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# Exploring Ethnomathematics in a Malay Traditional House and Architecture on Meranti Island as a Geometry Learning Resource for Elementary School

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**ABSTRACT**

Traditional architecture often reflects the cultural values, local wisdom, and mathematical thinking of a community. In Meranti Island, traditional Malay houses contain rich geometric elements that have yet to be fully explored in the context of mathematics education. This research aims to investigate the traditional Malay house and architectural designs in Meranti Island a culturally relevant resource for teaching geometry in elementary schools. This study lies in integrating ethnomathematics into the elementary geometry curriculum by utilizing local architectural heritage, which has received limited academic attention. An ethnographic approach was employed to gain a deep understanding of the cultural and mathematical aspects embedded in the traditional architecture. This method was chosen as it allows researchers to capture the contextual meaning and lived experiences of the community through interviews, observations, documentation, and field notes. The findings reveal that traditional Malay houses in Meranti Island incorporate a variety of geometric concepts. Flat shapes identified include squares, rectangles, triangles, rhombuses, parallelograms, and trapezoids, while solid shapes include cubes, cuboids, cylinders, and triangular prisms. These findings demonstrate that traditional architectural elements can serve as meaningful and contextual learning materials for geometry instruction. The practical implication of this study is the development of culturally responsive teaching strategies that connect students' local environments with mathematical concepts. This approach not only enhances students' understanding of geometry but also fosters appreciation for local culture and identity through mathematics learning.



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## INTRODUCTION

Mathematics is a fundamental discipline in human life and an essential component of primary and secondary education. To make mathematics learning meaningful, it must be connected to real-

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world contexts, as mathematical ideas are deeply embedded in everyday human activities across diverse societies (Barton, 1999; D'Ambrosio & Borba 2010) . As a cultural construct, mathematics develops in response to human needs and challenges, and its understanding is strongly influenced by cultural backgrounds and lived experiences.(Zusmelia, 2016 ; Putra et al., 2024).

Culture-based mathematics education offers a meaningful and contextual alternative. It connects mathematical knowledge with learners' cultural communities, making learning more engaging and relevant (Anriana, et al., 2023).This approach aligns with constructivist learning theory, which emphasizes knowledge construction through lived experiences in social and cultural contexts (Kruckeberg, 2006). Ethnomathematics thus functions as a bridge between informal, culturally grounded mathematical practices and formal mathematics education, fostering deeper conceptual understanding while also strengthening students' cultural identity (Matang & Owens, 2014) ; Stathopoulou et al, 2006).

Culture-based mathematics learning is one way that is perceived to be able to make mathematics learning meaningful and contextual which is closely related to the cultural community, where mathematics is learned and will be applied later, and with that cultural community, as well as making mathematics learning interesting and enjoyable (Anriana, Witri, Putra, Fendrik, Dahnilsyah, et al., 2023). Learning conditions that enable contextual meaning creation based on experience as a member of a cultural society are one of the basic principles of constructivism theory (Kruckeberg, 2006b), and it is inline with the idea of ethnomathematics.

Ethnomathematics was first introduced by a famous mathematician from Brazil named D'Ambrosio in 1985 (D'Ambrosio, 1989). Ethnomathematics is referred to as science through culture as a starting point for building and connecting students' understanding of informal mathematics to formal mathematics (Matang & Owens, 2014b). The development of ethnomathematics through culture makes people unaware of its existence ethnomathematics because it is considered simple when compared to formal mathematics in schools (D'Ambrosio, 1995).

Ethnomathematics is a field of study that is usually used to show the relationship between culture and mathematics. It is further stated that the concept of ethnomathematics can make a huge contribution to improving mathematics learning because it links students' experiences in everyday life which can touch the realm of art and local culture so that students can better understand the mathematical concepts being studied (Stathopoulou & Kalabasis, 2006). It can be understood that mathematics learning can be taught using culture as a learning resource. Apart from that, ethnomathematics also offers learning based on local culture so that students can get to know and deepen the culture of their nation (Kurino & Rahman, 2022).

