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EXPLORATION OF ETHNOMATHEMATICS AND PHILOSOPHICAL MEANING OF KARO GARISTA TRADITIONAL HOUSES IN NORTH SUMATRA

Khairidatun Nisa[1]*, Eka Khairani Hasibuan[2]
[1,2] Mathematics Education, Faculty of Tarbiyah and Teacher Training, State Islamic University of North Sumatra – Medan, North Sumatra, Indonesia, 20371
*Corresponding author's email: khairidatun0305213095@uinsu.ac.id

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Abstract

This study aims to determine ethnomathematics of the roof and ornaments as well as the philosophical meaning contained in the Karo Garista Traditional House in North Sumatra. The research method used in this study is qualitative with an ethnographic approach. Data collection techniques were obtained through observation, interviews, and documentation. The results of the study indicate that there are mathematical concepts in the Karo Garista traditional house, namely, 1) On the roof of the house there are concepts of flat shapes, namely trapezoids and triangles 2) In the ornaments of the house there are concepts of geometric shapes and transformations, namely translation, reflection, rhombus and circle 3) In the philosophical meaning there are mathematical concepts, namely sets, ratios and folding symmetry through spatial layout, number of kitchens, and ornamental patterns full of symbolic meaning. This study provides empirical evidence in cultural preservation, development of culture-based mathematics learning, and enrich ethnomathematics studies in Indonesia.

Keywords: *ethnomathematics; Karo Garista traditional house; philosophical meaning*

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INTRODUCTION

Ethnomathematics is a field of science that studies the relationship between mathematics and culture in people's life activities. In the Indonesian context, traditional houses are a form of cultural heritage rich in mathematical values, both in their structure, proportions, and ornamentation. One of the traditional house that is important to study from an ethnomathematics perspective is the Karo Garista traditional house in North Sumatra. This traditional house not only possesses unique architecture but also reflects geometric and mathematical concepts that have been used for generations by the Karo people (Saputra, 2024).

Currently, a growing body of research focuses on preserving local culture through a mathematical approach. This aligns with efforts to integrate culture-based mathematics education into the Indonesian curriculum (Wardoyo et al., 2024). However, deeper exploration is still needed to gain a broad understanding of the mathematical concepts

specifically in the form and ornamentation of the Karo Garista traditional house. Besides serving as a form of cultural preservation, this research can also help develop more contextual learning methods in mathematics and traditional architecture.

According to research by Sinulingga et al. (2025) shows that the Karo Siwaluh Jabu traditional house contains ethnomathematic elements that can be observed in the form of two- and three-dimensional geometric concepts such as triangles, squares, rectangles, rhombuses, trapezoids, circles, and cubes. In addition, the concepts of area of flat shapes, volume of spatial shapes, and symmetry are also found. The symbolic meaning of this traditional house symbolizes unity and harmony in the life of the Karo people. The value of mathematical discipline is reflected in the measurement and placement of parts of the house, as well as cultural and aesthetic values are seen from the ornaments and decorative variations on the walls of the house.

Research by Yanti & Surya (2021) revealed that mathematical concepts in Karo culture are not limited to traditional houses but are also reflected in geometric patterns in traditional weaving, carvings, and traditional dances. This study demonstrates how the Karo people integrate mathematics into various aspects of their lives, which can be used as an innovative approach to culture-based mathematics learning. By understanding how mathematics has been used in local culture, students can more easily connect mathematical concepts to real life.

Although extensive research has been conducted on ethnomathematics in traditional houses in Indonesia, studies specifically addressing the Karo Garista Traditional House are still very limited. This gap indicates that understanding how the Karo people have traditionally applied mathematical principles in their traditional house architecture has not been fully uncovered. Most previous research has focused on traditional houses from other ethnicities, so the unique Karo perspective is often overlooked. Over time, the application of mathematical concepts in the preservation of traditional houses has also decreased, potentially leading to the loss of their mathematical values. Thus, this research gap can be bridged through an in-depth ethnomathematics study of the Karo Garista Traditional House, in order to identify and analyze the mathematical concepts reflected in its philosophical meaning, roof shape, and ornamentation.

