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Ethnomathematics in the Roof-Covering Culture of Ar-Rahman MosqueLaimu Village Central Maluku Regency

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Abstract

This study aims to examine the relationship between mathematical concepts and local culture through an ethnomathematical study of the Roof-Covering Tradition of Ar-Rahman Mosque in Laimu Village. The research employed a qualitative approach with an ethnographic method, encompassing field observations, interviews, and documentation. The findings reveal that the Tutup Atap tradition embodies various geometric concepts, including two-dimensional and three-dimensional shapes, measurement, proportional arrangement, and roof-layer patterns. Furthermore, these mathematical concepts are closely interconnected with local cultural values, particularly *pela gandong*, cooperation, and the preservation of traditional knowledge, demonstrating the integration of mathematics within the community's cultural practices. Beyond mathematical aspects, the tradition also embodies cultural values such as unity (*pela gandong*) and the preservation of customs. These findings affirm that integrating local culture into mathematics learning can enhance students' relevance, connection, and understanding of mathematical concepts.

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Introduction

Mathematics is not merely a science of calculation, numbers, or abstract formulas, but also encompasses shapes, patterns, space, and the relationships among objects that appear in everyday life and cultural practices. From this perspective, mathematics is viewed as a human activity that develops through social interaction and cultural experience. Ethnomathematics provides a framework for understanding how mathematical ideas emerge, evolve, and are practiced within specific cultural contexts, including traditions, architecture, craftsmanship, and other social activities (D'Ambrosio, 1985). Rather than being culturally neutral, mathematics is closely related to history, culture, and community practices that shape the way people conceptualize and apply mathematical knowledge (Bishop, 1991). Recent studies further emphasize that ethnomathematics supports culturally responsive mathematics education by connecting formal mathematical concepts with learners' cultural experiences, thereby promoting meaningful learning and social justice in mathematics education (Rosa & Orey, 2023).

In Indonesia, ethnomathematics has become an important approach for integrating local wisdom into mathematics education. A systematic literature review shows that various cultural products, such as traditional houses, batik motifs, traditional dances, weaving, temples, and mosque architecture, contain identifiable mathematical concepts, particularly in geometry (Iskandar et al., 2022). Furthermore, recent mapping studies indicate that ethnomathematics research has continued to grow rapidly, with increasing emphasis on culturally responsive pedagogy, contextual learning, and the preservation of local knowledge (Rahmawati et al., 2025). Consequently, integrating local culture into mathematics learning not only enriches students' conceptual understanding but also strengthens cultural literacy and appreciation of local wisdom (Rosa & Orey, 2016; Rosa & Orey, 2023).

Mosques, as places of worship, represent one of the cultural artifacts where religious values, local traditions, aesthetics, and mathematical principles are integrated. Previous studies have consistently demonstrated that mosque architecture embodies numerous mathematical concepts that can be utilized as contextual learning resources. Purniati et al. (2020) identified geometric and algebraic concepts in the architecture and ornaments of the Great Mosque of Cimahi, including symmetry, plane figures, and three-dimensional shapes. Similarly, Radiusman et al. (2021) reported that the architecture of the Great Mosque of Demak reflects concepts of geometry and geometric transformations through its tiered roof (*tajug*), main pillars, and ornamental designs. Zuliana et al. (2023) further revealed that traditional Javanese mosque architecture embodies various geometric patterns, symmetry, and transformations while simultaneously reflecting philosophical values. More recent studies have extended these findings by identifying ethnomathematical concepts in the Sheikh Zayed Mosque in Surakarta, the Great Mosque of Tanjung Pauh Hilir, the Great Mosque of Sultan Thaf Sinar Basarsyah, and the Great Mosque of Sumenep, confirming that mosque architecture provides rich contextual resources for mathematics learning.

Collectively, these studies demonstrate that mosque architecture contains rich mathematical concepts, particularly geometry, symmetry, proportional structures, measurement, and geometric transformations (Purniati et al., 2020; Radiusman et al., 2021; Zuliana et al., 2023). Nevertheless, most previous studies have primarily concentrated on identifying mathematical concepts embedded in architectural structures and ornaments. Comparatively little attention has been devoted to traditional construction practices that integrate mathematical concepts with local cultural values and community knowledge, particularly those that can be transformed into contextual learning resources for mathematics education. Recent reviews also indicate that future ethnomathematics research should move beyond merely identifying mathematical objects toward explaining how mathematical knowledge is socially and culturally constructed within communities.

