1 Interview

The interview aims to achieve direct information and an overview of the pinisi ship as well as to describe a certain thing, situation, or condition (Kawasati, R., Iryana., 2019). The data obtained is highly influenced by the situation or respondent. First, the researchers prepared questions and the necessary tools, such as cameras and tape or voice recorders. This study uses unstructured interviews to provide flexibility for both sides. Researchers can dig up information about the Pinisi ship through open-ended questions and long responses (Kawasati, R., Iryana., 2019). After obtaining permission, the recording process was conducted during the interview to make it easier for researchers to do verbatim transcription. This verbatim transcript uses the local language (konjo) and Bahasa Indonesia. The questions asked are regarding the implementation of mathematics in the creation of the pinisi ship components and

the philosophical meaning of the pinisi ship. The interview will be terminated when the data has reached saturation, no more new data, themes, information, or codes are obtained (Bastian, I., Winardi, R., & Fatmawati, D. 2018).

2.4.2 Participant Observation

According to Sugiyono, (2016), in participatory observation, researchers are involved in the daily activities of the Ara village community to observe carefully and thoroughly every aspect and relationship of pinisi shipbuilding with mathematical, philosophical, and cultural concepts. When researchers make observations, they participate in the data sources activity. Through observation, the data obtained is more complete, accurate, and displays a reality. This study aims to describe, develop theories and hypotheses, or test theories and hypotheses. The steps in this observation consist of describing, inputting, and providing generalizable data.

2.4.3 Documentation

Sugiyono, (2016) states that Documents are records of events that could be in various forms, for example, field notes during observations, photos of Pinisi ship components, interview recordings, or videos of Pinisi shipbuilding. This documentation method is efficient as supportive evidence because the documentation can also be quoted, developed, or evaluated from previous research and journals about Pinisi Ship. It is intended that all the results of the documentation can be collected and processed.

2.4.4 Data Analysis Technique

Primarily, data analysis and data collection are inseparable units. Therefore, this study uses the data analysis model proposed by Miles and Huberman (Rijali, A., 2018) because they view the data analysis process as a reciprocal relationship

2.4.4.1 Data Reduction

After the data about the Pinisi ship is collected, the raw data will be reduced in four ways, such as selection, summarizing, coding, and classifying. The purpose of data reduction itself is to provide a more accurate description and meaning of the Pinisi ship, make it easier for researchers to collect data by decreasing redundant data, and allow researchers to obtain the most important elements of data [14].

2.4.4.2 Data Display

A collection of information that has been reduced is presented in a concise and digestible form (Bastian, I., Winardi, R., & Fatmawati, D., 2018). The evidence shown is only representative proof that has been selected based on relevancy. The presentation of the data must show the link between Pinisi shipbuilding and mathematical or philosophical aspects. The data presented also explains how the concept of ethnomathematics contributes to the Pinisi ship. This study uses a narrative data display with several supporting illustrations that summarize the data analysis.

2.4.4.3 Conclusions Drawing/ Verification

Conclusions will be carried out continuously during the research and data collection process in Ara Village. The conclusion will be confirmed by increasing the data through the verification process. Initial conclusions will be weak due to the lack of data obtained. This summary will gradually become stronger as the data extends

3. RESULT AND DISCUSSION

3.1 General Description of Research Location

Administratively, Ara Village is one of the villages located in Bonto Bahari District, Bulukumba Regency, South Sulawesi Province. The total area of Ara Village is 13.40 km²

Mattaliu. (2022). Ara village is known as “*Butta Panrita Lopi*” which means the homeland of ship-builders (Setiawan, 2021; Ramadhani, 2017). On the coast of Ara Village, you can find lots of ships, mainly the Pinisi type, ranging from ready-made ones to those still in the process of being built, whether large or small. At the same time, we can see the *sawi* working together in the shipbuilding process led by the *Panrita Lopi* or *Punggawa*. Pinisi shipbuilding in Ara Village is a hereditary skill passed down from generation to generation. According to the local legend, it all started with the Sawerigading mythology. It is said that the crown prince of the Luwu kingdom made a voyage to China. However, on the way home the ship was torn apart by a storm and stranded in three areas. The keel or body of the ship is stranded in Ara Village, the *sotting* section is stranded in Lemo-Lemo, and the rope and sail are stranded in Bira (Setiawan, 2021; Ramadhani, 2017). From a historical point of view, Pinisi has long been developed by the Bugis-Makassar people as a means of transportation and inter-island trade. At first, the original Indonesian sails were rectangular, known as *Tanjaq*. However, the Sulawesi ship experienced rapid development with the inspiration to combine *Tanjaq* sails with European and American sails which then create the Pinisi Ship we know today (Arif, Fadillah, Ahmad. B. K, Ibrahim, Shanty, Manullang., 2020). In addition, in terms of resources, in the past, Ara Village had a dense forest that was able to provide a source of raw material for shipbuilding, namely strong wood, which encouraged local residents to build Pinisi ships.