Several previous studies have discussed ethnomathematics in the context of traditional houses in various regions, such as the Betawi traditional house (Saputra, 2024), the Honai traditional house from Papua (Wardoyo et al., 2024), the Karo Heritage Museum (Rizqi et al., 2025), and the Karo traditional house (Sinulingga et al., 2025). These studies identified various mathematical concepts such as geometry, symmetry, and numerical patterns in the architecture and ornamentation of traditional houses. However, in-depth research on the Karo Garista traditional house is still very limited. This study identifies the geometric forms and examines their philosophical meanings within the architectural design of the Karo Garista Traditional House.

With this research, the study of the Karo Garista Traditional House will provide a new contribution to understanding how the cultural and spiritual values of the Karo people are reflected in their architectural design. One important aspect that requires further study is how the geometric patterns on the supporting pillars, roof, and wall carvings of this traditional house. Not only serve a structural function but also symbolize philosophical values, such as the balance between humans, nature, and God (Nasution & Maysarah, 2024).

The main objective of this research is to explore the ethnomathematics concept contained in the roof shape and ornaments as well as the philosophical meaning of the Karo Garista traditional house. The specific objective is to identify the mathematical concept contained in the roof shape and ornaments, in addition to analyzing the philosophical

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meaning of the Karo traditional house where in the house, there are four kitchens that in the past were used together by eight families. The existence of four kitchens used together by eight families in the Karo Traditional House (Siwaluh Jabu Garista) reflects the philosophy of togetherness, mutual cooperation, and efficiency in the life of the Karo people. From this philosophy there is a mathematical concept such as a set, where each family is an element of the set, and the use of the kitchen is a relationship that occurs within the set.

The findings of this study can be a basis for further research on ethnomathematics and its philosophical meaning in various aspects of Nusantara culture. This research can also help the Karo people in understanding and maintaining the cultural values contained in their traditional houses, while providing inspiration for educators in applying mathematical concepts in traditional house buildings. In addition, the results of this study can also be a useful source of information in culture-based mathematics learning, as proposed by Harahap & Nurlaelah (2023) in research related to ethnomathematics and education.

Considering the lack of research on the Karo Garista traditional house from an ethnomathematics and philosophical perspective, this study seeks to provide new insights in this field. Through an exploration of the roof shape, ornamentation, and philosophy of the traditional house, this research will contribute to science, cultural preservation, and culture-based mathematics education in Indonesia. This research aims to foster public appreciation to better appreciate the mathematical values that have been applied from generation to generation in the construction of Karo Garista traditional houses.

METHODS

The type of research used was qualitative research with an ethnographic approach. According to Rukminingsih et al. (2020), ethnography is a qualitative research method used to describe or explain the distinctive characteristics of individuals and groups. This approach focuses on understanding various aspects of social life, culture, language, traditions, human interactions, and more. This study aims to explain the results of ethnomathematics exploration related to mathematical concepts in the philosophical meaning, form or motifs found in the Karo Garista traditional house.

This research was conducted at the Karo Garista Traditional House, located at Jalan Bunga Herba 5 Ujung No. 89, Medan City, North Sumatra on May 18th 2025 to May 20th 2025. The subjects of this research is the Karo Garista Traditional House Manager, Mr. Mardianto. While the objects of this research are the roof shape, ornaments and philosophical meaning of the Karo Garista Traditional House.

Data collection techniques were carried out through observation, interviews, and documentation. Observation sheets were used to systematically record the physical form of the Karo Garista Traditional House, using a structured observation approach so that the data obtained were more objective and comparable. Interview guidelines were structured in the form of open-ended questions and each interview process was recorded using an audio device, then transcribed verbatim to maintain data accuracy. Documentation was used to collect data in the form of photographs of the Karo Garista Traditional House building, which were then validated by comparing the results of field documentation with related literature sources and official archives. All collected data were then classified into primary data and secondary data.

