

Exploring the Concept of Ethnomathematics in the Madelaras, Datulaya, and Tambakbaya Batik Motifs as a Resource for Learning Mathematics

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INFO ARTICLES

Key Words:

Ethnomathematics; Batik Banten: Geometric; Mathematical Concept; Philosophical Values, Local Culture



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Abstract: Banten Batik is one of the local cultural heritages that embodies the historical, philosophical, and cultural identity of the Banten community. The motifs examined in this study, namely Madelaras, Datulaya, and Tambakbaya, not only possess aesthetic value but also contain mathematical concepts that can be explored through an ethnomathematical approach. This study aims to analyze the ethnomathematical elements found in Banten Batik motifs and examine their potential as alternative mathematics learning resources in schools. This research employed a qualitative method with an ethnographic approach. Data were collected through observation and documentation at Batik Banten Mukarnas in Serang, Banten. The findings reveal that Banten Batik motifs contain concepts of geometry and geometric transformations, including symmetry, reflection, rotation, translation, geometric shapes, geometric patterns, and sequences. These findings indicate that Banten Batik has significant potential to be utilized as a contextual, meaningful, and culturally based mathematics learning resource.

Abstrak: Batik Banten merupakan salah satu warisan budaya lokal yang mencerminkan identitas sejarah, filosofis, dan budaya masyarakat Banten. Motif-motif yang dikaji dalam penelitian ini—yaitu Madelaras, Datulaya, dan Tambakbaya—tidak hanya memiliki nilai estetika, tetapi juga memuat konsep-konsep matematika yang dapat dieksplorasi melalui pendekatan etnomatematika. Penelitian ini bertujuan untuk menganalisis unsur-unsur etnomatematika yang terdapat pada motif Batik Banten serta mengkaji potensinya sebagai sumber belajar matematika alternatif di sekolah. Penelitian ini menggunakan metode kualitatif dengan pendekatan etnografi. Pengumpulan data dilakukan melalui observasi dan dokumentasi di Batik Banten Mukarnas, Serang, Banten. Hasil penelitian menunjukkan bahwa motif Batik Banten memuat konsep geometri dan transformasi geometri, meliputi simetri, refleksi, rotasi, translasi, bangun geometri, pola geometri, dan barisan. Temuan ini mengindikasikan bahwa Batik Banten memiliki potensi besar untuk dimanfaatkan sebagai sumber belajar matematika yang kontekstual, bermakna, dan berbasis budaya.

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How to Cite (APA 6th Style): Azizah, S. N., Syahidah, A., Mutohharoh, Kusuma, J. W., Hamidah, & Ayuningtyas, V. (2026). Exploring the Concept of Ethnomathematics in the Madelaras, Datulaya, and Tambakbaya Batik Motifs as a Resource for Learning Mathematics. *Prosiding Diskusi Panel Nasional Pendidikan Matematika*, 801-812.

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INTRODUCTION

Indonesia is a country rich in traditional knowledge and culture, including batik. The wax-resist dyeing method is used in traditional Indonesian batik craftsmanship to produce beautiful and symbolic designs. (Hastuti et al., 2025).

Batik reflects a region's cultural identity because it possesses philosophical, symbolic, and artistic value. (Hayati Syari et al., 2022). One example of a region with a diverse array of unique batik motifs is Banten, which is famous for motifs such as Datulaya, Madelaras, and Tambakbaya—all of which stem from the revival of the ancient values of the Bantenese people. (Ayuningtyas et al., 2025). Banten batik motifs feature patterns that can be analyzed mathematically, in addition to carrying philosophical meanings rooted in the historical values of the Bantenese people.

Banten is a region with a diverse array of unique batik designs. On October 2, 2009, UNESCO in Abu Dhabi officially designated batik as Intangible Cultural Heritage. National Batik Day is celebrated every October 2. (Zahroh et al., 2021). Archaeological research on the remains of the Banten Sultanate has led to the revival of Banten batik, which has subsequently been reimaged into various contemporary batik themes. Batik Banten Mukarnas, a production facility in Serang, plays a crucial role in the development of Banten batik. Batik Mukarnas is recognized as the first to use Banten batik motifs based on historical artifacts, including ceramics, palace ornaments, and traditional spatial architecture. To date, Batik Banten Mukarnas has created more than one hundred themes that reflect the richness of Banten's cultural heritage. (Banten Provincial Government, 2023)