3.2 Results

3.2.1 Shapes

Table 1. Pinisi ship has a variety of flat and solid figures

No	Name	Description
1	<i>Lunas/keel (kalebiseang)</i>	2-dimensional figure: rectangle 3-dimensional figure: cuboid Function: as the base or main support of the ship
2	<i>Tambugu</i>	2-dimensional figure: rectangle 3-dimensional figure: cuboid Function: to determine the layout of the board position
3	<i>Soloro</i>	2-dimensional figure: rectangle 3-dimensional figure: cuboid Function: to strengthen the ship's walls
4	<i>Lepe</i>	2-dimensional figure: rectangle 3-dimensional figure: cuboid Function: to strengthen the ship's walls
5	<i>Lambung perahu/ the ship hull</i>	2-dimensional figure: scalene trapezoid Function: provide buoyancy for the ship and flank the keel
6	<i>Sotting</i>	2-dimensional figure: rectangle 3-dimensional figure: cuboid Function: to connect between the ship's components on the left and on the right, such as the planks and <i>soloro</i>
7	<i>Anjong</i>	2-dimensional figure: Isosceles Triangle and Isosceles Trapezoid

		Function: as a place to tie the three <i>Cocoro sails</i> . Also serves as a decoration to beautify the appearance of the Pinisi ship
8	<i>Papan lantai induk (ibu dek) dan papan lantai biasa (katabang)/ The main floorboard (mother deck) and the ordinary floorboard (katabang)</i>	2-dimensional figure: rectangle 3-dimensional figure: cuboid Function: as a support for transverse strength
9	<i>Ujung belakang papan lantai/Back end of floorboard</i>	2-dimensional figure: Isosceles Trapezoid Function: as a support for transverse strength
10	<i>Ujung depan papan lantai/ Front end of floorboard</i>	2-dimensional figure: Isosceles Triangle Function: as a support for transverse strength
11	<i>Bangkeng salara</i>	2-dimensional figure: rectangle 3-dimensional figure: cuboid Function: as a place for the <i>tiang agung</i> to lean on
12	<i>Tiang agung/The great masts</i>	3-dimensional figure: cylinder Function: Place to attach sails and rigging
13	<i>Tanpasere sails</i>	2-dimensional figure: Acute Scalene Triangle Function: operate as a small sail and ship propulsion aid when sailing
14	<i>Sombala sails</i>	2-dimensional figure: scalene trapezoid Function: as the main sail
15	<i>Cocoro tarengke</i>	2-dimensional figure: Right Scalene Triangle Function: assisting sail on the back
16	<i>Cocoro tangnga</i>	2-dimensional figure: Obtuse Scalene Triangle Function: assisting sail on the middle
17	<i>Cocoro pantara</i>	2-dimensional figure: Obtuse Scalene Triangle Function: assisting sail on the front

Based on the table above, it can be seen that the Pinisi ship has a variety of flat and solid figures. Rectangular shapes and cuboids are found in *kalebiseang*, *tambugu*, *soloro*, *lepe*, *sothing*, *the main floorboards and the ordinary boards*, and *bangkeng Salara*. The scalene trapezoid is found on the hull of the ship and *Sombala sails*. An isosceles triangle is found on the *anjong* and the front end of the floorboard. An isosceles trapezoid appears on the *anjong* and the back end of the floorboard. The cylinder can be seen on the *tiang agung*. The acute scalene triangle is present on the *tanpasere sails*. The right scalene triangle is found on *Cocoro tarengke* while the obtuse scalene triangle is found on *Cocoro tangnga* and *Cocoro pantara*.