This research gap is particularly evident in the ethnomathematical traditions of remote communities in Central Maluku. One such tradition is the *Tutup Atap* tradition of the Ar-Rahman Mosque in Negeri Laimu, where community members collectively construct and maintain the mosque

roof using carefully stitched sago palm leaves. Beyond its technical function, this tradition embodies local wisdom through mutual cooperation (*gotong royong*), environmental sustainability achieved by utilizing natural materials, and communal solidarity. These cultural practices potentially contain mathematical concepts, including plane and solid geometric figures, measurement, spatial arrangement, and repetitive patterns, while simultaneously reflecting local knowledge that has been transmitted across generations. Such characteristics indicate that the *Tutup Atap* tradition provides an authentic context for connecting mathematics with cultural practices and students' everyday experiences.

Therefore, this study aims to identify the geometric concepts embedded in the Tutup Atap tradition of the Ar-Rahman Mosque in Negeri Laimu and to explain their relationship with the cultural values practiced by the local community. By addressing the limited attention given to traditional construction practices in previous ethnomathematics studies, this research contributes to expanding ethnomathematics literature beyond architectural objects and demonstrates the potential of local cultural traditions as contextual resources for mathematics learning.

Methods

This study employs a qualitative approach with an ethnographic method, as its focus is to explore cultural practices of the community that contain mathematical values. Qualitative research seeks to understand the meaning individuals or groups ascribe to a social or cultural phenomenon (Creswell, J. W. & Poth, 2018). The ethnographic method was chosen to describe and interpret behavioral patterns, beliefs, and practices of the community related to the Tutup Atap tradition of the Ar-Rahman Mosque in Negeri Laimu.

The subjects of this study are the people of Negeri Laimu, Central Maluku Regency, who are involved in the Tutup Atap tradition of the Ar-Rahman Mosque. The main informants include traditional leaders, mosque administrators, community members engaged in the practice, as well as religious leaders from different groups who take part in the tradition. The research site was purposively determined in Negeri Laimu, as this tradition is still collectively practiced and is rich in cultural values. The selection of informants was carried out using purposive sampling, based on their direct involvement in the tradition (Sugiyono, 2018).

Data were collected through three main techniques: observation, interviews, and documentation. Observation was conducted by directly examining the *Tutup Atap* process, from material preparation and the technique of stitching sago palm leaves to the installation of the mosque roof. In-depth interviews were carried out with community leaders, mosque administrators, and participants involved in order to understand both the cultural meanings and the practical calculations embedded in the tradition. Documentation was conducted by recording photographs, videos, and field notes to support data analysis. The combination of these techniques is essential in qualitative research to obtain rich and comprehensive data (Moleong, 2013).

The data were analyzed using the interactive analysis model, which consists of three main steps: (1) data reduction (selecting, simplifying, and organizing the data obtained from observations, interviews, and documentation), (2) data display (organizing the information into narrative form, tables, or geometric sketches of the Tutup Atap tradition), and (3) conclusion drawing, which involves interpreting the mathematical and cultural values embedded in the tradition (Miles, M. B., Huberman, A. M., & Saldaña, 2014).

To ensure data validity, this study employed source and method triangulation. Triangulation was carried out by comparing the results of observations with interviews and visual documentation, allowing the information obtained to be verified from multiple perspectives.Validity in qualitative research can be achieved through credibility, transferability, dependability, and confirmability (Lincoln, Y. S., & Guba, 1985). Therefore, the processes of data collection and analysis were conducted carefully to ensure that the findings are valid and accountable.

Result and Discussion

This section presents the findings derived from field observations, interviews, and documentation concerning the Tutup Atap tradition of the Ar-Rahman Mosque in Negeri Laimu. The results are presented descriptively to illustrate the connection between cultural practices and mathematical concepts, particularly geometry. Following the presentation of these findings, the discussion situates them within the framework of ethnomathematics theory and engages with previous studies on the application of ethnomathematics in mosque architecture and cultural practices in Indonesia ((D'Ambrosio, 1985); (Bishop, 1991); (Rosa & Orey, 2016)).

