Ethnomathematics Exploration in The Architecture of Osing Traditional Houses: Revealing the Application of Mathematical Principles in Banyuwangi Culture

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Abstract

This research explores the application of mathematical principles in the architecture of Osing traditional houses in Banyuwangi through an ethnomathematics approach. Ethnomathematics is a study that examines the relationship between mathematics and culture within specific communities. By exploring this connection, the research aims to uncover the application of mathematical concepts in Osing culture, particularly in the context of their traditional house architecture. The study employs an ethnographic approach, using data collection techniques such as document studies, content analysis, and semiotic analysis. The findings reveal that the architecture of Osing traditional houses is rich in mathematical elements integrated with the cultural values of the Osing community. Geometric concepts are evident in roof shapes, decorative patterns, and building structures. Proportions and measurements are considered in the design of rooms and building elements. Numerical concepts and calculations are utilized in the construction process.These findings highlight the harmonious integration of mathematical knowledge and cultural values in the architecture of Osing traditional houses, where every building element holds symbolic meanings related to the beliefs and worldview of the Osing community. This research contributes to the preservation of Banyuwangi's cultural heritage and local wisdom while enhancing appreciation for mathematics within a cultural context.

Keywords: *ethnomathematics, Osing traditional house architecture, geometry, proportion, numbers, Osing culture*

INTRODUCTION

Ethnomathematics is a study that explores the relationship between mathematics and culture in a particular society (D'ambrosio, 1985). This study recognizes that mathematics not only developed in academic settings, but also in the cultural practices of society, including in traditional crafts, arts, games and architecture (Gerdes, 1994). Ethnomathematics aims to reveal the application of mathematical concepts and principles contained in people's cultural activities, and how these concepts are passed down from one generation to the next (Wahyuni et al., 2023).

Studying ethnomathematics in local cultural contexts has an important role in preserving cultural heritage and increasing appreciation of mathematics. By exploring the link between mathematics and culture, we can understand how local communities develop mathematical knowledge through their cultural activities and practices (Rosa & Orey, 2011). This helps us appreciate the rich cultural heritage and strengthens the cultural identity of local communities.

In addition, studying ethnomathematics can increase appreciation of mathematics. By seeing the application of mathematics in a familiar cultural context, students can understand mathematics as something that is close to everyday life and relevant to their culture (Adam, 2004). This can reduce the perception that mathematics is an abstract discipline and separated from the realities of life, thereby increasing students' motivation and interest in studying mathematics (Lipka et al., 2008).

In this way, ethnomathematics bridges the gap between formal mathematics taught in schools and the knowledge and cultural practices of local communities. This provides an opportunity for educators to integrate cultural elements in mathematics learning, thereby making learning more meaningful and contextual (Rosa & Orey, 2011). This approach not only enriches the learning experience, but also helps preserve cultural heritage and increases appreciation of mathematics.

The Osing people are a Javanese tribe who live in the Banyuwangi area, East Java. They have a unique culture that is unique and different from Javanese society in general. Historically, the Osing people are descendants of farmers who migrated from Madura and Bali in the 17th century (Fauziah et al., 2012). Through the acculturation process, they form a unique

cultural identity, mixing elements of Javanese, Madurese and Balinese culture.

One of the most prominent cultural aspects of the Osing people is the architecture of their traditional houses. The Osing traditional house, called "Rumah Nggawu," has great significance in reflecting the cultural values of the Osing people. The design and layout of this traditional house not only functions as a place to live, but also represents the philosophical and spiritual concepts adhered to by the Osing people (Hariastuti, 2018). Each building element, such as pillars, doors and roofs, has a symbolic meaning related to the life, beliefs and outlook of the Osing people.

The Osing traditional house is an interesting object of study in the context of ethnomathematics for several reasons. First, the architecture of this traditional house reflects the application of mathematical principles in the local cultural context. For example, the concept of geometry can be seen in building patterns and structures, the concept of proportion and size in room design, as well as number calculations in the construction process (Safitri, 2023). Second, an exploration of ethnomathematics in the Osing traditional house can provide insight into how the Osing people integrate mathematical knowledge with their cultural values. Third, this study contributes to efforts to preserve Osing's unique and rich cultural heritage.

By exploring the application of mathematical principles in the architecture of Osing traditional houses, this research can reveal the relationship between mathematics and culture in the context of Osing society. This not only enriches understanding of ethnomathematics, but also helps preserve local cultural heritage and increases appreciation of mathematics in everyday life.

Traditional architecture is a field that is rich in the application of mathematical principles. Since ancient times, architects have applied mathematical concepts to design and construct sturdy and aesthetic building structures. In the context of Osing traditional house architecture, we can identify several mathematical principles that are applied.

First, geometry plays an important role in the pattern and structure of Osing traditional house buildings. The basic shapes of buildings, such as squares, rectangles, and triangles, are manifestations of basic geometric concepts. Apart from that, the decorative patterns on the walls and roofs of Osing traditional houses also reflect the use of the concepts of symmetry and geometric transformation (Fahik et al., 2023). The use of these geometric elements not only serves an aesthetic function, but also provides structural strength to the building.