3.2.2 Geometry Transformation

Table 2. Geometry Transformation

No	Name	Description
1	<i>Tambugu</i>	Translation
2	<i>keseluruhan kapal bagian kiri dan kanan (The whole ship)</i>	Reflection

3	<i>tungku-tungkuluq, pannapu sarro, rakka, bengo, sangahili pintallung, sangahili pinruang, pangepeq, urussangkaraq, papangannang, papang lamma, rembasang</i>	Reflection
4	<i>papangappa</i>	Translation
5	<i>Soloro and lepe</i>	Reflection
6	<i>soloro</i>	Translation
7	<i>Bangkeng salara</i>	Reflection And Translation
8	<i>Anjong</i>	Reflection
9	<i>Anjong</i>	Dilation and translation
10	<i>Papan lantai induk (ibu dek) dan papan lantai biasa/ The main floorboard and the ordinary boards</i>	Dilation and translation
11	<i>Tiang agung belakang dan depan/ the great masts at the front and rear</i>	Dilation and translation
12	<i>Komponen Tiang Agung tegak dan miring/ The vertical and oblique components of the great masts</i>	Dilation and rotation
13	<i>Tanpasere sails</i>	Dilation and translation
14	<i>Sombala sails</i>	Dilation and translation

In the table above, several components of the pinisi ship apply geometric transformations, such as translations that can be seen in *tambugu*, *Papangappa*, *soloro*, and *bangkeng salara*. Reflections can also be found on the entire left and right side of the ship, *Tungku-tungkuluq*, *pannapu sarro*, *rakka*, *bengo*, *sangahili pintallung*, *sangahili pinruang*, *pangepeq*, *urussangkaraq*, *Papangannang*, *Papang Lamma*, *Rembasang*, *Soloro* and *Lepe*, *Bangkeng Salara*, and *Anjong*. Furthermore, A combination of dilation and translation is found on *anjong*, the main and ordinary floorboards, the rear and front *tiang agung*, *tanpasere sails*, and *sombala sails*. And finally, the dilation and rotation occur in the vertical and oblique components of the great masts.

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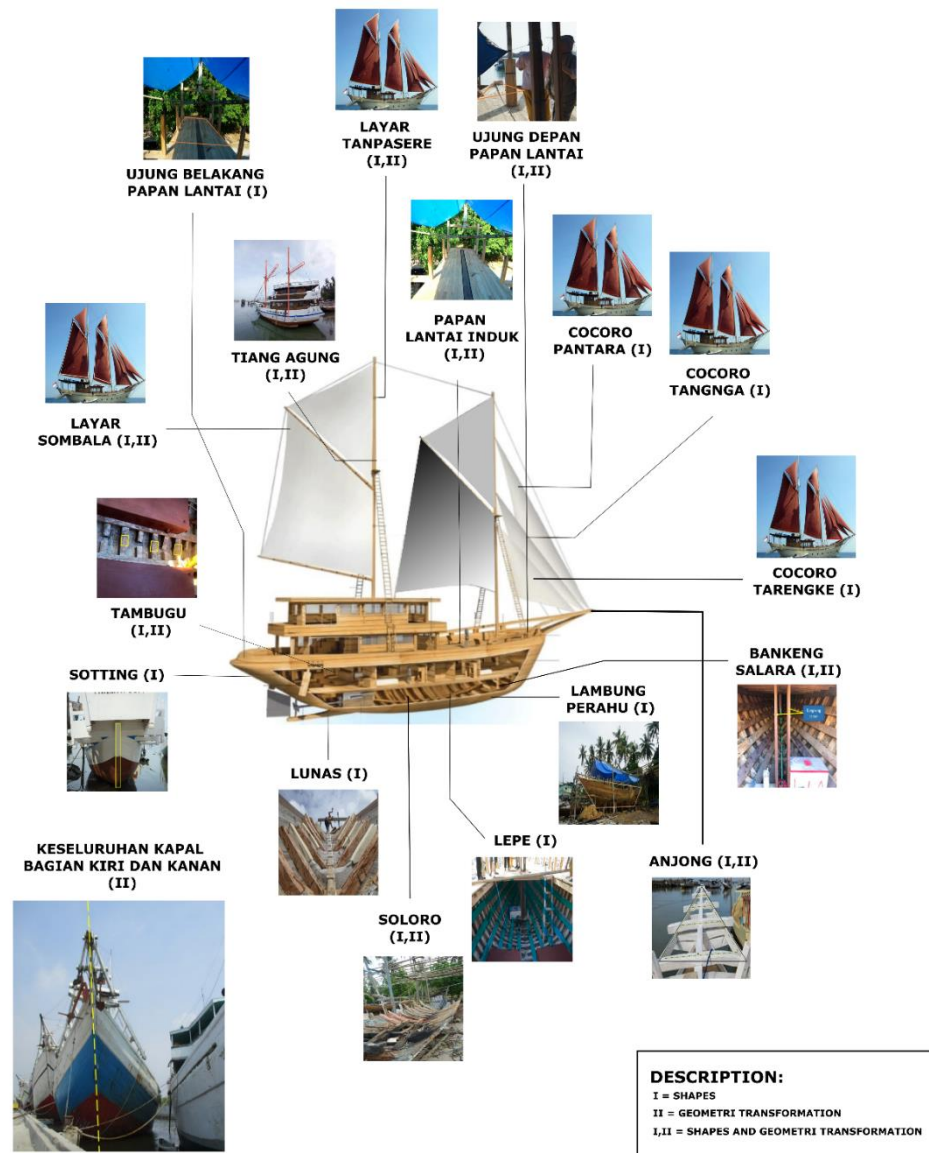