Ethnomathematics is a term used in education to describe the combination of mathematics and culture. The study of how mathematics and culture interact—that is, how mathematical concepts are incorporated into the practices or artifacts of a particular society—is known as ethnomathematics. (Safira et al., 2021). Ethnomathematics can help students visualize and make abstract mathematical topics more concrete by incorporating the culture and contexts they are familiar with. (Yudhi & Septiani, 2024). Through this method, students view mathematics as an integral part of their daily lives, rather than as an abstract subject. Mathematical concepts such as geometry, transformations, symmetry, and repeating patterns can be observed in batik motifs, such as those found in Banten batik. Geometric shapes, geometric transformations, and concepts of symmetry and congruence are examples of mathematical features found in Banten batik motifs, according to previous research. (Subekhi & Nindiasari, 2021). This demonstrates how batik can be utilized as a contextual learning tool when studying mathematics.

Furthermore, the use of ethnomathematics in the classroom has the potential to enhance student motivation, conceptual understanding, and the ability to connect mathematical concepts to real-world scenarios. Students can develop a love for local culture and learn mathematics in a more relevant way through local cultural contexts such as Banten batik. (Mulyatna et al., 2026). Nevertheless, very few studies on ethnomathematics have been based on the theme of Banten batik, particularly on motifs such as Datulaya, Madelaras, and Tambakbaya, which are rarely examined from a mathematics education perspective. In fact, there are many possibilities for utilizing these Banten batik designs in education.

Based on this discussion, this study aims to identify the ethnomathematical concepts present in Banten batik motifs—specifically Datulaya, Madelaras, and Tambakbaya—and to examine their application in mathematics education at Batik Banten Mukarnas in Serang, Banten. The findings of this study are expected to help create mathematics instruction grounded in local culture that is more contextual, creative, and relevant to readers.

METHOD

This study employs an ethnographic approach and qualitative methodology. In this method, the researcher directly observes and interacts with a specific community or cultural group as part of the

scientific process (Syahdan, 2021). Local batik ornamental motifs—specifically the Madelaras, Datulaya, and Tambakbaya motifs—serve as representations of Banten culture in this context. Theoretically, there are three phases of ethnography in research, in line with the views of Rehzi and Najib (in Dianlestari & Kusno, 2024), which include the field familiarization phase, the field research phase, and the research report writing phase. Through these phases, this study aims to investigate the mathematical concepts embedded in regional culture (ethnomathematics) as an alternative to traditional mathematics instruction in the classroom. The research was conducted at Batik Banten Mukarnas, the first batik production site in Banten. This production facility is located at Jl. Bhayangkara No. 5, Kubil, Cipocok Jaya, Cipocok Jaya Subdistrict, Serang City, Banten. Data collection was conducted directly at the site through observation and documentation to explore the philosophical values and characteristics of Banten's distinctive batik motifs. After the data was collected, the researcher selected several specific motifs from the many available batik patterns and photographed them for mathematical analysis to identify the geometric elements contained within them.

RESULT

The results of this study explore the concepts of ethnomathematics contained in the Banten batik motifs found in Mukarnas, Serang, Banten. The Madelaras, Datulaya, and Tambakbaya motifs were examined in this study. These results indicate that Banten batik possesses educational value that can be applied to ethnomathematics-based mathematics instruction, in addition to its aesthetic and cultural value. The following is a description of each motif along with an analysis of the mathematical concepts contained within each motif.

1. Batik Madelaras

Madelaras Batik is a unique Banten batik motif created based on archaeological research into various artifacts and cultural relics of the Banten Sultanate. As part of efforts to preserve Banten's cultural heritage, this design is part of a collection of Banten batik motifs that was reintroduced to the public in the early 2000s. (People, 2026)



Figure 1. Madelaras Batik Pattern

In addition to its cultural and philosophical significance, the Madelaras motif also incorporates various mathematical concepts that can be studied through an ethnomathematics approach.

