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Ethnomathematical Exploration of Tembe Nggoli Mbojo Local Culture

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Abstract
Mathematics is a field of study that emphasizes logical and systematic reasoning. From a cultural perspective, mathematics is closely related to various community activities, which can be examined through the ethnomathematics approach. This study aims to explore ethnomathematical elements embedded in Tembe Nggoli Mbojo, a traditional woven fabric of the Bima community in West Nusa Tenggara. The research employed a qualitative method using observation, documentation, and interviews with local weavers and cultural figures. The findings reveal that the motifs of Tembe Nggoli Mbojo contain mathematical concepts such as geometric transformations (including two-dimensional shapes such as squares, rectangles, triangles, parallelograms, and rhombuses), patterns, and symmetries. These results indicate that Tembe Nggoli Mbojo not only possesses aesthetic values but also contributes to contextual mathematics learning that is culturally relevant, while simultaneously supporting cultural preservation and reinforcing national identity.

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1. INTRODUCTION

Mathematics is a universal science and plays a vital role in the development of science, technology, and everyday life. As an abstract science, mathematics is often perceived as separate from real life, even though mathematical concepts are naturally present in cultural activities, traditions, and the local wisdom of a society.[1]. The relationship between culture and mathematics gave birth to a field of study known as ethnomathematics, namely the study of how certain societies understand, articulate, and use mathematical concepts contained in their cultural practices.[2].

Ethnomathematics serves as a bridge between formal mathematics learning and the realities of community life, thus providing students with contextual understanding. Through ethnomathematics, students not only learn abstract mathematical concepts but also connect this knowledge to the cultural practices around them. Thus, mathematics is no longer viewed as a rigid science, but rather as a close connection to the lives and cultural identities of communities.[3], [4]

One of the local cultures that has great potential to be explored from an ethnomathematics perspective is *Tembe Nggoli Mbojo*. *Tembe Nggoli Mbojo* one of the cultural heritages of the Bima people, West Nusa Tenggara, which is rich in philosophical values, aesthetics, and local wisdom. *Tembe Nggoli Mbojo* functions not only as a symbol of cultural identity, but also as a medium that represents the mindset, social values, and

technical skills of the local community.[5]. In form and motif of *Tembe Nggoli Mbojo* various geometric structures, symmetrical patterns, and mathematical principles that arise from the empirical experiences of society.

Ethnomathematical exploration in *Tembe Nggoli Mbojo* is important for two main reasons. First, it contributes to the preservation of local culture so that it remains relevant in modern life, especially in the era of globalization which often erodes the cultural identity of the community.[6] Through an ethnomathematics approach, culture is not merely preserved as symbols but also scientifically studied, yielding new insights into the relationship between mathematics and culture. Second, this exploration can be a source of innovation in mathematics education, particularly at the elementary and secondary levels. Through this approach, students not only understand mathematical concepts more easily but also develop a love for their own culture.[4], [5], [7]

Besides that, *Tembe Nggoli Mbojo reflects* the existence of a mathematical thinking system internalized in the cultural practices of the Bima people. For example, the use of flat geometric patterns such as triangles, rhombuses, parallelograms, squares, and rectangles arranged to form certain symmetries, simple arithmetic calculations used in determining the amount of material or size, to the representation of the concept of transformation in the form of rotation and reflection in the motifs displayed. This shows that the local community has indirectly implemented mathematical concepts in everyday life, although not using formal terms as known in the academic world.[3], [8], [9]

Studies on ethnomathematics in local cultures such as *Tembe Nggoli Mbojo* in line with the national education vision, which emphasizes the importance of integrating science, 21st-century skills, and preserving local wisdom, the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia encourages the implementation of culture-based learning (*culture based learning*) as a strategy to improve the quality of education while maintaining the sustainability of regional culture[10], [11][12]. In this context, ethnomathematical exploration on *Tembe Nggoli Mbojo can* be a model for implementing local wisdom-based learning, which is relevant from both pedagogical and sociocultural perspectives.

Furthermore, ethnomathematics exploration can also contribute to the development of interdisciplinary knowledge. This study focuses not only on mathematical aspects but also incorporates anthropological, historical, and cultural perspectives. This interdisciplinary approach allows for a more comprehensive understanding of how mathematics is rooted in the practices of community life. For example, the analysis of motifs in *Tembe Nggoli Mbojo* can be related to group theory in modern mathematics, while the emerging symmetry patterns can be analyzed using the concept of geometric transformations.[11], [13], [14]. Thus, this research has the potential to make a significant contribution in enriching the ethnomathematics literature in Indonesia, which until now has been relatively limited and has focused more on major cultures.[6].

