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Exploring Ethnomathematical Elements in Tongkonan Traditional House Architecture as A Learning Resource for Developing Cultural Literacy and Numeracy Among Junior High School Students

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Abstract

Ethnomathematics provides a meaningful connection between formal mathematical knowledge and the cultural practices embedded in students' everyday lives. As one of the cultural heritages of the Toraja community, the Tongkonan traditional house contains various structural and visual elements that reflect mathematical ideas developed and transmitted through generations. This study aims to explore the ethnomathematical elements embedded in Tongkonan architecture and examine their potential as a contextual mathematics learning resource for developing cultural literacy and numeracy among students at SMPN 2 Kapala Pitu. This study employed a qualitative exploratory approach. Data were obtained through a literature review, indirect observation of Tongkonan architectural structures, and analysis of visual documentation. The data were analyzed descriptively through data reduction, categorization of mathematical elements, and interpretation of their potential applications in mathematics learning. The findings indicate that Tongkonan architecture embodies several mathematical concepts relevant to junior secondary school mathematics, including plane and solid geometry, symmetry, geometric transformations, numerical patterns, ratios, and proportions. These mathematical elements are manifested in the structural forms, spatial arrangements, proportions, and decorative patterns of the Tongkonan. Integrating these cultural elements into mathematics learning provides opportunities for students to explore mathematical concepts through contexts that are familiar and meaningful to them. Furthermore, the use of Tongkonan as a learning resource has the potential to support students' numeracy by engaging them in interpreting shapes, patterns, measurements, and quantitative relationships, while simultaneously fostering cultural literacy through appreciation and understanding of local cultural heritage. Thus, Tongkonan architecture represents a valuable culturally responsive learning resource that can connect mathematical knowledge with local cultural identity.

Keywords: Ethnomathematics; Tongkonan; Cultural Literacy; Numeracy; Contextual Learning; Local Cultural Heritage.

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INTRODUCTION

Mathematics is an essential component of education because it provides students with knowledge and skills for reasoning, interpreting information, solving problems, and making decisions in everyday life. Nevertheless, mathematics learning at the junior secondary school level is often perceived as abstract and disconnected from students' lived experiences. Mathematical concepts are frequently presented through symbols, formulas, and formal procedures without sufficient connection to the social, cultural, and environmental contexts in which students live. Such learning conditions may make it difficult for students to recognize the relevance of mathematics beyond the classroom and may limit opportunities to develop meaningful conceptual understanding.

Contemporary mathematics education increasingly emphasizes the development of mathematical competencies that extend beyond computational skills. One of these competencies is numeracy, which involves the ability to understand, use, interpret, and communicate mathematical information in a variety of real-life situations. Numeracy requires students to reason quantitatively, recognize mathematical relationships, interpret information, and apply mathematical knowledge to make appropriate decisions. Consequently, mathematics learning needs to provide students with opportunities to encounter mathematical ideas in meaningful contexts rather than treating mathematics solely as a collection of abstract rules and formulas.

A contextual approach to mathematics learning can be strengthened by incorporating the cultural environment in which students live. One approach that explicitly connects mathematical knowledge with cultural practices is ethnomathematics. D'Ambrosio (2001) conceptualizes ethnomathematics as a way of understanding how cultural groups develop, organize, and use mathematical ideas in accordance with their social practices, traditions, and needs. From this perspective, mathematics is not exclusively a formal body of knowledge developed within academic institutions but is also embedded in human activities and cultural practices.

The integration of ethnomathematics into mathematics education can provide a bridge between students' cultural experiences and formal mathematical concepts taught at school. Cultural objects, traditional practices, architectural structures, patterns, measurement systems, and other forms of local knowledge may serve as meaningful contexts through which students explore mathematical ideas. Such integration can make mathematical concepts more accessible because students encounter them through cultural phenomena that are familiar and relevant to their lives. It may also encourage students to recognize that mathematical thinking exists within their own communities and cultural traditions.