Second, the principles of proportion and size are very important in the design of rooms and building elements of Osing traditional houses. Each room and element have harmonious proportions, reflecting the concept of balance and beauty in the culture of the Osing people (Hariastuti, 2018). For example, the height of the support pillars, the width of the doors, and the size of the roof are determined by taking into account the right proportions to create a comfortable and functional space.

Third, the concept of numbers and calculations plays an important role in the process of building Osing traditional houses. Craftsmen use traditional calculation systems to determine the amount and dimensions of materials needed, as well as regulate the sequence and time in the construction process (Ambyo & Kusumah, 2018). The application of this number concept ensures that each building element meets the requirements and meets the desired aesthetic and functional criteria.

Through this exploration, we can see that the architecture of the Osing traditional house is not only an expression of culture, but also a manifestation of the application of mathematical principles that have been passed down from generation to generation. By uncovering the relationship between mathematics and culture in traditional architecture, we can gain a deeper understanding of local wisdom and appreciate the cultural heritage of the Osing people.

METHOD

In this research, an ethnographic approach will be used to explore the application of mathematical principles in the architecture of Osing traditional houses in Banyuwangi. The ethnographic approach was chosen because it allows researchers to gain an in-depth

understanding of the culture of the Osing people and how they integrate mathematical knowledge in their cultural practices, especially in the context of their traditional house architecture.

The data collection technique that will be used in this research is collecting and studying related documents, such as books, research reports, historical notes, ancient manuscripts, and other written sources that discuss the culture of the Osing people and the architecture of their traditional houses. This document study will provide context and supporting information to enrich the data obtained. Apart from that, researchers will also carry out an extensive literature search to identify previous research that is relevant to this research topic, both in the form of journals, proceedings and reference books.

Data obtained from document studies will be analyzed using content analysis and semiotic analysis methods. Content analysis will be used to identify key concepts, patterns and themes related to the application of mathematical principles in Osing traditional house architecture. Meanwhile, semiotic analysis will be used to interpret the symbolic meaning and cultural values contained in the architectural elements of the Osing traditional house.

To ensure the validity and reliability of research findings, researchers will triangulate data by comparing and integrating information from various different document sources. Apart from that, researchers will also involve experts or experts in the field of ethnomathematics and Osing culture to provide input and validate the results of data analysis.

In conducting this research, researchers will always pay attention to ethical aspects of research, such as respecting the copyright of written sources used, maintaining the confidentiality of informants (if any), and avoiding plagiarism in writing research reports. Researchers will also strive to present research findings objectively and impartially, while still respecting the cultural values and customs of the Osing community.

RESULTS AND DISCUSSION
Geometric Concepts in Osing Traditional House Architecture

The architecture of the Osing traditional house is rich in geometric elements that are integrated with the cultural values of the local community. One element that stands out is the shape of the roof of the Osing traditional house. There are three types of roofs known in the culture of the Osing people, namely cerocogan, baresan, and tikel balung. Cerocogan is saddle-shaped with two sides, baresan has three sides, and tikel balung has four sides. These roof shapes reflect basic geometric concepts such as triangles and trapezoids.

Figure 01 Osing Traditional House (front view)

Apart from the shape of the roof, the decorative patterns on the walls and ornaments of Osing traditional houses also show the application of geometric concepts such as symmetry and geometric transformation. Although decorative motifs are flexible according to the wishes of the homeowner, there are certain patterns that reflect geometric order and balance.

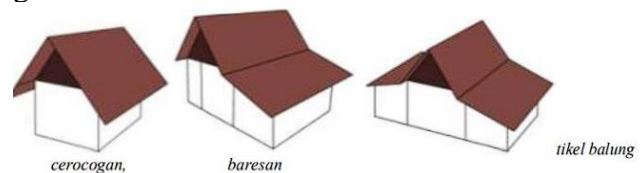cerocogan,   baresan   tikel balung

Figure 02. Roof shape of the Osing traditional house

The concept of geometry can also be seen in the structure and layout of the rooms of the Osing traditional house. The Osing traditional house is divided into three main rooms: mbyale (living room), jerumah (private room/bedroom), and pawon (kitchen). The arrangement of this room takes into account aspects of functionality and the needs of the Osing community, which is based on geometric principles such as space division and proportion.

The Concept of Proportion and Size in Osing Traditional House Architecture

Apart from geometric concepts, proportion and size also play an important role in the architecture of Osing traditional houses. Each room and building element were designed taking into account harmonious proportions and in accordance with the needs of the Osing

community. For example, the size of the mbyale (living room) is adjusted to accommodate a large number of guests, while the jerumah (private room) is smaller for personal comfort.