The data analysis technique used follows the Miles and Huberman analysis stages with data analysis stages that include data reduction, data presentation, and drawing conclusions. A large amount of data obtained from the field requires careful and detailed recording. Consequently, data reduction for analysis must occur quickly. Summarizing,

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prioritizing, focusing on the basics, and searching for themes and patterns are all part of data minimization. In this case, researchers conduct interviews, observations, and documentation. Once the results are collected, researchers determine which data will be usable and which will be discarded. Data presentation often used in qualitative research is through narrative or text. Initial conclusions may change if not supported by strong evidence from further data. However, if valid and consistent evidence is obtained during additional data collection, conclusions become more convincing (Sugiyono, 2020).

RESULTS AND DISCUSSION

The Garista Karo Traditional House is the first Siwaluh Jabu House to appear in Medan. The term Siwaluh Jabu comes from the Karo language, meaning a dwelling for eight families. This house originally stood in Tanah Karo, its original location. Built in 1893, it was relocated and rebuilt in Medan between 2018 and 2019. The Siwaluh Jabu House now in Garista once belonged to a former soldier and had long been unoccupied. Due to its long neglect and lack of maintenance in its original location, the house was eventually moved to Medan to become a cultural tourism destination.

The construction of the Siwaluh Jabu House utilizes natural materials such as wood, bamboo, and palm fiber. Wood is used to construct the pillars, main frame, floor, and walls of the house. Bamboo is then used to form the roof frame and terrace. The roof covering is made of tightly arranged palm fiber. This house is shaped like a stilt house with a curved roof resembling a horse saddle. At the end of the roof is an ornament of a buffalo head, believed to function as a ward against disasters and protection. Inside the house are four kitchens that were previously shared by eight families. Entry to the house can only be done through small doors located on the front and back terraces. The space under the house was once used to raise livestock. Researchers have found several findings regarding mathematical concepts and philosophical meanings in the Karo Garista traditional house. The following sections will discuss mathematical concepts and philosophical meanings found in the design of the Karo Garista traditional house.

The Shape of the Roof of the Karo Garista Traditional House

Figure 1 shows the roof of a Karo Garista traditional house made of palm fiber. A mathematical concept in the shape of an isosceles trapezoid is found on the roof of a Karo traditional house.

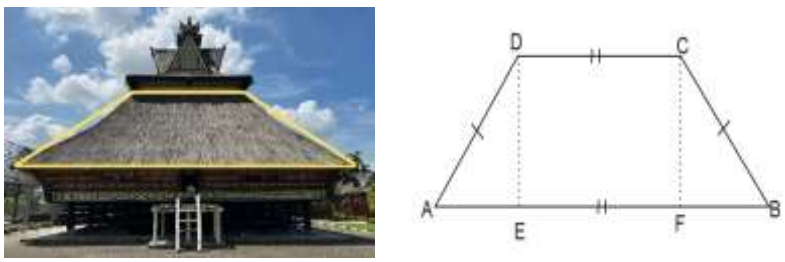

Figure 1. Roof of the Karo Garista Traditional House

In a study conducted by Agustini et al. (2019), the trapezoid shape was also found on the roof of a Waibalun traditional house, which was made from palm tree trunks for the frame and thatch to cover the frame. An isosceles trapezoid is a quadrilateral with a pair of parallel sides (called the base and the top), and two other sides (the legs) of equal length. The characteristic of an isosceles trapezoid is its symmetrical shape and equal angles on the legs. The elements contained in the image above are seen on the two parallel sides, namely sides AB and DC. Sides AD and BC are the hypotenuses or legs of the trapezoid and their

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sides are of equal length. Sides DE and CF are the heights perpendicular to the two parallel sides. The formula for a trapezoid is $K = AB + BC + CD + AD$ and $L = \frac{1}{2} \times (a + b) \times t$.