In addition to supporting mathematical learning, culturally contextualized education has an important role in developing cultural literacy. Cultural literacy involves the ability to understand, appreciate, interpret, and respond appropriately to cultural knowledge and practices. In an increasingly globalized society, students need not only academic competencies but also an awareness of their cultural identity and an appreciation of cultural diversity. Mathematics learning that incorporates local cultural heritage can therefore serve a dual purpose: strengthening students' mathematical competencies while fostering their awareness and appreciation of the cultural environment in which they live.

The Toraja community possesses a rich cultural heritage reflected in its traditional architecture, ceremonies, social structures, and artistic expressions. One of the most prominent cultural artifacts is the Tongkonan, the traditional house of the Toraja people. Tongkonan is more than a physical structure or dwelling; it represents family identity, social relationships, cultural continuity, and the values held by the Toraja community. Its architectural form, spatial organization, structural components, and decorative motifs demonstrate a high degree of order, proportion, repetition, and symmetry that can be examined from a mathematical perspective.

From an ethnomathematical perspective, the architecture of Tongkonan provides a rich context for identifying mathematical concepts that are relevant to junior secondary school mathematics. The structural forms can be associated with plane and solid geometry, while the arrangement of architectural elements and decorative motifs may illustrate symmetry and geometric transformations. Repetitive arrangements can provide contexts for exploring numerical patterns, whereas the proportional relationships among architectural components may be used to introduce ratios and proportions. These features demonstrate that mathematical ideas can be observed in cultural artifacts even when they are not expressed through formal mathematical terminology.

Previous ethnomathematical studies have demonstrated that traditional cultural artifacts can serve as valuable contexts for mathematics education. Research on traditional architecture and cultural objects has identified mathematical ideas related to geometry, symmetry, patterns, measurement, and proportional relationships. However, many studies remain primarily descriptive, focusing on identifying mathematical concepts embedded in cultural artifacts without sufficiently examining how these concepts can be transformed into meaningful learning resources for school mathematics. In particular, studies that connect Tongkonan architecture explicitly with the development of students' numeracy and cultural literacy at the junior secondary school level remain relatively limited.

This gap is particularly relevant in regions where local cultural heritage is closely connected to students' everyday environment. For students in North Toraja, Tongkonan is not merely a cultural artifact that can be encountered in textbooks or museums; it forms part of the cultural landscape and social identity of the community. Consequently, using Tongkonan as a mathematical learning context may provide students with opportunities to investigate mathematical concepts through an environment that is culturally familiar and meaningful.

The use of Tongkonan as a learning resource also offers opportunities to develop numeracy in an authentic context. Students can be encouraged to investigate measurements, compare dimensions, identify geometric shapes, analyze patterns, examine symmetry, and interpret proportional relationships found in the architecture. Such activities can move students beyond routine calculations toward interpreting and applying mathematical knowledge within a real-world cultural context. At the same time, students can explore the cultural meanings and values associated with Tongkonan, thereby creating opportunities for the development of cultural literacy.

Based on this background, this study explores the ethnomathematical elements embedded in the architecture of the Tongkonan traditional house and examines their potential as a

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contextual mathematics learning resource for students at SMPN 2 Kapala Pitu. The study specifically focuses on identifying mathematical concepts that can be connected to junior secondary school mathematics and interpreting how these concepts may support the development of students' numeracy and cultural literacy.

This study is expected to contribute to the development of culturally responsive mathematics education by demonstrating how local cultural heritage can be positioned as a meaningful learning resource. Rather than viewing culture merely as supplementary material, the study places Tongkonan at the center of a learning context in which mathematical knowledge and cultural understanding can be developed simultaneously. In this way, mathematics learning can become more relevant to students' lived experiences while contributing to the preservation and appreciation of local cultural heritage.

IDENTIFY, RESEARCH AND COLLECT IDEA

Identify

The initial stage of this study involved identifying the Tongkonan traditional house as a potential source of contextual mathematics learning. The identification process focused on architectural elements that demonstrate regularity, patterns, proportions, geometric forms, and spatial relationships. Particular attention was given to the main structure, roof, supporting columns, spatial arrangement, and decorative elements of the Tongkonan.

The identification was guided by the relevance of these architectural elements to mathematical concepts taught at the junior secondary school level. The researchers examined whether particular forms and arrangements could be connected to concepts such as plane and solid geometry, symmetry, geometric transformations, numerical patterns, ratios, and proportions. At this stage, the Tongkonan was viewed not only as a cultural artifact but also as a potential representation of mathematical ideas embedded in local cultural practices.