Several studies related to the exploration of ethnomathematics in traditional buildings have been carried out, including research by (Kurino & Rahman, 2022) regarding the exploration of ethnomathematics of traditional *Panjalin* houses on basic geometric concepts in elementary schools. (Safitri et al., 2021) explore ethnomathematics of the *Uma Lengge* traditional building and they found that the measurement methods used by the Bima traditional community are very diverse. A study conducted by (Bayu, 2021) examines the geometric materials found in *Langkanae* traditional house buildings in Palopo City. Meanwhile, (Khaqiqi, 2022) study shows that the *Muhammad Cheng Hoo* Mosque consists of three cultural elements, namely Chinese, Arabic, and Javanese. As for this study, the ethnomathematics study focuses on the Malay Traditional House and Architecture on Meranti Island. The Meranti Island is one of the districts in Riau province which has a variety of cultures and characteristics, one of which is the traditional house and architecture. It is known as *Lembaga Adat Melayu Riau* (LAMR) Meranti Island. It contains elements of traditional houses in Riau including roofs, pillars, windows, doors, etc. Those elements

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are potential for geometrical learning in elementary school. This study contributes to expanding ethnomathematics research by situating it in an underexplored cultural setting, thereby enriching cross-cultural perspectives on mathematics education. Practically, it provides educators with culturally relevant learning resources that can make mathematics instruction more meaningful, contextual, and engaging for students. Therefore, the present study aims to explore Malay ethnomathematics in the Malay traditional house and architecture in Meranti Island. This is also supported by the fact that there has been no research on ethnomathematics exploration in the LAMR in Meranti Islands. Thus, research questions lead this study is stated as follows:

a. What ethnomathematics objects are found in the Malay traditional house and architecture in Meranti Islands?
b. What is the geometrical concept contained in the Malay traditional house and architecture in Meranti Islands in line with mathematics learning in elementary school?

## LITERATURE REVIEW

### Malay Ethnomathematics

Ethnomathematics is defined as mathematical activities carried out by certain cultural groups in a society (D'Ambrosio, 1989). The development of science provides some spaces for the application of ethnomathematics in schools to solve complex problems in mathematical practice, so that its application begins to grow rapidly in the world of education, especially in Indonesia (Anriana, Witri, Putra, Fendrik, Dahnilsyah, et al., 2023; Putra et al., 2024).

Ethnomathematics is a form of culture and has actually been integrated into all aspects of people's lives wherever they are. In essence, mathematics is a symbolic technology that grows from skills or activities in a cultural environment. Thus a person's mathematics is influenced by his cultural background, because what they do is based on what they see and feel (Dwidayati et al., 2019).

Ethnomathematics has been explored in many cultures, including in Malay community. The term of Malay ethnomathematics has been used by some researchers (Anriana, Witri, Putra, Fendrik, Dahnilsyah, et al., 2023; Hasanuddin, 2017; Putra et al., 2024; Zain, 2002) to study ethnomathematics in Malay cultures, such as Malaysia peninsula and Riau province. (Zain, 2002) defines "Malay ethnomathematics as a mathematics legacy of Malay civilization that is taught, spoken, pronounced, written, used and read in the Malay language and according to Malay values." Malay in the sense conveyed by (Zain, 2002) is a group of Malays in the archipelago. The Malay community of Riau as a community certainly also has a knowledge system that has not been fully utilized, especially in the field of ethnomathematics.

### Geometry

Geometry is one of mathematics domain that has been introduced to students from early age. Clements (in Nidho, 2013) builds concepts starting with identifying shapes and investigating buildings and separating figures such as quadrilaterals, circles, triangles. Ismiyani (Faudiyah Nidho, 2013) geometry is an understanding of the concept of various geometric forms of flat shapes and spatial shapes. Get to know the names and characteristics of various geometric shapes and look for shapes that are the same as each of these shapes in the real world. Concrete learning of the objects introduced makes it easier for children to understand the differences in shape, characteristics and properties of an object more quickly.

Gardner (Triharso, 2013: 62), good introduction of geometric shapes, besides being able to improve their cognitive abilities, children can understand their environment. Apart from that, children are able to think logically and mathematically and can understand simple concepts in

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everyday life, such as when children see coins, they will know that they are circular, books are rectangular, house roofs are triangular and so on.

In accordance with the Decree of the Minister of Education and Culture of the Republic of Indonesia Number 21 of 2016 concerning Content Standards for Primary and Secondary Education (Kemdikbud 2016), geometry is part of the mathematics content in elementary schools. The 2023 Merdeka Curriculum Learning Outcomes in Phases A, B, and C contain geometric and spatial geometric content.

## METHOD

This study employed a qualitative approach to explore ethnomathematics in the Lembaga Adat Melayu Riau (LAMR) building in Meranti Island. A qualitative design was chosen because it enables in-depth description of cultural and mathematical phenomena that cannot be quantified (Komariah, 2011; Kusumastuti & Khoiron, 2019).