Figure 03. Mbyale in the Using Traditional House

The concept of proportion is also seen in the use of building materials and decorative elements. The woven bamboo (gedheg) used as side walls, back walls and house partitions has a certain pattern that reflects visual and aesthetic balance. The interviewee stated that in rooms other than the bedroom (jerumah), single bamboo woven material was used to allow good air circulation, while in the jerumah double bamboo woven material was used for privacy.

Picture 04. Jerumah on Using Traditional House

The Concept of Numbers and Calculation in Osing Traditional House Architecture

In the process of building a traditional Osing house, the concept of numbers and calculations is also applied. The Osing community uses a traditional calculation system to determine the amount and dimensions of materials needed, as well as regulate the sequence and time of construction. This can be seen in the main structure of the Osing traditional house which consists of a four-post wooden frame (saka) with a sparring system without nails, but using paju (flat pegs).

The resource person provided information about the wooden components in the Osing traditional house, such as suwunan (long wood on top of the house), ander (two short standing pieces of wood), ampik-ampik (wood that forms the slanted sides of a triangle), emblem (wood at the bottom ander), short and long stitches (connecting poles), and runners (wood connecting two symbols). The naming and use of these components reflects the concept of numbers and calculations that have been passed down from generation to generation in Osing society.
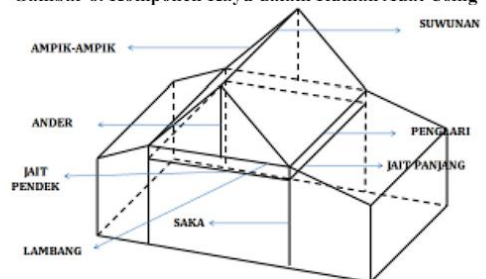

Figure 5. Wooden components in the framework of a traditional house

Integration of Mathematical Knowledge and Cultural Values

The research results show that in the architecture of the Osing traditional house, there is a harmonious integration between mathematical knowledge and the cultural values of the local community. The concepts of geometry, proportion, size and number are not only applied technically in the construction of traditional houses, but also have symbolic meaning related to the beliefs, philosophy and way of life of the Osing people.

For example, the roof shape of the Osing traditional house, which consists of cerocogan,

baresan, and tikel balung, used to be a marker of social strata in Osing society. Cerocogan represents the underprivileged, baresan for the middle economic group, and tikel balung for the high economic group. Even though currently the differences in social strata are no longer so rigid, the shape of the roof remains a cultural symbol that reflects the values and history of the Osing people.

The architecture of the Osing traditional house not only functions as a place to live, but also represents high culture in the Osing community. Therefore, the exploration of ethnomathematics in the architecture of Osing traditional houses makes an important contribution in preserving the cultural heritage and local wisdom of the Banyuwangi people.

CONCLUSION

This research has explored the application of mathematical principles in the architecture of Osing traditional houses in Banyuwangi through an ethnomathematics approach. The research results reveal that the architecture of Osing traditional houses is rich in mathematical elements that are integrated with the cultural values of the Osing people. The concepts of geometry, proportion, size and number are clearly visible in the design, pattern, structure and construction process of the Osing traditional house. The roof shapes of Osing traditional houses, such as cerocogan, baresan, and tikel balung, reflect basic geometric concepts such as triangles and trapezoids. The proportions of rooms and building elements are based on the concept of balance and beauty adopted by the Osing people. In addition, traditional calculation systems are used in determining the quantity and dimensions of materials and managing the sequence and time of construction.

Research findings reveal that in the architecture of Osing traditional houses, there is a harmonious integration between mathematical knowledge and the cultural values of the local community. Each architectural element of the Osing traditional house not only has a practical function, but also has a symbolic meaning related to the beliefs, philosophy and way of life of the Osing people. This research contributes to preserving the cultural heritage of the Osing

people which is rich in meaning. By revealing the relationship between mathematics and culture in the context of traditional architecture, we can gain a deeper understanding of local wisdom and appreciate the rich culture of the Indonesian nation

SUGGESTION

Further research could be conducted to explore the application of mathematical principles in other cultural aspects of the Osing people, such as handicrafts, performing arts, or traditional ceremonies. This will provide a more comprehensive picture of ethnomathematics in the context of Osing culture.

Efforts to preserve and document the culture of the Osing people, including the architecture of Osing traditional houses, need to continue. This can be done through collaboration between local governments, educational institutions and local communities to ensure this cultural heritage is maintained for future generations.

The integration of local cultural elements, such as the architecture of traditional Osing houses, in mathematics learning in schools in Banyuwangi and surrounding areas can be an effort to increase students' appreciation of mathematics and strengthen their cultural identity.

The development of teaching materials and learning resources that explore mathematical concepts in local cultural contexts can be an alternative to enrich students' learning experiences and encourage more meaningful learning.

Similar research can be carried out in other regions in Indonesia to reveal the richness of ethnomathematics contained in traditional architecture and local community culture. This will provide broader insight into the diversity of Indonesian culture and the role of mathematics in it.

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