Research

The research stage involved exploring relevant information concerning ethnomathematics, Tongkonan architecture, cultural literacy, numeracy, and contextual mathematics learning. A literature review was conducted to establish a theoretical foundation for interpreting mathematical elements within the Tongkonan architecture.

Relevant literature was examined to understand the cultural significance and architectural characteristics of the Tongkonan, as well as previous findings concerning mathematical concepts embedded in traditional cultural artifacts. The researchers also examined mathematics education literature to determine the relevance of the identified elements to junior secondary school learning.

In addition, visual documentation of Tongkonan architecture was examined through indirect observation. The observation focused on visible architectural features, including geometric forms, symmetry, repetition, spatial arrangements, and proportional relationships. Information obtained from different sources was compared to strengthen the interpretation of the identified mathematical elements.

Collect Ideas

The final stage involved collecting and organizing ideas regarding how the identified ethnomathematical elements could be transformed into meaningful mathematics learning contexts. The ideas were developed by connecting specific architectural features of the Tongkonan with mathematical concepts that are relevant to junior secondary school students.

For example, the geometric forms of the Tongkonan can be used as contexts for exploring plane and solid geometry, while repeated decorative patterns can provide opportunities to discuss symmetry, reflection, rotation, and translation. The proportional relationships among architectural components can be used to introduce ratios and proportions, whereas repeated arrangements may serve as contexts for investigating numerical patterns.

The collected ideas were further considered in relation to the development of students' numeracy and cultural literacy. Numeracy can be supported through activities involving measurement, comparison, estimation, geometric reasoning, and the interpretation of quantitative relationships. At the same time, cultural literacy can be developed by encouraging students to understand the cultural meaning and significance of the Tongkonan as part of Toraja cultural heritage.

Thus, the Identify, Research, and Collect Ideas stage provided the foundation for positioning Tongkonan architecture as a culturally meaningful and mathematically relevant learning resource. The process emphasized the connection between mathematical concepts, students' local environment, and the cultural heritage of the Toraja community.

RESULTS AND DISCUSSION

Results

The analysis of the Tongkonan traditional house reveals several ethnomathematical elements that are closely related to mathematical concepts taught at the junior secondary school level. Through a review of relevant literature, indirect observation of architectural structures, and visual documentation analysis, several mathematical concepts were identified, including plane and solid geometry, symmetry, geometric transformations, numerical patterns, ratios, and proportions.

These findings indicate that the mathematical ideas embedded in Tongkonan architecture are not merely formal mathematical concepts imposed on a cultural object. Rather, they can be observed through the structural regularity, arrangement, proportions, and decorative patterns that characterize the traditional house.

1. **Plane and Solid Geometry in Tongkonan Architecture**

One of the most visible ethnomathematical elements in Tongkonan architecture is the presence of geometric shapes. Various components of the building can be associated with concepts of plane and solid geometry.

The main structure of the Tongkonan can be examined through the characteristics of three-dimensional objects. The body of the building has a spatial form that can be used to introduce students to concepts related to solid geometry, including dimensions, surfaces, edges, and spatial relationships. Meanwhile, several architectural components and decorative elements can be represented using

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plane figures such as rectangles, triangles, and other quadrilateral forms.

The roof of the Tongkonan is particularly interesting from a geometric perspective because of its distinctive shape and curved structure. Although its traditional form is primarily associated with cultural and symbolic meanings, its structure can also be examined mathematically through dimensions, angles, symmetry, and spatial relationships.

These characteristics provide opportunities for students to move from observing concrete cultural objects toward identifying and formalizing mathematical properties. For example, students can be asked to identify geometric shapes in different parts of the Tongkonan, estimate or compare dimensions, calculate area or volume, and investigate the relationships among different structural elements.

2. Symmetry in Tongkonan Architecture

Symmetry is another important mathematical element identified in Tongkonan architecture. The arrangement of architectural components and decorative elements demonstrates patterns of balance and repetition.