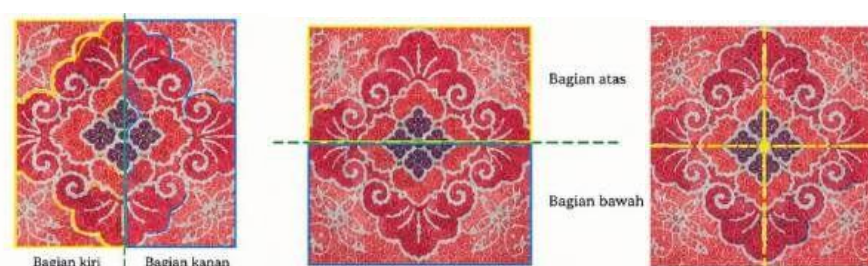


Figure 2. Symmetry (Reflection) in the Madelaras Batik Pattern

The Madelaras batik motif shown in Figure 2 is an example of the ethnomathematical concept of symmetry (reflection). The arrangement of these motifs, which are identical on both sides and create a balanced pattern along both the vertical and horizontal axes, illustrates this concept.



Figure 3. Geometric Shapes in Madelaras Batik Patterns

According to Figure 3, the Madelaras batik motif uses geometric patterns to represent the concept of ethnomathematics. The systematic and repetitive arrangement of rhombuses, circles, curves, and rectangles illustrates this point. One of the unique qualities of the Madelaras batik motif is its mathematical regularity, as demonstrated by these patterns.

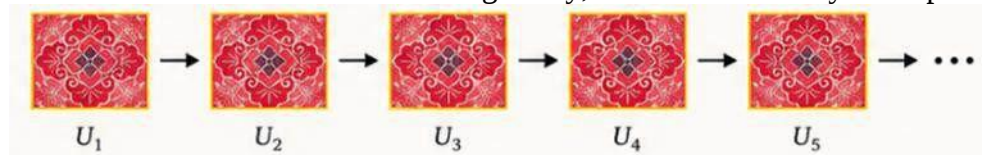


Figure 4. Horizontal Patterns and Rows in the Madelaras Batik Motif

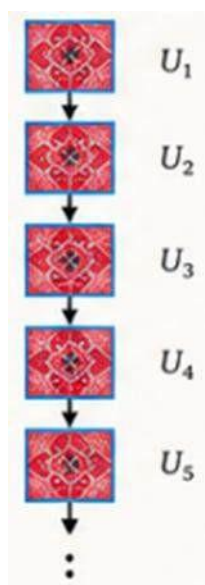


Figure 5. Vertical Patterns and Rows in the Madelaras Batik Motif

The Madelaras batik motif, as shown in Figures 4 and 5, uses patterns and sequences to represent the concept of ethnomathematics. This concept is illustrated by a number of motifs arranged vertically and horizontally in an orderly and sequential manner. This systematic arrangement of motifs creates repeating patterns, demonstrating the regularity associated with mathematical concepts of sequence.

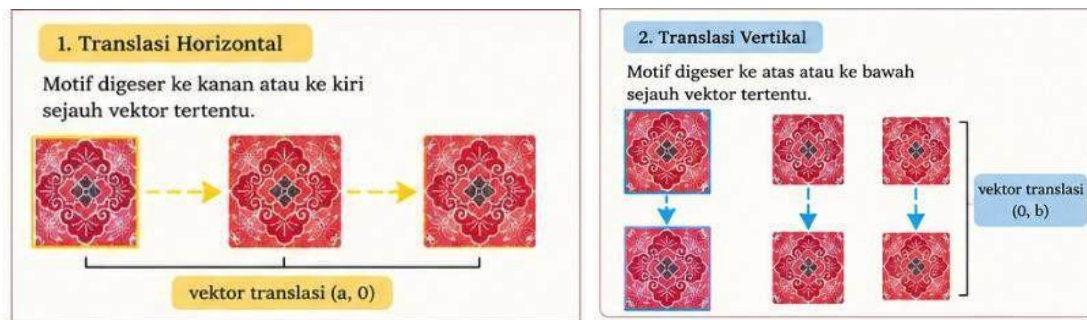


Figure 6. Translation in the Madelaras Batik Motif

Based on Figure 6, the Madelaras batik design represents the ethnomathematical concept of translation (shifting). The main motif, which is often repeated both vertically and horizontally, illustrates this point. Without changing its size, shape, or direction, each motif moves a specific distance. By demonstrating the concept of translation in geometric transformations, this repetition of the pattern results in a more harmonious, balanced, and orderly arrangement of motifs.