Based on the description above, the exploration of ethnomathematics in local culture *Tembe Nggoli Mbojo* is relevant to carry out both in order to preserve local culture and to improve the quality of contextual-based mathematics education. This research is expected to identify the mathematical concepts contained in *Tembe Nggoli Mbojo*, describing how the concept is applied in cultural practices, and analyzing its potential for integration into mathematics learning in schools. In this way,*Tembe Nggoli Mbojo not* only seen as a cultural artifact, but also as a source of learning rich in value, connecting modern science with local wisdom passed down from generation to generation.

In the context of Indonesian education, the application of ethnomathematics supports the implementation of the Independent Curriculum, which emphasizes context-based learning and local wisdom. The use of traditional textiles as a learning medium enables

students to understand abstract concepts in a more concrete and relevant way.[12] This also strengthens character education through the internalization of cultural values. Furthermore, the use of ethnomathematics aligns with efforts to preserve the nation's cultural heritage, as affirmed in Law Number 5 of 2017 concerning the Advancement of Culture.[15] .

One of the cultural heritages that is rich in mathematical values is *Tembe Nggoli Mbojo*, a traditional woven cloth of the Bima people. The motifs in this cloth not only contain philosophical symbolism, but also mathematical structures such as line symmetry, rotational symmetry, translation, number sequences, and plane geometry. Thus, *Tembe Nggoli Mbojo has* great potential to be used as a medium for ethnomathematics-based mathematics learning.

Based on this description, this study aims to explore the motifs in *Tembe Nggoli Mbojo*, mapping its mathematical concept content, and analyzing its potential as a source for local wisdom-based mathematics learning. This research is expected to contribute to the development of more contextual mathematics learning, support the preservation of local culture, and enrich the ethnomathematics literature of the Bima community.

2. RESEARCH METHOD

This research uses a qualitative approach with an exploratory design and employs ethnographic-descriptive methods. The main objective of the research is to explore the relationship between the local culture of Tembe Nggoli Mbojo and the mathematical concepts contained within it.

Data collection was conducted through interviews, observation, and documentation. The researcher personally participated in the field to obtain data from artisans, cultural figures, and community members involved in weaving practices. Interviews were used to gather in-depth information regarding the symbolic and mathematical meanings of the woven motifs, while observations were conducted to observe the emerging geometric patterns, shapes, and structures. Documentation in the form of photographs and field notes were used to support the research data.

Data analysis was conducted interactively through three stages: data reduction, data presentation, and conclusion drawing. In the reduction stage, data deemed irrelevant was eliminated, while data related to the research focus was categorized. Next, the data was presented in narrative form, making it easier for researchers to identify mathematical concepts in woven motifs. The final stage, drawing conclusions, was conducted by interpreting the results of the ethnomathematics exploration to select appropriate and relevant mathematical elements for learning in elementary schools.

The results of this research are expected to enrich understanding of ethnomathematics and contribute to the development of local culture-based mathematics learning by integrating cultural elements deeply rooted in Bima society, particularly through *Tembe Nggoli Mbojo*, mathematics learning in schools can be more contextual, meaningful, and at the same time foster students' love for their own cultural heritage.

3. RESEARCH RESULTS AND DISCUSSION

3.1 Research result

This research produced the main findings in the form of identification of traditional motifs. *Tembe Nggoli Mbojo* which contains mathematical elements. Based on field observations, interviews with craftsmen, and visual documentation, four main motifs were obtained which were analyzed in depth, namely:

a) Motif *Golden Night Monca*, shaped like a flower with repeating square petals, contains the concepts of eighth-order rotational symmetry, number patterns, and geometric transformations.

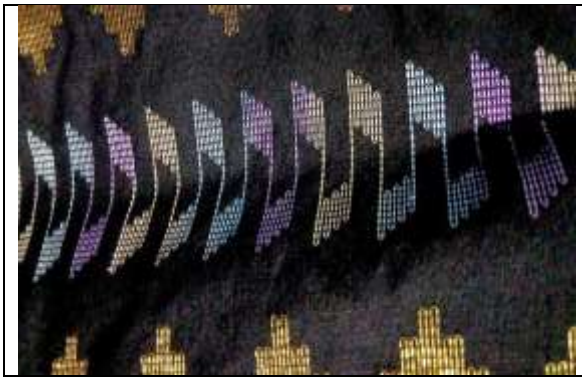
b) Motif *Nggusu Waru*, octagonal in shape, related to the concept of flat shapes, angles in polygons, and geometric regularity.
c) Motif *If Sape*, in the form of an isosceles triangle, contains the concepts of similarity, proportion, and angle theorem.
d) Motif *Lare-Lare*, in the form of a repeating straight-line pattern, represents the concepts of translation, repetition, and arithmetic number sequences.