Figure 1: (Kompas. (2019); Mohammadwildan. (2016); Cun, C., 2017)

3.3 Discussion

3.3.1 Shape

3.3.2 Rectangles and Cuboids

We can see this rectangle or cuboid in the *kalebiseang* (keel) which is the most basic foundation of a ship. These keel shapes have their respective symbols. *Kalebiseang* consists of 3 pieces of wood that are put together, where the male keel is deliberately placed in front while the female keel is placed at the stern (at the rear) because it is considered that the male is the *karaeng* (higher status) who must lead the female. The keel grafting is considered a marriage procession to produce a baby in the form of a Pinisi ship (Putra, A. P. B., 2019).

"Jadi ini lunas pertama, lunas kedua, lunas ketiga, sotting, sotting terting jadi ini lima lima kerangka ini" (ww.16-09-22/bpk Dg U)

"So this is the first keel, the second keel, the third keel, sotting, the highest sotting, so here are these five five frameworks" (translated)

"Ada namanya jadi eeeee lunas depan, ee jadi ini dibelakang ee misalnya di anu karaeng itu bahwa dia laki laki, di belakang perempuan" (ww.16-09-22/bpk Dg U)

"There is a name so eeeee the front keel, ee so this is on the back, for example in anu karaeng it says that it is a man, behind a woman" (translated)

In addition, there is also a *sotting* or *linggi* which amounts to 2 and is located at the bow and stern of the ship. *Sotting* in the form of a cuboid or rectangle will be connected with the 3 keels so that it will symbolize the human spine which consists of 5 parts, namely the cervical, thoracic, lumbar spine sections, sacrum, and coccyx,

"Nah kan ini kan dia punya tulang juga tulang uhh istilahnya lunas pertama itu kan tulang belakang nya kita" (ww.16-09-22/bpk P)

"Well, it has bones, too, uhh, the term is the first keel, it's our spine, right?" (translated)

"Jadi ini ini di satu, dua, tiga, empat, lima. Ini lima kerangka jadi ini termasuk kerangka jadi didalam tubuh manusia itu dibelakang ini ada lima kerangka ini di bekakang coba kita eeee pelajari toh ada berapa kerangka di tulang belakang kita ada berapa kerangka disini pasti dia bilang lima" (ww.16-09-22/bpk DG U)

"So, it's one, two, three, four, five. It's five skeletons, so this is included as skeletons. So in the human body, behind this there are five skeletons, on the back, you can try to learn about it, how many skeletons are in our spine, how many skeletons are here, they will say five" (translated)

Soloro and *lepe* have relatively the same function, namely to strengthen the ship's walls. The location of both components is behind the ship's wall and has a shape that is not too different. *Soloro* or *gading* symbolizes human ribs while *Lepe* signifies human veins.