2. Batik Datulaya

The Datulaya batik motif consists of a diamond-shaped background and floral elements such as flowers and leaf tendrils. Datulaya batik is typically identified by its gray floral patterns and shades of yellow. The name Datulaya derives from the prince's residence. "Laya" means "house," while "Datu" means "kingdom." Therefore, Datulaya can be interpreted as the prince's house or the residence of the royal family. This motif represents the life of the Banten nobility, who upheld the values of simplicity and elegance in their daily lives.

Elegance is reflected in the orderly, balanced arrangement of the motifs and their aesthetically pleasing forms, while simplicity is evident in the patterns—which are understated yet retain high artistic value.



Figure 7. Datulaya Batik Motif

The Datulaya motif contains several mathematical concepts that can be studied using ethnomathematics, in addition to its philosophical, aesthetic, and cultural significance.

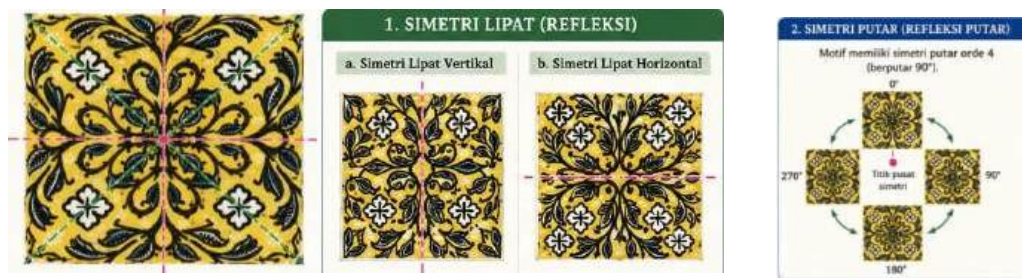


Figure 8. Symmetry (Reflection) in the Datulaya Batik Pattern

Figure 8 clearly illustrates that the Datulaya batik design embodies an ethnomathematical concept of symmetry (reflection). The shapes on both sides of the motif are symmetrical with respect to the vertical and horizontal axes, which underscores this point. Furthermore, the Datulaya motif also exhibits fourth-order rotational symmetry, as evidenced by the fact that the motif remains unchanged when rotated by 90° , 180° , 270° , and 360° . Datulaya batik patterns are characterized by regularity and balance, as demonstrated by the presence of these symmetry concepts..

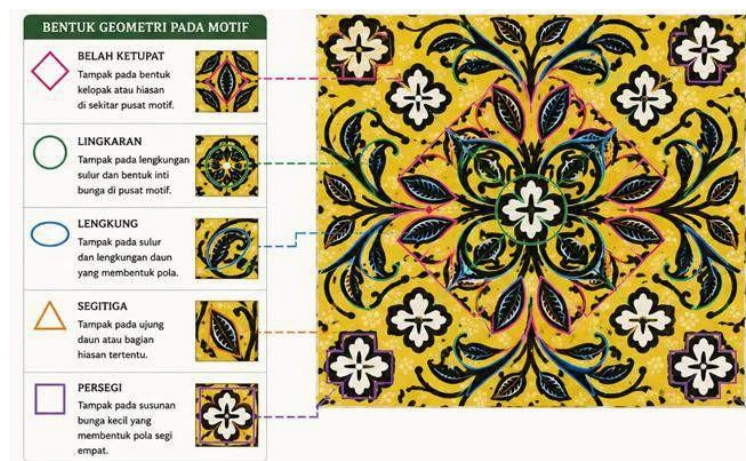


Figure 9. Geometric Shapes in Datulaya Batik Motifs

The Datulaya batik motif features a variety of geometric shapes that form the overall pattern, as shown in Figure 9. Rhombuses, circles, curves, triangles, and squares are characteristic examples of recognizable geometric shapes. In the main pattern, a flower-like circle is located in the center, while rhombuses surround the center. Additionally, the decorative leaf and vine motifs in the ornamental pattern are curved. Square shapes are visible in the arrangement of small flower motifs that form a regular pattern, while triangles can be found at many of the ornament's tips.