Researchers tried to dig up information through literature, observations and interview processes (Agasi & Wahyuono, 2016) with cultural figures and craftsmen in Meranti Island. This research aims to describe the results of exploration of forms of ethnomathematics in the LAMR Kep Building. Meranti Island as a resource for learning geometry in elementary schools. Then describe the ethnomathematics objects contained in the traditional house and architecture in Meranti Island. Respondents were selected using purposive sampling, involving cultural leaders, traditional craftsmen, administrators of traditional houses, representatives of the local government, elementary school teachers, and students in Meranti Island. Observations focused on traditional architectural forms and ornaments, while semi-structured interviews were conducted with cultural figures, craftsmen, and teachers to reveal the cultural meanings and mathematical elements embedded in traditional architecture. Documentation and field notes were used to complement and cross-check the data. These groups were chosen because they possess direct experience and knowledge relevant to the cultural and educational aspects of ethnomathematics.

Data analysis followed the (Miles & Huberman, 1994) interactive model, consisting of three steps:

1. Data Reduction-organizing, coding, and selecting relevant information related to ethnomathematics
2. Data Display-presenting the data descriptively to identify patterns and relationships.
3. Conclusion Drawing/Verification-interpreting findings and validating them through triangulation.

To ensure data validity, triangulation of sources, methods, and data was applied. Information from observations, interviews, and documents was compared to enhance credibility and confirm consistency across data sources.

## RESULTS AND DISCUSSION

The results of this research are presented in several parts, first the researcher began to provide a story about the ethnomathematical objects contained in the building, the philosophical meaning contained in the building, then we aligned the ethnomathematical objects into geometry teaching in elementary schools.

### Flat geometric objects in the traditional house and architecture in Meranti Island

Several two-dimensional shapes were identified in the architectural structures and decorative motifs:

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- Triangles were observed in bamboo shoot motifs carved on wooden supports
- Squares appeared in the stair railing ornaments located at the front and back of the building
- Rectangles were found in the design of windows, doors, and wall ventilation panels
- Rhombuses were identified in ceiling decorations
- Parallelograms were seen in the stair railing design
- Trapezoids were observed in the pangkelang door frames

## Geometric Objects for Building Space in the traditional house and architecture in Meranti Island

In addition to plane figures, several three-dimensional objects were also found:

- Cuboids represented by the structural arrangement of wooden pillars supporting the building
- Cylinders reflected in the bolster pillows placed on the traditional Malay bridal stage (pelamin)
- Triangular prisms identified in the roof construction, which used a screen-roof design

## Flat geometric objects in the traditional house and architecture in Meranti Island

Triangular objects are often found in the traditional house and architecture in Meranti Island includes a support, bamboo shoot motif cloth as a cover for the wooden support for storing spears/kojou (Figure 1).

Figure 1. Triangular motif on wooden support, LAMR Kep. Meranti

In line with Mr. AL's opinion:

"Supports to strengthen the pillars in the form of a triangular motif"

The triangle where the weapon is placed is made of bamboo shoot motif with curved and straight lines in it. Inside the triangle there is a perpendicular line connected by twigs (lines) curved to the left and right. These curved lines form the carved pattern of bamboo shoots. This motif is taken from newly growing bamboo shoots.

The square object can be found in the traditional house and architecture in Meranti Island includes the stair railing motif located at the front and back of the LAMR Kep Meranti building (Figure 2).

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Figure 2: Square motif on stair railing, LAMR Kep. Meranti

The squares on the supports function to strengthen the pillars, provide ventilation and, more precisely, sweeten and decorate the house.

Rectangles are often found in traditional house and architecture in Meranti Island includes on windows, doors, ventilation at the top of each window and on walls with a pian tongue wall installation pattern (Figure 3). In line with Mr WZ's opinion:

> "The rectangular shape of the door window, the many windows and ventilation holes guarantee freshness and comfort for the people who occupy the house. "The house and the high position of the windows and doors means that the arrival of guests or threats can be seen from afar, so preparations for welcoming them can be done well."

Figure 3. Rectangular shape on window and ventilation, LAMR Kep. Meranti

The rhombus object was found on the ceiling of the traditional house and architecture in Meranti Island as acculturation with modern culture in accordance with the needs of facilities and infrastructure (Figure 4).

Figure 4. Rhombus pattern on ceiling, LAMR Kep. Meranti

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The ceiling functions to improve aesthetics in addition to protecting the area beneath it from dirt on the roof. The ceiling is made of high quality felted wood and wood is a material that easily maintains the temperature in the room because it has excellent soundproofing properties and eliminates annoying sounds.

Obstacle row objects were found on the stair railings of the LAMR Kep building. Meranti. The stairs in the building are no longer made of wood and are found at the front door and back door of the LAMR Kep building. Meranti (Figure 5).