In Figure 2, a mathematical concept is also found on the roof of a Karo traditional house in the form of an isosceles triangle.

Figure 2. Roof of the Karo Garista Traditional House

In research conducted by Siregar & Hasibuan (2024), the triangular shape is also found in the Syahrun Nur Sipirok Mosque, specifically on the ceiling of the mosque which looks very beautiful. An isosceles triangle is a type of triangle that has two sides of equal length and two angles of equal size. The elements contained in the image above are having two sides of equal length (CA and CB) and AB is the base side. It has two base angles of equal size ($\angle A = \angle B$) and $\angle C$ is the apex angle. It has a height that is perpendicular to AB. It has an axis of symmetry that passes through point C and is perpendicular to side AB. The formula for an isosceles triangle is $K = AB + BC + AC$ and $L = \frac{1}{2} \times a \times t$.

Ornaments of the Karo Garista Traditional House

Figure 3 shows a picture of the Sikawiten dew ornament. This ornament consists of interconnected or lined clouds, symbolizing Rakut Sitelu in Karo society. The cloud section above represents Kalimbubu, while the cloud layer below depicts Anak Beru as a follower. In this ornament, the concept of translation is found in geometric transformation.

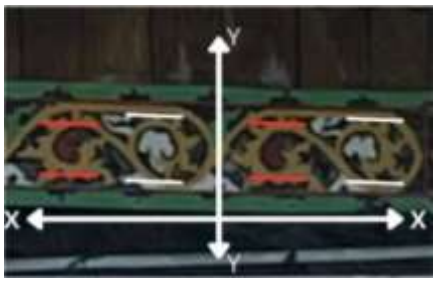

Figure 3. Sikawiten Dew Ornament

In research conducted by Sawita & Br Ginting (2022), the concept of translation was also found in the jasmine flower motif in Langkat Malay woven songket cloth, whose flowers are identical to the Malay ethnic group and mean white, clean, and pure. Translation is the movement of all points from a plane at a certain distance and direction. In this ornament, the form of translation can be seen in the form of clouds arranged repeatedly, indicating the movement of objects at a certain distance and direction.

Figure 4 depicts a pengret-ret ornament. In the Karo community, this ornament is interpreted as a symbol of Derpih reinforcement in traditional Karo houses. The Pengeret-Ret ornament functions like a nail that provides strength to strengthen each board in the

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Karo traditional house building. In this ornament, the concept of reflection is found in geometric transformation.

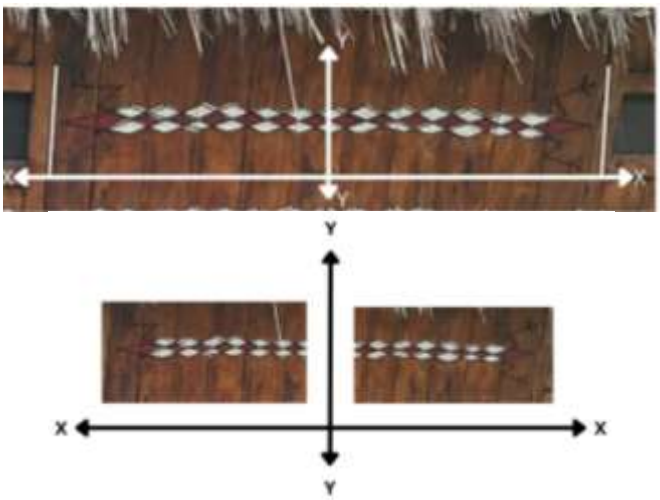

Figure 4. Pengret-Ret Ornament

In research conducted by Rasyada et al. (2025), the concept of reflection was also found on the door of the Sungai Banar Jami' Mosque, which has 23 doors designed to facilitate access for Muslims who come to worship. The number of doors symbolizes the various paths to God, where each door leads people to peace and forgiveness. Reflection is the movement of each point or object to another point or object, such as the formation of an image in a flat mirror. The distance between the origin point to the mirror will certainly be the same as the distance from the image point to the mirror. In this ornament, the reflection form can be seen as a symmetrical shape like an image in a mirror.