"Nah ini kan kalau kita lihat ada tulang di dalam ini menanda menyimbolkan bahwa itu tulang rusuk manusia" (ww.16-09-22/bpk P)

"Well, if we see there is a bone in it, it symbolizes that it is a human rib" (translated)

"Nah ini gading uhh menandakan bahwa tulang, tulangnya manusia nah. Kalau galar ini atau lepe menandakan bahwa itu adalah urat" (ww.16-09-22/bpk P)

"Well, this gading uhh indicates the bones, the human bones. On the other hand, galar or lepe indicates that it is a vein" (translated)

Ten *tambugu* are placed along the keel at the same distance. *Tambugu* has the shape of a cuboid or rectangle and is always side by side with the *roang*. The floorboards (*papan lantai*) on the Pinisi ship have a cuboid shape when viewed as a solid figure, but also have a rectangular shape when classified as a plane figure. This section is used functionally. *Bangkeng salara* also has a cuboid

or rectangular shape and is usually placed between the great masts (*tiang agung*) and penetrates to the bottom of the ship.

3.3.3 Scalene Trapezoid

The hull of the Pinisi ship (*lambung kapal*) has a scalene trapezoid shape when viewed from a two-dimensional form. This section is composed of *Lamma boards* and *Terasa boards*. The walls of the ship can be interpreted as parts of the human body, namely 14 knuckles, 1 wrist joint, 1 elbow joint, and 1 shoulder joint in each arm, and if calculated on both human arms there will be 34 in total, which based on interviews are said to be in accordance with the number of *Terasa boards*. *Terasa boards* are strong, hard-to-bend planks that cover all of the parts that lie beneath the *Lamma boards* arrangement.

"iya iya setiap papannya itu eee kalo tradisional dulu kita itu ee apa Namanya jumlahnya itu ee 34 lembar" (ww.16-09-22/bpk P)

"Yes, yes, traditionally each board is used with a total of 34 pieces" (translated)

"iya jumlah papannya kan dari tubuh manusia ini ada 34 jadi kita hitung dari jari-jari ini. pas ini 1,2,3,4,5,6,7,8,9, 10, 11, 12, 13, 14, 15, 16, 17. jadi ee gunanya ini toh walaupun kapal ini tertumbuk di karang tidak akan bisa retak tidak akan bisa patah karena dia tidak kena iini jari jari. jadi itu" (ww.16-09-22/bpk P)

"Yes, the number of boards that come from the human body is 34, so we count from these fingers. This fits perfectly, 1,2,3,4,5,6,7,8,9, 10, 11, 12, 13, 14, 15, 16, 17. the point of this, even though this ship is hit by a rock, it won't crack, it won't break because it doesn't hit the fingers." (translated)

However, there are also those who argue that the number of *Terasa boards* is 36 which symbolizes the *hijaiyah letters* and human joints. This board component indicates the ship is elastic and sturdy.

"Hijaiyah kan ada... ada 36... 36 huruf. Huruf hijaiyah toh? Ada 36 dari abba, a sampai shod toh? A sampai shod. Itu dari papan terassanya kapal ini, perahu ini ada 36 . 36 lembar. Ada 36 lembar itu yang mengatakan bahwa kapal ini sudah keras, istilahnya sudah kokoh. Nah diambil dari... kalau diambil dari manusia, tubuh manusia, dia ambil dari persendian. Ini hitungan satu, dua, tiga, empat, lima, enam disini ada empat belas dari sini. Semua persendian di pergelangan ini. 14 kali 2, 28 juga. Eh 28, 28 " (ww.16-09-22/bpk P)

"There are hijaiyah... there are 36... 36 letters. Hijaiyah letters, right? There are 36 from abba, a to shod, right? A to shod. That's from the Terasa board of this ship, there are 36 in general. 36 sheets. There are 36 pieces that say that this ship is firm, it is strong. Now if it is taken from... if it is taken from humans, the human body, it is taken from the joints. Started from one, two, three, four, five, six, here... fourteen from here. All the joints in this wrist. 14 times 2, 28 too. Uh 28, 28" (translated)

The bark on this ship is also often associated with the outer wall of the bone.