Figure 10. Patterns and Sequences in the Datulaya Batik Motif

Based on Figure 10, Datulaya batik motifs incorporate the concept of ethnomathematics in the form of patterns and sequences. Several main motifs, arranged in regular horizontal and vertical groups, make this concept quite clear. This repetition results in a regular arrangement of motifs, creating a consistent pattern. From top to bottom and from left to right, each motif can be viewed as a sequence of elements arranged in a specific pattern.

3. Batik Tambakbaya

The name of the layout or structure of the palace where the palace night guards were stationed during the Banten Sultanate served as the inspiration for the Tambakbaya batik motif in Banten. Small circles and geometric shapes resembling diamond-shaped ketupat are used in this motif to represent protection, vigilance, and the preservation of the palace grounds. (Surtini et al., 2022)



Figure 11. Tambakbaya Batik Motif

The Madelaras motif has cultural and philosophical significance, as well as a number of mathematical concepts that can be studied using ethnomathematics methods.



Figure 12. Symmetry (Reflection and Rotation) in the Tambakbaya Batik Pattern

Figure 12 illustrates how symmetry, reflection, and rotation are examples of ethnomathematical principles found in Tambakbaya batik designs. Motifs with shapes that are congruent along the vertical and horizontal axes demonstrate the concept of reflection, as both halves of the motif will overlap exactly when folded along the line of symmetry. In addition, some components of the motif exhibit diagonal symmetry, which demonstrates reflection along a diagonal line. The main pattern, which has second-order rotational symmetry (180°), illustrates the concept of rotation. This is demonstrated by the fact that the motif returns to its original position after being rotated 180° .



Figure 13. Geometric Shapes in the Tambakbaya Batik Motif

Based on the analysis in Figure 13, it can be concluded that the Tambakbaya batik motif incorporates the concept of ethnomathematics in the form of geometric patterns. The various geometric shapes in the motif—such as rhombuses, triangles, circles, semicircles, rectangles, and dots—illustrate this concept. Harmonious patterns of high aesthetic value are created through the orderly and repetitive arrangement of geometric figures.



Figure 14. Patterns and Sequences in the Tambakbaya Batik Motif

Based on Figure 14, it can be concluded that Tambakbaya batik motifs incorporate ethnomathematical concepts in the form of patterns and sequences. The combination of themes grouped in a regular pattern—both vertically and horizontally—illustrates this idea. Each motif has the same size and shape, creating a uniform pattern arrangement that follows specific guidelines. Furthermore, various motifs can be arranged in rows, including diamond, triangle, and small flower motifs. The repetition of these motifs demonstrates mathematical regularity related to mathematical concepts of patterns, the n th term, and sequences.

Research findings indicate that three Banten batik motifs—Madelaras Batik, Datulaya Batik, and Tambakbaya Batik—contain various ethnomathematical concepts related to geometry and geometric transformations. Symmetry (reflection), rotation, translation, geometric patterns, flat shapes, as well as patterns and sequences are among the mathematical concepts identified. The arrangement of motifs, pattern repetition, geometric shapes, and regularity in each batik design make these concepts very clearly visible. The results of this study indicate that Banten batik possesses educational value that can be utilized as a resource for ethnomathematics-based mathematics instruction, in addition to its cultural, historical, and aesthetic value. Consequently, Banten batik motifs can be used as contextual learning tools to foster an appreciation for Banten's cultural heritage while helping students understand mathematical principles through local culture..

CONCLUSION

Based on the findings discussed above, it is evident that Banten batik motifs—particularly Sebakingking, Singayaksa, and Ratu Pacar—incorporate various mathematical concepts that can be examined through the lens of ethnomathematics and are integrated with the philosophical values inherent in each motif. This underscores that mathematics is not confined to formal academic contexts but also evolves within the cultural practices of communities and is reflected in traditional art forms such as batik. The interconnection between mathematical concepts and philosophical values found in these motifs demonstrates that Banten batik holds potential as a source for contextually rich and meaningful, culture-based mathematics learning. The use of Banten batik motifs in the classroom can help students understand mathematical concepts more concretely while fostering an appreciation for local culture, helping them understand the philosophical values embedded within the motifs, and supporting the preservation of the nation's cultural heritage. As for suggestions for future research, it is recommended to explore the process of making Banten batik in greater depth to identify a wider range of mathematical concepts and to uncover its relationship with the cultural practices of the community more comprehensively.

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