Figure 5 shows a picture of a gundur flower ornament. This ornament is shaped like a rhombus with a picture of a gundur flower inside. This ornament contains a mathematical concept in the form of a rhombus.

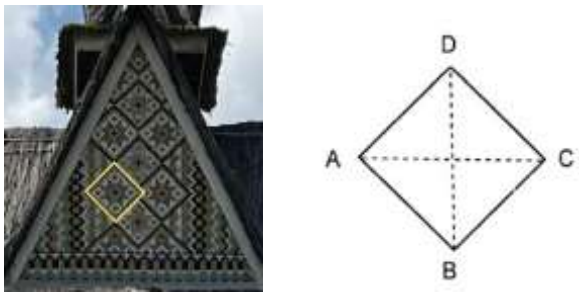

Figure 5. Gundur Flower Ornament

In research conducted by Kou & Deda (2020), the rhombus shape is also found in shawl motifs which contain meaning as an expression of identity and contain the meaning of human closeness to their environment. A rhombus is a flat shape that has four sides of equal length with opposite sides parallel and not perpendicular to each other. The elements contained in the image above have four sides of equal length. It has two pairs of equal angles and opposite angles are equal. It has two diagonals that are perpendicular to each other and intersect at the midpoint. It has two axes of symmetry (lines AC and BD). The formula for a rhombus is $K = 4s$ and $L = \frac{1}{2} \times d1 \times d2$.

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Figure 6 shows a flower-shaped ornament. This ornament has five colors taken from five clans, namely Karo-karo (red), Ginting (yellow), Tarigan (white), Sembiring (black), and Perangin-angin (green). In this ornament, a mathematical concept in the form of a circle is found.

Figure 6. Flower-Shaped Ornaments

In research conducted by Aflah & Andhany (2022), the circle shape is also found in the canang situ musical instrument, which is played by hitting it with a wooden mallet. A circle is the location of points that are equidistant from a certain point. The specified point is the center of the circle, while the equidistant is the radius of the circle. The diameter is twice the radius. The formula for a circle is $K = \pi \times d \; or \; K = 2 \times \pi \times r$ and $L = \pi \times r^2$.

Philosophical Meaning of the Karo Garista Traditional House

Inside the house, there are four kitchens that were once shared by the eight families living there. The existence of four kitchens shared by eight families in the Karo Traditional House (Siwaluh Jabu Garista) reflects the philosophy of togetherness, mutual cooperation, and efficiency in the life of the Karo people. As for its relationship to mathematics learning, namely the use of a shared kitchen, it can be conceptualized as a set, where each family is an element of the set, and the use of the kitchen is the relationship that occurs within the set. This is supported by previous research conducted by Nurhasanah & Puspitasari (2022) which stated that there is a concept of geometric shapes in the kitchen space of the Kampung Pulo traditional house, Cangkuang Village, Garut Regency. Figure 7 illustrates the four kitchens of the Karo Garista Traditional House.

Figure 7. Four Kitchens of the Karo Garista Traditional House

The Karo traditional house, or Siwaluh Jabu Garista, is constructed without the use

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of nails. All parts of the building are connected using wooden pegs, bamboo, and palm fiber ties. The materials used are largely sourced from the previous structure. Nevertheless, this house is believed to be strong enough to withstand earthquakes. Although the construction is nail-free, precision measurements and calculations are required, incorporating mathematical concepts such as ratios, scale, and measurement. This is supported by previous research conducted by Yuningsih et al. (2021) who in their study of the Lengkong traditional house emphasized the application of accurate ratios in traditional building construction, including the use of the golden ratio system in the placement of pillars and structural elements. Figure 8 shows the Karo Garista Traditional House.