The façade and ornaments of the Tongkonan can be examined in relation to reflectional symmetry. Certain decorative patterns are arranged in balanced positions, creating corresponding forms on different sides of an axis. This visual regularity can provide a concrete context for introducing the concept of line symmetry to students.

In addition to reflectional symmetry, repeated decorative arrangements can also be examined in terms of rotational patterns. The repetition and positioning of motifs provide opportunities for students to investigate how a shape or pattern changes when it is rotated around a particular point.

Thus, Tongkonan architecture can serve as a visual representation for teaching symmetry and geometric transformations. Students can observe the actual cultural object, identify symmetrical elements, and subsequently represent these observations using mathematical diagrams.

3. Geometric Transformations in Tongkonan Ornaments

The decorative elements of Tongkonan provide further evidence of mathematical patterns. Repeated motifs can be analyzed through geometric transformations such as translation, reflection, and rotation.

Translation can be observed in the repetition of similar motifs along a particular direction. Reflection can be identified when a motif is reproduced as a mirror image across an axis. Rotation can be examined when similar patterns are arranged around a particular point or orientation.

These patterns demonstrate that geometric transformations can be found within traditional cultural expressions. For mathematics learning, such patterns can be used as concrete examples to help students understand transformations that are otherwise often introduced through abstract coordinate diagrams.

Teachers can, for example, present an image of a Tongkonan ornament and ask students to identify the transformation applied to a particular motif. Students can then reproduce the motif using translation, reflection, or rotation on grid paper or digital geometry software. Such activities can connect cultural observation with formal mathematical representation.

4. Numerical Patterns, Ratios, and Proportions

In addition to geometry, numerical patterns, ratios, and proportions can be identified in the arrangement of structural components and spatial organization of the Tongkonan.

The relative distances between architectural elements and the division of spaces demonstrate regularity and proportional relationships. These relationships can be represented mathematically through ratios and proportions. The repeated arrangement of certain elements may also provide opportunities to identify numerical or spatial patterns.

For example, students can compare the dimensions of different parts of the building and express the relationships using ratios. They can also investigate how changes in one dimension may affect another dimension when a particular proportion is maintained.

These activities provide a meaningful context for developing numeracy because students are required not only to calculate numerical values but also to interpret quantitative relationships within a real cultural object.

5. Tongkonan as a Contextual Mathematics Learning Resource

The findings indicate that Tongkonan architecture has considerable potential as a contextual learning resource for junior secondary mathematics. Its mathematical elements can be connected to several topics in the mathematics curriculum, particularly geometry, transformations, patterns, ratios, and proportions.

The use of Tongkonan as a learning context can begin with students' direct or indirect observation of the building. Students can identify mathematical features, formulate questions, collect measurements or visual information, and subsequently represent their observations mathematically.

This learning process allows students to move from an informal understanding of their cultural environment toward formal mathematical concepts. Consequently, Tongkonan functions not simply as an illustration accompanying mathematics lessons but as a meaningful context through which mathematical ideas can be explored.

6. Potential for Developing Students' Numeracy

The integration of Tongkonan architecture into mathematics learning provides opportunities to strengthen students' numeracy. Numeracy involves more than performing calculations; it includes the ability to interpret quantities, recognize relationships, analyze patterns, and apply mathematical reasoning in real-life contexts.

For example, students can be asked to compare the dimensions of architectural components, calculate the area of a particular section, determine ratios between different structural elements, identify patterns in ornaments, or analyze transformations in decorative motifs.

Such tasks require students to interpret mathematical information within a meaningful context. Therefore, Tongkonan can provide a culturally relevant environment in which students practice mathematical reasoning and apply mathematical concepts to situations beyond conventional textbook exercises.

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7. Potential for Developing Cultural Literacy

In addition to numeracy, the integration of Tongkonan into mathematics learning has the potential to strengthen students' cultural literacy.

Tongkonan is an important cultural heritage of the Torajan community and represents social identity, kinship, and cultural values. When students investigate its mathematical characteristics, they are simultaneously encouraged to recognize the knowledge and cultural practices embedded in their local environment.

This approach allows mathematics learning to contribute to cultural awareness. Students can learn that mathematical ideas are not exclusively found in textbooks or formal academic settings but can also be identified in traditional architecture and cultural practices.