"Nah terus ini ada tulang di dalam ini, ini kan di tulang baru ada lagi kulit, kulit kayu itu dinding luar mi... dinding luarnya" (ww.16-09-22/bpk P)

"Well then there's the bone inside, right on here it is the bone there's also outer skin, the bark is the outer wall" (translated)

The *sombala sails* are located on the great masts called *tiang agung* with the front *sombala* being larger than the rear. The number of sails on the Pinisi itself is seven, including 2 *sombala*, 2 *tanpasere*, 1 *cocoro tarengke*, 1 *cocoro tangnga*, and 1 *cocoro pantara*. Some people believe that the number of sails symbolizes the 7 letters of Al-Fatihah (Setiawan, A. 2012; Putra, A. P. B., 2019). *"itu tujuh layar cuma perasaan kalau saya kasi layar seperti itu toh mungkin lajunya akan seperti itu. tapi ba sekarang itu di pelintir bahwa apa namanya dua dua layar dua kali syahadat, tujuh layar ee tujuh ayat di dalam al' fatihah."* (www.16-09-22/bpk Dg U)

"It's seven sails, it's just a feeling that if I give a sail like that, maybe the speed will be like this. but now it's twisted that what is called two sails symbolize two shahadat, seven sails means seven verses in Al' Fatihah." (translated)

3.4 Scalene Triangle

3.4.1 Acute

The *Tanpasere sails* are small sails located at the very top of the masts (*tiang agung*).

3.4.2 Right

Cocoro Tarengke is one of the three assisting sails located at the very back.

3.4.3 Obtuse

Cocoro tangnga and *cocoro pantara* have the shape of an obtuse scalene triangle. *Cocoro Tangnga* is located in the middle, between the three assisting sails while *Cocoro Pantara* is located at the very front. Basically, the three *cocoro* are tied to the *anjong*.

3.5 Isosceles Triangle

The *anjong* and the front end of the floorboard (*ujung depan papan lantai*) has the shape of an isosceles triangle located at the bow of the Pinisi. In general, *anjong* is used as decoration or aesthetic value. Likewise, the front end of the floorboard (*ujung depan papan lantai*) is adjusted to the shape of the hull and the function of the ship.

"kalau bentuk rangkanya tergantung dari anunya toh kita mau model lancip, model ee kayak kerbau iya toh tergantung dari kita, kita mau ee apa namanya misalnya mau muat barang iya toh harus seperti kerbau toh atau batang tedong ee toh jadi ada lagi yang model kerucut toh iya toh ee itu akan kurang dia muatan itu, tapi lajunya akan cepat. jadi itu kemiringannya toh maksudnya itu tadi toh perasaan iya toh jadi pakai rasa tidak diukur bilang oh mau sekian ini sekian ini ee." (ww.16-09-22/bpk Dg U)

"The shape of the structure depends on what we want. we want a lancip model (pointed model), and the kerbau model (buffalo model). yes, it depends on us. For example, if we want to load goods, it must be like a kerbau (buffalo) or batang tedong model. There's also kerucut model (cone model). Yes, it's going to be less loaded, but the speed will be fast. So that's the slope, anyway, I mean that's the feeling, yes, so we need to use emotion. it's not measured. I say oh, I want this, then I will do this, etc." (translated)

3.6 Isosceles Trapezoid

When viewed in detail, *anjong* is composed of several trapezoids of different sizes and is located at the bow of the Pinisi ship. while the rear end of the floorboard (*ujung belakang papan lantai*) has an isosceles trapezoidal shape located at the stern.

3.7 Cylinder

The cylinder form is only found on the two great masts (*tiang Agung*) where the front mast is slightly higher than the rear mast. The great masts are fundamental for Pinisi ships to sail. Often people believe the two great masts (*tiang agung*) are related to the foundation or basis of Islam, namely the two shahadat (Setiawan, A. 2012; Putra, A. P. B., 2019).

"sekarang itu banyak orang dua dua yang berlayar maksudnya menandakan dua kali syahadat itu mana bisa iya toh." (ww.16-09-22/bpk Dg U)

"Nowadays there are many people who say two in sailing, means the two shahadat. it's absurd." (translated)

3.8 Geometric Transformation

3.8.1 Reflection

Reflections can be obtained through the axes of symmetry which are visible from the top, front, and back sides of the ship.