Figure 8. Karo Garista Traditional House

On the roof of the house, there are eight buffalo heads at the end of the triangular "Ayo Ayo" ornament, which has a philosophical meaning, namely as a ward against disaster for the house's inhabitants. The relationship with the mathematical concept is the concept of symmetry, where there are four buffalo heads at the top and four buffalo heads at the bottom. This teaches the concept of symmetry. This is supported by previous research conducted by Syafindra et al. (2019) in their study that discussed the buffalo head ornaments located at the end of the roof of the house will protect the house's inhabitants from mystical things. It is natural that in traditional Karo houses, buffalo horns are always found. Figure 9 depicts the buffalo head ornament of the Karo Garista Traditional House.

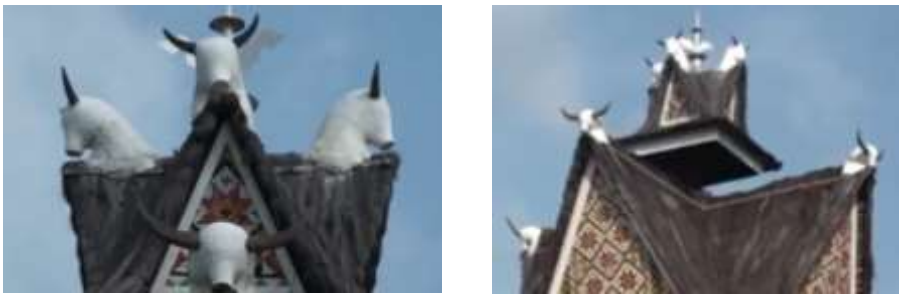

Figure 9. Buffalo Head of the Karo Garista Traditional House

Thus, the Karo Garista Traditional House is not only a symbol of the Karo people's culture and identity, but also a contextual mathematics learning medium rich in local values and geometric concepts used in everyday life. This is supported by previous research conducted by Halim (2022), which stated that the Karo traditional house is not only a symbol of the Karo people's culture and identity, but also contains mathematical concepts that have been unconsciously applied in everyday life, particularly through decorative motifs rich in geometric elements such as triangles, rhombuses, circles, and squares. This research strengthens the case that the aesthetic elements of the Karo traditional house can be used as a contextual mathematics learning medium that integrates local cultural values.

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CONCLUSION AND SUGGESTIONS

Based on the research results, Exploration of Ethnomathematics and Philosophical Meaning in the Karo Garista Traditional House in North Sumatra, found that in the shape of the roof of the house, the concept of flat shapes in the form of trapezoids and triangles is found which shows the Karo people's understanding of basic geometric shapes. Meanwhile, in the house ornaments, there are applications of various geometric transformation concepts, such as translation in the Embun Sikawiten ornament, reflection in the Pengret-ret ornament, as well as other geometric shapes such as rhombuses in the Bunga Gundur ornament and circles in the five-colored flower ornament.

The Karo Garista Traditional House not only reflects local wisdom in terms of form and ornamentation, but also contains philosophical values that can be linked to mathematics learning. The existence of four kitchens shared by eight families reflects the values of mutual cooperation, togetherness, and efficiency, which in mathematics can be linked to the concepts of sets and relations. In addition, the construction of the house which is built without nails, only using pegs and ties, shows the application of the concepts of ratio, scale, and measurement in real practice. The folding symmetry is shown through the placement of eight buffalo heads on the symmetrical roof of the house.

It is recommended for future researchers to conduct research that includes traditional houses from other tribes or regions in Indonesia so that ethnomathematics studies can be broader, and to analyze in more depth the relationship between traditional building structures and the mathematical and philosophical principles contained therein.

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