Interviews conducted by researchers with weavers indicate that the weaving process follows specific counting rules, such as determining the number of repetitions of a motif based on a specific multiple, for example, eight repetitions for a full pattern. This demonstrates that the cultural practice of weaving is closely linked to the application of concepts of number, geometry, and mathematical regularity.

Based on the results of the observation also, the mapping of motifs to visible mathematical concepts can be presented in the following table 1:

Table 1. Motif Mapping of *Tembe Nggoli Mbojo*

Picture	Mathematical Concepts
	The concept of flat triangles and congruence
	Flat shapes of rhombuses, diagonals, line symmetry and rotational symmetry
	Square plane shapes, line symmetry and rotational symmetry
	Rectangular flat shape, reflection

	Parallelogram plane shape, reflection

This mapping shows a close connection between local culture and formal mathematics materials, so that woven motifs can be used as a concrete medium for local wisdom-based learning.

3.2 Discussion

This research emphasizes the relationship between the local culture of the Bima people through *Tembe Nggoli Mbojo* with mathematical concepts that can be integrated into learning. Research findings show that each traditional woven motif not only functions as an aesthetic expression and cultural symbol, but also contains a systematic mathematical structure. This is in line with ethnomathematics theory which emphasizes that the cultural practices of society are full of mathematical activities that can be revealed through contextual studies [16], [17]. Thus, the exploration of ethnomathematics in *Tembe Nggoli Mbojo* shows how local wisdom values can be transformed into meaningful learning resources.

The connection between motifs and the concepts of geometry, transformation, and number patterns supports research that found that traditional motifs can be used as contextual resources for mathematics learning [1], [16]. In addition, craftsmen weave with certain counting rules showing how mathematics is applied naturally in everyday life, as emphasized regarding the importance of ethnomathematics *pedagogy* [1].

Based on the research results, we obtained geometric mathematical concepts contained in each component of *Tembe Nggoli Mbojo*. These concepts include: 1) Geometric forms including flat shapes; 2) Similarity and congruence; 3) Transformation geometry, namely reflection. The Tembe Nggoli Mbojo motif displays various two-dimensional geometric elements that can be used as teaching materials to enrich contextual problems in mathematics learning. For example, the perimeter and area elements of a plane figure can be developed into simple calculation exercises. The concept of similarity is evident in patterns with similar shapes but different sizes, while congruence is seen in patterns with identical shapes and sizes. The following are the mathematical concepts in each component: *Tembe Nggoli Mbojo*:

a) Flat Shapes in Motifs of *Tembe Nggoli Mbojo*

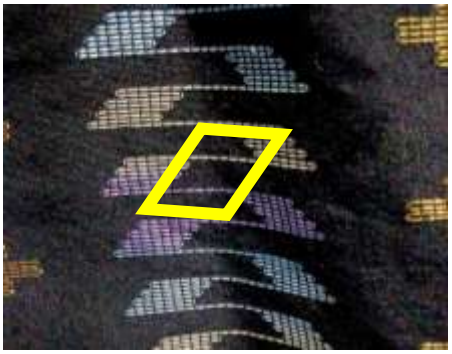


Figure 2. Parallelogram Motif

Based on the image above, one of the flat shapes that appears in the motif is *Tembe Nggoli Mbojo* is **parallelogram** Geometrically, a parallelogram is a quadrilateral with two pairs of opposite sides that are parallel and of equal length. Each pair of sides is identical in size and parallel in direction. The presence of the parallelogram shape in woven motifs of *Tembe Nggoli Mbojo demonstrates* the application of basic geometric concepts in traditional cultural works. The repeating patterns formed from parallelograms provide aesthetic value and reflect the integration of mathematical aspects and artistic creativity passed down through generations in Bima society.

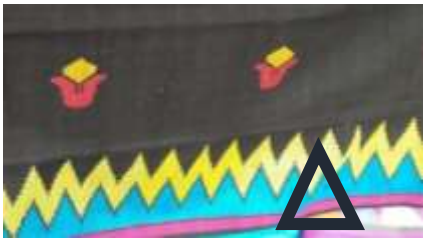


Figure 3. Equilateral Triangle Motif

Based on Figure 3, one of the flat geometric shapes found in the motif of *Tembe Nggoli Mbojo* is an equilateral **triangle**. An equilateral triangle is defined as a triangle that has three sides of identical length. The consequence of the equality of the lengths of the sides is the formation of three angles of equal size, namely each of equal length.**60°**. This symmetrical nature also gives equilateral triangles a strong aesthetic value, making them frequently used in various works of art and design. Thus, the presence of equilateral triangles in motifs of *Tembe Nggoli Mbojo not* only shows the application of mathematical concepts, but also reflects the philosophical meaning of stability and harmony in the visual culture of the Bima people.