Figure 5. Parallelogram design on stair railing, LAMR Kep. Meranti

Construction of stairs in the traditional house and architecture in Meranti Island no longer uses wood but uses cement and ceramic materials, it is no longer made strictly taking into account safety. Mr. SI said the same thing:

> "The stairs going up to the house facing the road are made like a parallelogram, the stairs are made from cement and ceramic, no longer using wood, acculturation with modern culture makes the in the traditional house and architecture in Meranti Island unable to avoid the need for facilities and infrastructure. which is the demand of the times."

There are 7 (odd) steps on each right and left side, because according to belief even numbers are not good.

Trapezoidal objects are found on the pangkelang on the right and left sides of the door and are only found on the back door of the traditional house and architecture in Meranti Island (Figure 6).

Figure 6. Trapezoid on door frame *(Pangkelang),* LAMR Kep. Meranti

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The door is locked using the side of the door or the door frame (door frame from the inside). On the side of the door there is a piece of broti crossed over the two door jambs or frames. The door is made of beautiful holes which symbolize the high dignity of its owner.

## Geometric Objects for Building Space in the traditional house and architecture in Meranti Island

Many block objects are found in the traditional house and architecture in Meranti Island including on the front pillar of the LAMR Kep building. The Meranti has 6 pillars, the rear pillar has 4 pillars, the lower pillar has 40 pillars, and the inner pillar has 2 pillars consisting of a right porch and a left porch (Figure 7).

Figure 7. Cuboid form on building pillars, LAMR Kep. Meranti

The tube object was found on a bolster pillow located on the Malay traditional pelamin at the front of the LAMR Kep building. Meranti (Figure 8). Apart from functioning as a place for traditional ceremonies, the LAMR Kep building. Meranti has traditional Malay bridesmaids that can be used for wedding ceremonies for the general public.

Figure 8. Cylindrical bolster pillow on Malay bridal stage, LAMR Kep. Meranti

The Malay traditional wedding is inside the LAMR building. The general public considers

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the wedding as a place for a bride and groom to sit together, the Malay people consider the wedding as something more than that. The opinion expressed by Mr. DR:

> "The wedding ceremony is provided at LAMR so that people who want to get married without having to pay any money can come directly to the LAMR building and it is open to the public"

Pillow arrangements also decorate the sofa, there are four gadok pillows, eight matching pillows, a crocodile egg pillow and a back pillow. Don't forget to include a bolster pillow. The podium where the bride and groom sit together is also tiered. In Malay it is called peterakne which is divided into three words. Namely pe means chest or box, rack means tiered, and ne means more than one.

The triangular prism object is on the roof of the LAMR Kep building. Meranti uses a screen roof design (Figure 9). The main materials for the roof are palm leaves and thatch, but in its development tin roofs are often used. This is also found in the LAMR Kep building. Meranti, which already uses a tin roof, uses a combination of ridges, where a gutter is made at the roof junction which is useful for collecting water.

Figure 9. Triangular prism shape on the roof, LAMR Kep. Meranti

The main materials for the roof are palm leaves and thatch leaves, but in its development tin roofs are often used. At the LAMR Kep building. Meranti uses a combination of ridges and high gutters which are useful for collecting rainwater. Judging from the shape of the LAMR kep building. Meranti uses five ridges, the parabung has a straight shape, as a symbol of the straight heart of the Malay people.

## The Relationship of Geometry Concepts in the traditional house and architecture in Meranti Island Caring for Mathematics Learning in Elementary Schools

Geometry learning is integrated with culture, has positive values and meanings that can be taken for the continuity of society's culture by also increasing students' mathematical abilities. Ethnomathematics teaching that incorporates local cultural wisdom in the geometry teaching and learning process, students are expected to be better able to deepen mathematical concepts contextually by intermediary results of the culture around them. Ethnomathematics contained in the LAMR Kep building. Meranti can be used as a source of learning geometry, where geometric concepts are implemented in a building that has noble cultural patterns and wisdom and can be

strengthen students' understanding of geometry, also that mathematics is a science that can be applied in the real world.

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Measuring activities have become something commonly associated with mathematics material. On the architecture of the LAMR Kep building. Meranti, part of the LAMR Kep building. Meranti is almost everything related and always implements measuring activities. This is in line with D'Ambrosio's theory that mathematics is implemented in various sectors in society. Design and construction activities are clearly present in the LAMR Kep building. Meranti. From the shape of the building alone, it can be seen that the architect or designer is truly skilled in design and construction activities. The architectural form of the LAMR Kep building. Meranti cannot be separated from the meaning contained in it. Design and construction activities apart from acting as an effort to build objects firmly, also create the LAMR Kep building. Meranti is neat and attractive and has its own charm.