3.8.2 Keseluruhan Kapal (the whole ship)

The existence of axes of symmetry on the front, back, and top of the ship proves that the Pinisi ship components on the left, reflect the Pinisi ship components on the right. The components include *Lepe* (horizontal beam frame), *soloro* (vertical beam frame), *bangkeng salara*, and *Anjong* section, as well as the hull of the ship (*lambung kapal*), keel (*lunas*), the great masts (*tiang agung*), sails, and so on. This symmetry is deliberately made to maintain the balance of the ship.

3.8.3 Papan tata tallu

From the secondary source obtained, there is a formula for the *tata tallu board* preparation. The arrangement can be studied using geometric transformation. Although there is a possibility that these boards will later be adapted to the shape of the ship desired hence the arrangement or order of the original boards can be changed and modified. We can still see several components, such as *tungku-tungkuluq*, *pannapu sarro*, *rakka*, *bengo*, *sangahili pintallung*, *sangahili pinruang*, *pangepeq*, *urussangkaraq*, *papangannang*, *papang lamma*, and *rembasang*, utilize reflection between the front and back sides of the *tata tallu board*. The total number of some boards, namely 2 *pangepeq*, 4 *sangahili pinruang*, and 2 *urussangkaraq*, if combined with 3 keels and 2 sotting will amount to 13 which corresponds to the number of pillars of prayer in Islam. This indicates that the bottom of the ship is strongly shaped.

“istilahnya kalau dari kita agama jadi dari... maksudnya dari...kajiannya dari agama Islam, itu dia kaji dari rukun Islam sebenarnya. Nah kenapa saya bilang itu, tiga lunas, dua pamaru. Istilahnya pamaru ini linggi depan, linggi belakang, sudah lima. Ah. Eh... lima. Lunas tiga, pamaru dua jadi pengapit luar tujuh, urussangkaraq luar sembilan, pakai empat, tiga belas, rukun tiga belas. Dia nda bakal lepas dari situ, itu menandakan bahwa itu perahu sudah berbentuk.” (ww.16-09-22/bpk P)

"According to us, the term derived from religion. I mean it is from the Islam interpretation. It is actually from the pillars of prayer. So why do I say that, three keels (lunas), two pamaru. Pamaru includes the front linggi, and the back linggi, now it is already five. Ah. Uh... five. The three keels (lunas), two pamaru then it becomes seven with the outer flank (pengapit luar), it becomes nine with the outer urussangkaraq, there are also 4 pakai, so now it's thirteen, the thirteen pillars. Both can't be separated, it is an indication that the ship is already in shape." (translated)

While the *Papang lamma* itself is a symbol to strengthen and embrace all parts which are considered as the flesh section of the human body (Putra, A. P. B., 2019)

3.8.4 Translation

Papang appa and Tambugu

In this section there are *tambugu* that have the same size along the keel (*lunas*), only their position changed (translation). This *tambugu* and *roang* have a certain measurement because the length is measured using body parts and later on will determine the fate of the keel (*lunas*). The objective is to look for two good traits among the 6 characteristics. The six characteristics are *mati di darat* (death on land), *tenggelam di Laut* (drowning in the sea), *massale-sale* (having fun), *mencari laba* (profit-seeking), *manggara maling*, and *nala pammusu*. The good faith people seek is *massale-sale* and *mencari laba*.

“Sudah ada aturannya ada dibilang ee massale sale, mencari laba, manggara maling, nala pammusu, tenggelam dilaut, mati di darat itu sudah ada, sudah ada aturannya itu” (ww.16-09-22/bpk Dg U)

"There are already rules for this, ee massale-sale, mencari laba, Manggara malling, Nala Pammusu, tenggelam di Laut, mati di darat, the rules were already made"(translated)

"A... dua ya itu dua sifat yang kita cari, makanyalah muncullah teorinya ini, tambugu dan Roang"
(ww.16-09-22/bpk P)

"A... two yes, those are the two traits we are looking for, that's why this theory came up, tambugu and Roang"(translated)

Similarly, the *Papang appa* also have the same proportion along *the tata tallu board*, which is 4 *tambugu* and 4 *roang*. Thus, only translation occurs. Some *soloro* (vertical beam frames) have the same shape and only shifted from their place. Hence some *soloro* undergo translation.