Therefore, the use of Tongkonan in mathematics education provides a dual learning opportunity: students develop mathematical competencies while also strengthening their understanding and appreciation of local cultural heritage.

Discussion

The findings of this study demonstrate that Tongkonan traditional house architecture contains various mathematical elements that can be interpreted through an ethnomathematical perspective. These elements are manifested in the geometric forms, symmetrical arrangements, repetitive patterns, and proportional relationships found in different parts of the architecture. The findings support the view of ethnomathematics that mathematical ideas are not exclusively found in formal school mathematics but are also embedded in cultural practices and artifacts developed within particular communities.

Ethnomathematics in Tongkonan Architecture

The identification of plane and solid geometry in Tongkonan architecture demonstrates the close relationship between cultural artifacts and formal mathematical concepts. Architectural structures provide concrete representations of geometric objects and relationships that students can observe directly or through visual documentation. Concepts such as faces, edges, vertices, length, width, height, area, and volume can be explored through the structural components of the Tongkonan.

This finding is consistent with the perspective of D'Ambrosio (2001), who emphasizes that mathematical knowledge develops within cultural contexts and human activities. From this perspective, the geometric characteristics of Tongkonan should not merely be regarded as architectural features but also as representations of mathematical thinking embedded in the cultural practices of the Toraja community. The use of these features in mathematics education can therefore provide a bridge between students' formal mathematical knowledge and their cultural environment.

The architectural structure of Tongkonan also illustrates that mathematical ideas can exist without being expressed through formal mathematical terminology. The construction and arrangement of architectural components require consideration of form, balance, measurement, spatial relationships, and proportion. Although these practices may not have originally been intended as mathematical instruction, they can be interpreted educationally as contexts through which students explore mathematical concepts.

Symmetry and Geometric Transformations

The symmetrical arrangements and repeated decorative motifs identified in Tongkonan architecture provide meaningful contexts for learning symmetry and geometric transformations. Patterns appearing on architectural elements can be analyzed in terms of reflection, rotation, and translation. These characteristics demonstrate that mathematical transformations can be observed in cultural designs that are familiar to students.

The educational significance of this finding lies in the opportunity to transform visual cultural patterns into mathematical representations. Instead of introducing symmetry and transformation solely through diagrams created for textbooks, teachers can present students with authentic cultural objects and ask them to identify, describe, and reproduce the mathematical patterns observed.

Such activities may encourage students to engage in visual reasoning and mathematical communication. Students can, for example, determine an axis of symmetry, describe the movement of a motif, identify repeated units, or create a geometric representation based on an existing Tongkonan pattern. In this way, cultural artifacts can function as starting points for mathematical investigation rather than merely serving as decorative illustrations in teaching materials.

Numerical Patterns, Ratios, and Proportions

The repetitive arrangements and proportional relationships found in Tongkonan architecture also provide potential contexts for developing students' understanding of numerical patterns, ratios, and proportions. Repeated architectural components can be counted and organized to identify regularities, while relationships between different dimensions can be represented using ratios or proportional models.

These findings are particularly relevant to numeracy development because numeracy involves more than performing calculations. Students need to be able to recognize relationships between quantities, interpret information, reason quantitatively, and apply mathematical knowledge to meaningful situations. Tongkonan provides a culturally relevant context in which these processes can be developed through observation and mathematical investigation.

For example, students can examine the relationship between the dimensions of different architectural components, compare the sizes of structural elements, or investigate repeated patterns in decorative designs. Such activities can encourage students to move from simple observation toward quantitative reasoning and mathematical interpretation.

However, the use of ratios and proportions in this context needs to be supported by reliable measurement data when actual quantitative tasks are developed. Since the present study is based primarily on literature review and indirect observation of visual documentation, the identified proportional relationships should be understood as potential learning contexts rather than as empirically verified architectural measurements.

Tongkonan and Numeracy Development

One of the important implications of this study is the potential of Tongkonan architecture to support the development of students' numeracy. The identified mathematical elements can be transformed into contextual tasks involving measurement,

DOI: 10.5281/zenodo.22722509

comparison, estimation, geometric reasoning, pattern recognition, and proportional relationships.