In line with research conducted by Dwi Yuniarti Bayu regarding exploration of Langkanae traditional houses in the city of Palopo, there is an ethnomathematics concept of geometric material that can be used as a learning resource. At the LAMR Kep building. Meranti also has flat mathematical objects, triangles which are found on fabric support motifs, squares on ventilation supports, rectangles which are most commonly found on doors, windows and ventilation, rhombuses on ceilings, parallelograms on stair handrails, trapezoids on door plinths , and there are also ethnomathematics objects for building space in the LAMR Kep building. Meranti, beams on poles, tubes on bantar which are in Malay traditional pelamin, and triangular prisms on the screen roof.

Alignment of Phase A, B and C Learning Achievements with ethnomathematics objects in the LAMR Kep building. Meranti The properties of flat shapes and spatial shapes are one of the mathematical contents contained in the learning outcomes of Phases A, B and C. Geometry learning is integrated with culture, has positive values and meanings that can be taken for the continuity of society's culture by also increases students' mathematical abilities. Ethnomathematics teaching that incorporates local cultural wisdom in the geometry teaching and learning process, students are expected to be better able to deepen mathematical concepts contextually by intermediary results of the culture around them. Ethnomathematics contained in the LAMR Kep building. Meranti can be used as a source of learning geometry, where geometric concepts are implemented in a building that has noble cultural patterns and wisdom and can strengthen students' understanding of geometry, also that mathematics is a science that can be applied in the real world.

Learning resources can be taken from anywhere as long as they have a good impact on real life, such as the geometry learning resources found in the LAMR Kep building. Meranti is packaged in an ethnomathematics process. The shape of a building has special characteristics so that it illustrates the implementation of a certain geometric concept that can be

taken as a real geometry learning process. Alignment of geometry learning in accordance with the learning outcomes of the 2022 Merdeka Curriculum. Phase A learning outcomes in geometry material discuss various shapes of flat shapes and spatial shapes. The learning outcomes that are aligned in phase A with ethnomathematics objects are related to recognizing flat shapes and spatial shapes, apart from that they are also related to composition material.

Phase B Learning Achievements, students after getting to know flat shapes and space shapes in the traditional house and architecture in Meranti Island can describe the characteristics of various flat shapes and can arrange (compose) various flat shapes in one or more ways in the traditional house and architecture in Meranti Island. So that students clearly understand the concept of geometry in the traditional house and architecture in Meranti Island. Learning Outcomes Students can determine the perimeter and area of several plane shapes and their combinations. They can construct and decompose several spatial figures and their combinations, and recognize

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spatial visualization. They can compare characteristics between flat shapes and between spatial shapes.

The ethnomathematical exploration of the LAMR building in Kep. Meranti demonstrates that traditional Malay architecture incorporates a wide range of geometric forms. These include plane figures such as triangles, squares, rectangles, rhombuses, parallelograms, and trapezoids, as well as solid figures such as cuboids, cylinders, and triangular prisms. The identification of these elements highlights the strong connection between cultural artifacts and mathematical concepts.

In the context of elementary education, these objects can be directly utilized as learning resources for geometry. By observing and analyzing the architectural features of the LAMR building, students can develop a contextual understanding of fundamental geometry, including shapes, spatial visualization, and measurement. This not only strengthens mathematical comprehension but also fosters cultural awareness, making geometry learning more meaningful and engaging.

## CONCLUSION

Based on the results of the research and discussion, the researchers came to the conclusion that the traditional house and architecture in Meranti Island shows the cultural arts of traditional Malay house building. Apart from the cultural elements inherent in the traditional house and architecture in Meranti Island has geometric concepts that can be used as learning resources in elementary schools, such as the concept of flat shapes. Fabric with bamboo shoot motifs on supports (triangles), ventilation decorations (squares), windows (rectangles), ceilings (rhombuses), stair handrails (parallelograms). *pengkeleng* (trapezoid) and the geometric concept of building a screen roof (triangular prism), bolster pillows in Malay culture pelamin (tubes), poles (beams). Via the traditional house and architecture in Meranti Island students can understand the geometric concepts of plane shapes and space shapes and become a learning resource to improve their ability to understand geometric concepts and get to know one culture, understand the relationship between the culture of the traditional house and architecture in Meranti Island and learning mathematics with a cultural approach will be more meaningful for students.

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