Bangkeng Salara

This section is composed of two pillars that have the same shape and size. They only experience translation.

3.9 The Combination of Dilation and Translation

Keep in mind that the occurrence of dilation depends on the ratio of each element. Many parts of the ship seem to apply the concept of geometric transformation in general. However, there is no guarantee of accuracy.

3.9.1 *Papan lantai (floorboard)*

The ordinary floorboard (*Papan Lantai Biasa*) is usually dilated in order to make its size wider and longer and then its position is moved from the original location to the middle section (translation). However, this only applies to a few certain floorboards due to the specific ratio needed by the dilation requirements.

3.9.2 *Anjong*

In this section, there are many trapezoids whose size continues to decrease proportionally, so it can be concluded that there is a possibility for dilation and translation to take place.

3.9.3 *Tiang agung (the great masts)*

If observed in the form of a line. The great front mast (*tiang agung depan*) is much higher than the rear great mast (*tiang agung belakang*). Thus, it has experienced dilation and translation. According to the interview, the different sizes of the masts are only used as aesthetic support. Nonetheless, there are some who believe that the higher mast symbolizes Allah SWT and the slightly lower mast located behind is the symbol of Prophet Muhammad SAW (Putra, A. P. B., 2019).

"karena itu kalau sama tinggi toh itu ee apa namanya ee penampakannya itu tidak akan bagus dilihat iya tapi karna kalau ee maksudnya toh ee tidak maksudnya tergantung dalam di dalam kapal itu ada namanya seni jadi kita mengarah ke seninya jadi kalau begini toh ee kalau tidak kelihatan seninya"
(www.16-09-22/bpk Dg U)

"That's why if it's the same height, the appearance will be bad, yes, eh, I mean it depends on the ships, there is something called art, so we're going to look for the art, so if it isn't like this, eh, you won't see the art" (translated)

3.9.4 *Tanpasere and Sombala*

It is evident that the *Tanpasere sails* which are in the form of a scalene triangle, and the *sombala sails* which are in the shape of a scalene trapezoid have different proportions. The sails on the back are much smaller than the front hence there is dilation and translation.

3.9.5 The Combination of Dilation and Rotation

If viewed in the form of a line. The rear and front masts (*tiang agung*) each own different sizes and consist of a vertical line and two oblique lines. Consequently, it can be said that it has dilated and rotated.

Overall, the Pinisi Ship is likened to the creation of mankind itself. First, humans have body organs as constituents, as well as the Pinisi ship. Furthermore, both are included elements of the microcosm, which is the smallest part of nature that must maintain harmony with the whole universe (macrocosm) in order for life to keep on existing. Thus, to maintain harmony, various rituals are carried out. The third reason is that both have a purpose. If God created humans in this universe with the aim of exploring the world, then the Pinisi ships were made with the aim of exploring the vastness of the ocean (Ramadhani, A., S. 2017; Putra, A. P. B., 2019).

"pembuatan perahu ini toh eee lebih ke apa Namanya eee ilmu tasawuf " (www.16-09-22/bpk Dg U)

"The process of making this ship is more about, what is it called, eee the science of Sufism (tasawwuf)" (translated)

"iya toh, karena di dalam kapal ini toh kita tidak mengandalkan mata tidak mengandalkan ee apa Namanya akal jadi harus mengandalkan hati Nurani dengan jiwa. " (www.16-09-22/bpk Dg U)

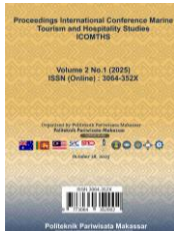
"Yes, after all, on this ship, we don't rely on our eyes, we don't depend on what's called intelligence, so we have to rely on conscience and psyche. " (translated)

4. CONCLUSION

Based on the results of the ethnomathematics research, it can be concluded that the pinisi ship displays several mathematical shapes such as triangles, trapezoids, rectangles, and cylinders. Meanwhile, geometric transformations can be found in tambugu, soloro, anjong, tiang agung, tanpasere sails, and in other parts. Furthermore, if it is associated with the philosophical meaning of geometrical shape and transformation, these values are inseparable from religious symbols and the human body as a whole.

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