Contextual learning allows students to encounter mathematics through situations that are connected to their environment. When mathematical problems are associated with familiar cultural objects, students may have greater opportunities to interpret mathematical information in relation to real situations. This is particularly important because numeracy requires students to apply mathematical knowledge rather than simply reproduce procedures.

Tongkonan-based mathematical activities can therefore be designed to involve higher levels of mathematical thinking. For instance, students may be asked to estimate dimensions from a scaled image, calculate the area of a particular component, compare proportions, identify geometric transformations in ornaments, or analyze numerical patterns. Such activities can encourage students to formulate mathematical representations, perform calculations, interpret results, and communicate their reasoning.

Nevertheless, the present study does not provide experimental evidence that integrating Tongkonan into mathematics instruction directly increases students' numeracy performance. The contribution identified in this study is the potential of Tongkonan to provide authentic and meaningful contexts for numeracy-oriented learning. Further empirical research is needed to examine the effectiveness of such learning activities.

Tongkonan and Cultural Literacy

The findings also indicate that ethnomathematics can provide a meaningful connection between mathematics education and cultural literacy. Tongkonan is an important representation of Toraja cultural heritage and carries meanings related to community identity, kinship, social relationships, and cultural continuity. Therefore, introducing Tongkonan in mathematics learning can provide students with opportunities to engage with their cultural heritage while studying mathematical concepts.

Cultural literacy is strengthened when students are encouraged not only to recognize cultural objects but also to understand their significance and appreciate the knowledge embedded within them. In this context, students can learn that the mathematical structures they observe in Tongkonan are connected to cultural practices and traditional knowledge that have been maintained across generations.

This integration may contribute to a broader understanding of mathematics as part of human culture. Students can develop the awareness that mathematical thinking is not limited to classrooms, textbooks, or modern technological environments but can also be found in traditional architecture and community practices. Such understanding can strengthen students' appreciation of local knowledge and cultural identity.

Implications for Mathematics Learning at SMPN 2 Kapala Pitu

The findings have practical implications for mathematics learning at SMPN 2 Kapala Pitu. Tongkonan can potentially be developed into contextual learning materials, worksheets, project-based activities, or mathematical investigation tasks. Teachers can select particular architectural elements and connect them with mathematical competencies appropriate for junior secondary school students.

For example, a lesson on geometry may begin with photographs of Tongkonan and ask students to identify geometric shapes and spatial elements. A lesson on transformation geometry may use Tongkonan decorative motifs to investigate reflection, rotation, and translation. Similarly, lessons on ratios and proportions may use appropriately scaled architectural representations to explore quantitative relationships.

The learning activities can also be designed to integrate numeracy and cultural literacy simultaneously. Students may be asked not only to calculate or identify mathematical properties but also to investigate the cultural significance of the architectural elements being studied. This approach can create an interdisciplinary learning experience in which mathematics becomes connected to local history, art, architecture, and cultural heritage.

Such integration is consistent with the principles of culturally responsive education, in which students' cultural backgrounds and local knowledge are recognized as valuable resources for learning. Rather than positioning local culture as additional material outside the mathematics curriculum, Tongkonan can be incorporated into mathematical tasks as a meaningful contextual foundation.

Contribution and Research Implications

The contribution of this study lies in extending the discussion of Tongkonan from a cultural and architectural object to a potential mathematics learning resource. Previous ethnomathematical research has frequently focused on identifying mathematical concepts embedded in cultural artifacts. The present study extends this perspective by explicitly considering how those mathematical elements may be connected to numeracy and cultural literacy development at the junior secondary school level.

The study also highlights the importance of maintaining a balance between cultural interpretation and mathematical formalization. Cultural artifacts should not be reduced merely to collections of geometric shapes or numerical patterns. Their cultural meanings should remain an integral part of the learning experience. In this way, ethnomathematics can function not only as a strategy for contextualizing mathematics but also as a means of recognizing and valuing local knowledge.