Result

Plane Geometric Shapes in the Mosque Roof Leaves

The observations revealed that the sago palm leaves used as roofing material were cut and stitched into plane geometric figures in the form of rectangles, with an average length of 2 meters and a width of 0.5 meters. This rectangular shape serves as the basic element that is subsequently arranged to construct the mosque roof.

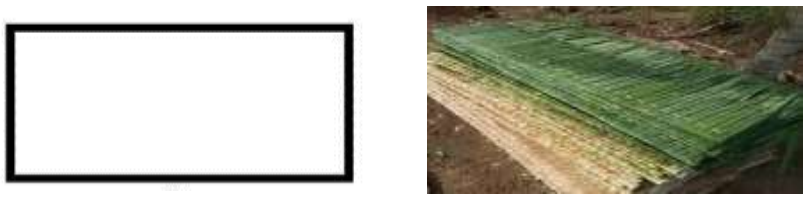

Figure 1. Mosque Roof Leaves in the Form of Rectangles

Three-Dimensional Shapes in the Dome and Roof Structure of the Mosque

The dome and roof structure of the Ar-Rahman Mosque in Negeri Laimu contain the concept of three-dimensional shapes in the form of square pyramids. The dome takes the form of a pyramid with a square base measuring 7 × 7 meters, while the main roof is a square pyramid with a height of approximately 29 meters and a width of 21 meters. These forms reflect the principles of similarity and geometric regularity in traditional mosque architecture.

Figure 2. The Mosque Dome in the Form of a Square Pyramid

The Thickness of the Roof Leaf Arrangement

The installation of the roof leaves shows variations in thickness according to the order of the layers. On the dome, the thickness begins with two layers at the base, then increases by one layer at each level until it reaches the seventh layer, after which it gradually decreases toward the top. mOn the main roof, the thickness begins with three layers at the base, and the same pattern is followed up to the top. This arrangement pattern illustrates the concept of a simple arithmetic sequence, in which the number of layers increases systematically before decreasing again.

The Spacing of Roof Leaf Installation

The measurement of the spacing in the installation of roof leaves also shows differences between the dome and the main roof. On the dome, the spacing between the leaves is 15 cm. On the main roof, the spacing between the leaves is 25 cm. This variation in spacing demonstrates the presence of mathematical calculations in the arrangement of materials to ensure that the roof is stronger and more durable.

Figure 3. The Installation of The Mosque Roof Begins From The Bottom and Continues Upward.

Comparison with Previous Studies

These findings are in line with the study which identified the presence of two-dimensional geometric concepts in the architecture of the Soko Tunggal Mosque(Susanti et al., 2023). However, the present study has its own distinctiveness, as it highlights not only the mathematical aspects but also the connection with the cultural value of pela gandong, a tradition of mutual cooperation in Maluku that unites various ethnic and religious groups in building the mosque.

Visual Documentation

The roof structure of the Ar-Rahman Mosque in Negeri Laimu, which resembles a square pyramid, can be seen in the field documentation (figure). This visualization emphasizes that geometric elements are not only present in small details (such as the roofing leaves) but also in the overall structure of the building. The roof structure of the Ar-Rahman Mosque in Negeri Laimu can be seen in the following figure.

Figure 4. Figure of The Mosque Dome

Discussion

The research findings show that the sago palm leaves, when sewn together, form a rectangular shape with an average size of 2 × 0.5 meters. This simple form can be associated with the concept of a rectangle, which in mathematics education is known to have two pairs of parallel and equalside(Johnson, K. P., & Rising, 1972). In the context of ethnomathematics, this rectangular shape is not merely a mathematical abstraction but serves a practical function in facilitating the arrangement of the roof to be neat and efficient. This supports the view that cultural activities such as making, measuring, and constructing are integral parts of a community's mathematical practices(Bishop, 1991).

The structure of the mosque's dome and roof, shaped like a square pyramid, demonstrates a close relationship between traditional architecture and the concept of three-dimensional geometry. The dome, with a square base measuring 7 × 7 meters, and the main roof, standing 29 meters high, resemble a square pyramid. This form illustrates the principles of similarity and symmetry commonly employed in Islamic architecture(Necipoğlu et al., 1995). Within the framework of ethnomathematics, this shows

that the local community is able to apply geometric principles in architectural works, not through formal academic approaches, but through collective knowledge inherited across generations.