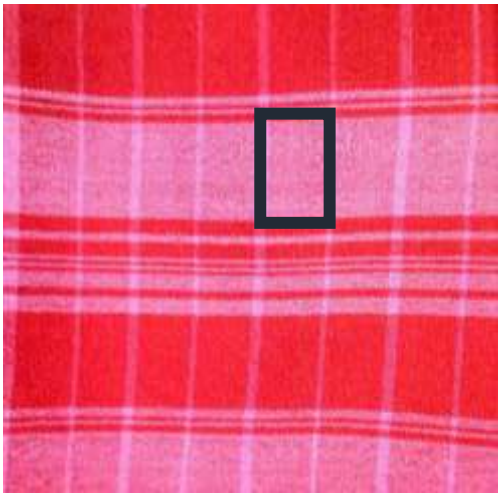


Figure 4. Rectangular Motif

Based on Figure 4, one of the motifs displayed on the woven fabric of *Tembe Nggoli Mbojo* is a rectangle, which is arranged through a repeating pattern. From a mathematical perspective, this repeating pattern can be related to the concept of number **patterns**, where the regular arrangement provides regularity of form and a rhythmic impression to the woven motif. In addition, all the angles in a rectangle are congruent **day by day** with a large angle of 90°. The presence of rectangular shapes in woven motifs not only emphasizes the application of basic geometric concepts but also provides aesthetic value through harmonious pattern repetition. This demonstrates that the craftsman of *Tembe Nggoli Mbojo* have traditionally implemented mathematical principles in their cultural practices, even though they are not formally stated in the framework of modern mathematics.

Figure 5. Square Motif

Based on Figure 5, the motifs on the woven fabric of *Tembe Nggoli Mbojo also* displays the form **rectangle**. In the study of geometry, a square is defined as a flat shape that has four sides of equal length and four angles in the shape of a rectangle **day by day**(90°). The presence of square motifs in the weaving *Tembe Nggoli Mbojo* not only demonstrates the application of basic geometric concepts, but also demonstrates order, balance, and symmetry. This provides aesthetic value and confirms that the craftsmen have intuitively integrated mathematical principles into their creative process. Thus, the squares in the woven motifs serve not only as decorative elements but also represent the close relationship between mathematics and the local culture of the Bima people.

Figure 6. Rhombus Motif

Based on Figure 6, the motifs displayed on the woven fabric *Tembe Nggoli Mbojo* is **rhombus** in geometry, a rhombus is a quadrilateral with four sides of equal length. This shape falls into a special category of parallelogram because, in addition to having two pairs of parallel sides, all sides are identical in length. Rhombus motif in weaving Tembe *Nggoli Mbojo not* only demonstrates the application of mathematical concepts, but also demonstrates aesthetic value through the regularity of the resulting patterns. This demonstrates that the craftsmen's creative process incorporates geometric elements intuitively integrated into the cultural heritage of the Bima people.

b) Mathematical Concepts in *Tembe Nggoli Mbojo*

Below is the flat shape found on *Tembe Nggoli Mbojo if* made in the form of a mathematical concept:

Figure 7. Replica of flat shapes on *Tembe Nggoli Mbojo*

Based on image 7 above, the flat shapes found in the motif *Tembe Nggoli Mbojo* that have been identified by researchers include: Parallelogram, Equilateral Triangle, Rectangle, Square, and Rhombus.

Integrating the results of this research into learning has great potential to increase student motivation and understanding. By utilizing local motifs in learning, students are not only encouraged to understand abstract concepts, but are also given the opportunity to internalize the cultural values contained within them. This is in line with the finding that ethnomathematics-based learning can increase the relevance of the material and make it closer to students' daily lives. In this way, learning becomes more meaningful and can connect knowledge with their experiences in a broader cultural context [18], [19].

4. CONCLUSION

This research shows that Tembe Nggoli-Mbojo, as a cultural heritage of the Bima people, not only has aesthetic and philosophical value but is also closely related to mathematics. The results of the exploration indicate that the main motifs found in the Tembe Nggoli-Mbojo are: motifs, including *Golden Night Monca* motifs, *Nggusu Waru*, *If Sape*, And *Lare-Lare*. As for the motifs found in *Tembe Nggoli Mbojo* related to flat shapes are as follows: parallelogram, equilateral triangle, rectangle, square, and rhombus.

Mapping motifs to mathematical concepts demonstrates a close relationship between weaving practices and mathematical thinking structures. This research demonstrates the significant potential for integrating Tembe Nggoli-Mbojo motifs into local wisdom-based mathematics learning. Utilizing motifs as contextual media allows students to understand abstract concepts through concrete representations while fostering an appreciation for regional culture. Thus, this research contributes to the expansion of ethnomathematics studies in Indonesia and opens up opportunities for the development of contextual, meaningful teaching materials that align with the cultural values of the Bima people.

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