Overall, the findings suggest that Tongkonan architecture has considerable potential as a culturally grounded learning resource for mathematics education. Its geometric forms, symmetry, transformations, patterns, ratios, and proportions provide opportunities for students to explore mathematical ideas through a familiar cultural context. At the same time, engaging with Tongkonan can encourage students to recognize the mathematical dimensions of their cultural heritage and develop greater appreciation for the knowledge and values embedded within it.

CONCLUSION

This study concludes that the architecture of the Tongkonan traditional house contains various ethnomathematical elements that are relevant to junior secondary school mathematics learning. The identified elements include plane and solid geometry, symmetry, geometric transformations, numerical patterns, ratios, and proportions. These mathematical ideas are reflected in the structural forms, spatial arrangements, proportional relationships, and decorative patterns of Tongkonan architecture.

The findings demonstrate that Tongkonan has considerable potential to serve as a contextual mathematics learning resource.

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By connecting formal mathematical concepts with a cultural artifact that is familiar to students, teachers can provide meaningful opportunities for students to explore mathematics through real-world and culturally relevant contexts. Such learning activities may support students in developing numeracy through mathematical reasoning, measurement, comparison, pattern recognition, and the interpretation of quantitative relationships.

At the same time, the integration of Tongkonan into mathematics learning provides opportunities to foster cultural literacy. Students can learn mathematics while simultaneously developing awareness, appreciation, and respect for Toraja cultural heritage. Therefore, ethnomathematics can serve as a bridge between mathematical knowledge and local cultural identity.

However, because this study employed a qualitative exploratory approach based primarily on literature review, indirect observation, and visual documentation, the findings represent the potential of Tongkonan as a learning resource rather than empirical evidence of improved student achievement. Further research is recommended to develop and implement Tongkonan-based learning materials and to empirically examine their effectiveness in developing students' numeracy, mathematical understanding, and cultural literacy.

APPENDIX

Appendix 1. Identification of Ethnomathematical Elements in Tongkonan Architecture

Tongkonan Architectural Element	Ethnomathematical Concept	Potential Mathematics Learning Topic
Main building structure	Geometric forms and spatial relationships	Plane and solid geometry
Roof structure	Three-dimensional geometric forms	Solid geometry
Supporting columns	Parallel and perpendicular relationships	Lines and geometric relationships
Symmetrical arrangement of architectural elements	Line and rotational symmetry	Symmetry
Decorative motifs	Repetition and geometric transformations	Reflection, rotation, and translation
Repeated architectural patterns	Numerical regularities	Number patterns
Relative dimensions of architectural components	Quantitative relationships	Ratios and proportions
Spatial arrangement	Position and geometric relationships	Geometry and spatial reasoning

Appendix 2. Observation Guidelines

The indirect observation of Tongkonan architecture focused on the following aspects:

1. Identification of geometric forms appearing in the main structure and architectural components.
2. Identification of symmetrical arrangements in the structure and decorative elements.
3. Identification of repeated motifs and patterns.
4. Identification of potential geometric transformations in decorative patterns.
5. Examination of proportional relationships among visible architectural components.
6. Identification of elements that can be connected to junior secondary school mathematics.
7. Consideration of the potential use of each element as a contextual mathematics learning resource.

Appendix 3. Literature Review Focus

The literature review was conducted by focusing on four major areas:

Focus Area	Purpose
Ethnomathematics	To establish the theoretical relationship between mathematics and cultural practices
Tongkonan Architecture	To understand the cultural and architectural characteristics of the traditional house
Numeracy	To identify mathematical competencies that can be developed through contextual learning
Cultural Literacy	To examine the potential contribution of local cultural contexts to students' cultural awareness and appreciation

Appendix 4. Potential Learning Activities

The identified ethnomathematical elements can be developed into contextual learning activities, including:

- identifying geometric shapes and solid figures from photographs of Tongkonan;
- identifying lines of symmetry in Tongkonan structures and ornaments;
- analyzing reflection, rotation, and translation in decorative patterns;
- identifying and extending numerical patterns found in repeated architectural elements;
- comparing dimensions and proportional relationships using scaled representations;
- estimating and calculating measurements related to selected architectural components; and
- discussing the cultural meaning and significance of Tongkonan while solving mathematical problems.

These activities are proposed as potential learning applications and require further development and empirical testing before their effectiveness can be established.

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