The pattern of roof leaf layering on the dome (starting with 2 layers, increasing to 7, then decreasing again) and on the main roof (starting with 3 layers, increasing to 7, then decreasing) reflects the concept of a simple arithmetic sequence. This variation in the number of layers not only demonstrates mathematical regularity but also embodies the principle of structural efficiency: the higher the position of the leaves, the thinner the layering required, as the load becomes lighter.Mathematical practices that emerge from the practical needs of communities represent a tangible form of ethnomathematics, linking formal mathematics to real-life contexts(Rosa & Orey, 2016).

The differing spacing of the roof leaves on the dome (15 cm) and the main roof (25 cm) exemplifies the application of measurement and comparison concepts.This variation in spacing reflects a technical strategy to ensure that the roof structure remains strong while using materials efficiently, as ethnomathematics arises from human efforts to understand, classify, and organize their environment through calculation, measurement, and pattern arrangement(D'Ambrosio, 1985). In this context, the people of Negeri Laimu employ mathematics not in the form of formal formulas, but through traditional construction practices.

Unlike the study which focused on geometric aspects in the architecture of the Soko Tunggal Mosque, the present study emphasizes the role of the pela gandong cultural value inherent in the Tutup Atap practice (Putra et al., 2020). The collective participation of people from diverse religious and ethnic backgrounds in arranging the roof leaves demonstrates that mathematics does not exist in isolation but is deeply intertwined with values of cooperation, solidarity, and communal togetherness. This finding supports the assertion that ethnomathematics encompasses not only numbers and shapes but also how a community integrates mathematical thinking into its social and cultural life(D'Ambrosio, 1985).

The findings of this study have significant potential for application in culturally based mathematics learning. By linking concepts such as plane and solid geometric shapes, measurement, and arithmetic sequences to the Tutup Atap tradition, teachers can provide students with learning experiences that are more concrete, relevant, and meaningful. This aligns with the notion of mathematical enculturation, which posits that learning mathematics involves understanding both formal knowledge and the cultural context in which it is used (Bishop, 1991).

Conclusion

This study demonstrates that the Tutup Atap tradition of the Ar-Rahman Mosque in Negeri Laimu is rich in mathematical values integrated within the community's cultural practices. The sago palm leaves serve as representations of plane geometric shapes, while the structure of the dome and roof reflects concepts of three-dimensional geometry. The layering pattern of the roof leaves resembles an

arithmetic sequence, and the spacing of the leaves exemplifies measurement concepts. These findings indicate that mathematical knowledge does not exist separately from daily life but is embedded in cultural activities and local traditions.

Furthermore, the collective practice of the community in arranging the mosque roof, guided by the pela gandong value, emphasizes that mathematics in the context of ethnomathematics is not only related to abstract concepts but is also closely intertwined with social, spiritual, and cultural values.

These findings have implications for culturally based mathematics learning, where teachers can relate topics such as geometry, measurement, and arithmetic to the real-life context of local traditions. In this way, learning becomes more contextual and meaningful, while simultaneously instilling values of mutual cooperation and religious moderation.

Recommendation

Based on the findings of this study, several recommendations can be proposed. Teachers and educational practitioners are encouraged to integrate local traditions, such as the Tutup Atap of the mosque, into mathematics learning, enabling students to understand concepts of plane and solid geometry, measurement, and arithmetic sequences through real-life experiences that are close to their daily lives. Future research is expected to explore other cultural traditions in Maluku or other regions of Indonesia, so that the richness of Nusantara ethnomathematics can be further uncovered and serve as diverse learning resources. For the local community, this tradition should continue to be preserved not only as a cultural-religious ritual but also as a repository of knowledge that embodies values of togetherness and mutual cooperation, while also serving as an educational medium for younger generations. Local governments and educational institutions are also expected to provide concrete support through teacher training, the development of ethnomathematics modules, and documentation of cultural traditions as contextual teaching materials. Moreover, curriculum developers can guide the integration of ethnomathematics not only toward achieving cognitive objectives but also toward strengthening character values, such as fraternity, solidarity, and religious moderation, as reflected in the collective practices of the Negeri Laimu community.

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