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Original Research

Ethnomathematics of Banten Batik: An Exploration of Geometry in the Ratu Suba, Tambakbaya, and Wamilahan Batik Motifs

Elsa Nabila[1], Yulyanah[2], Putri Febrianti[3], Jaka Wijaya Kusuma[4], Hamidah[5], & Vidya Ayuningtyas[6]

[1,2,3,4,5,6]Universitas Bina Bangsa

INFO ARTICLES

***Key Words**: ethnomathematics, Banten Batik, geometry, geometric transformation, mathematics learning.*

***Abstract*:** This study aims to identify and analyze the mathematical concepts contained in Banten Batik motifs through an ethnomathematics approach. Data were obtained through observation, visual documentation of batik motifs, literature studies, and interviews with batik artisans. Data analysis was conducted descriptively to identify geometric elements and transformations within each motif—rotation and dilation. The Ratu Suba motif is characterized by symmetry, translation, and proportion. The findings of this study indicate that Banten Batik not only has artistic and cultural value but also contains mathematical concepts that can serve as contextual learning resources.

Abstrak: Penelitian ini bertujuan untuk mengidentifikasi dan menganalisis konsep-konsep matematika yang terkandung dalam motif batik Banten melalui pendekatan etnomatematika. Data diperoleh melalui observasi, dokumentasi visual motif batik, studi pustaka, dan wawancara dengan pengrajin batik. Analisis data dilakukan secara deskriptif untuk mengidentifikasi unsur-unsur geometri dan transformasi dalam setiap motif—rotasi dan dilatasi. Motif Ratu Suba memiliki ciri khas simetri, translasi, dan proporsi. Temuan penelitian ini menunjukkan bahwa Batik Banten tidak hanya memiliki nilai artistik dan budaya, tetapi juga mengandung konsep-konsep matematika yang dapat berfungsi sebagai sumber belajar kontekstual.

Correspondence Address: JL Raya Serang - Jakarta, KM. 03 No. 1B, Panancangan, Cipocok Jaya, Serang, Banten 42124, Indonesia; e-mail: jakawijayak@gmail.com

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INTRODUCTION

Batik is one of Indonesia's cultural heritages, recognized by UNESCO as intangible cultural heritage since 2009. Amid the diversity of batik across the archipelago, Banten batik stands out as the identity of Banten Province, born of the Banten Sultanate's civilization during the 16th through 19th centuries. The uniqueness of Banten batik lies in its motifs, which are directly inspired by the names of historical figures, the layout of the palace, and the villages surrounding the royal court; thus, each motif holds profound historical and philosophical significance. However, behind its visual beauty lies another dimension that has not been extensively studied: the mathematical dimension hidden within the arrangement of patterns and geometric shapes in each motif (Firdaussa et al., 2021).

The issue is the lack of scientific exploration and documentation of the mathematical elements—particularly geometry—found in Banten batik motifs. Therefore, this study aims to identify and explore the geometric concepts found in three Banten batik motifs: Ratu Suba, Tambakbaya, and Wamilahan. This research is important given that mathematics education in Indonesia still tends to be abstract and detached from students' cultural contexts. The ethnomathematics approach offers a solution by presenting mathematics in a local cultural context closely tied to students' daily lives, thereby enhancing their motivation and understanding of the subject.

This study employs the ethnomathematics approach, a field of study that examines the relationship between mathematics and culture. The term "ethnomathematics" (ethnomathematics) was first introduced by d'Ambrosio (1985), who defined it as mathematics as practiced by specific cultural groups. In the context of batik motifs, this approach identifies geometric concepts such as symmetry, geometric transformations, and two-dimensional shapes found in batik patterns.

Several previous studies have examined ethnomathematics in batik from various regions. Rizka and Hodiyanto (2021) identified concepts of geometric transformations in Sintang batik from West Kalimantan. Nurhasanah et al. (2017) identified concepts of symmetry and fractals in Mega Mendung batik from Cirebon. Meanwhile, Prahmana and d'Ambrosio (1985) emphasized the importance of integrating ethnomathematics into formal mathematics education in schools. However, studies specifically addressing geometric elements in Banten batik motifs remain very limited; thus, this research aims to fill that gap.

In this study, several key terms need to be defined. Ethnomathematics is the study of the relationship between mathematics and the culture of a particular community. Transformational geometry encompasses four types of transformations: translation, rotation, reflection, and dilation. The Ratu Suba motif is inspired by the name of the eighth child of the Banten sultanate, who was active in religious activities. The Tambakbaya motif is inspired by the name of a palace district serving as the royal palace's night guard quarters. The Wamilahan motif derives from the name of a village where artisans split bamboo and weave mats near the palace.

Based on a visual exploration of these three motifs, this study hypothesizes that the Ratu Suba, Tambakbaya, and Wamilahan motifs contain geometric elements, such as fold and rotational symmetry, and concepts of geometric transformation, which can be integrated as a source of mathematics learning based on local wisdom at the high school level. (Firdaussa et al., 2021)

METHOD

Batik is one of Indonesia's cultural heritages, recognized by UNESCO as an intangible cultural heritage since 2009. Amid the diversity of batik across the archipelago, Banten batik stands out as the

identity of Banten Province, born of the Banten Sultanate's civilization during the 16th through 19th centuries. The uniqueness of Banten batik lies in its motifs, which are directly inspired by the names of historical figures, the layout of the palace, and the villages surrounding the royal court; thus, each motif holds profound historical and philosophical significance. However, behind its visual beauty lies another dimension that has not been extensively studied: the mathematical dimension hidden within the arrangement of patterns and geometric shapes in each motif (Firdaussa et al., 2021).

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RESULTS AND DISCUSSION

The results of this study consist of an explanation of the philosophical values and an analysis of the mathematical concepts found in the batik motifs of Ratu Suba, Tambakbaya, and Wamilahan. These mathematical concepts include geometric transformations and plane figures. The results of the analysis are presented descriptively, accompanied by tables summarizing the geometric findings for each motif.

Philosophical Values and Mathematical Concepts in the Ratu Suba Motif

1. The Ratu Suba motif takes its name from a descendant of the Banten sultanate

Figure 1 Ratu Suba Batik

The Ratu Suba motif features three distinct pattern zones, as indicated in the analysis diagram. Based on visual observations, the following geometric concepts were identified. Green Zone (Upper Section) – A repeating triangular pattern arranged in a series of stacked motifs. This pattern demonstrates the concept of translation (shifting), in which the triangular motifs move horizontally at equal intervals. Additionally, a concept of vertical reflection is observed in each pair of triangular units, with one facing upward and the other facing downward.

Yellow Zone (Middle Section) – The central pattern features circular ornamentation with symmetrically arranged channel motifs. It incorporates the concepts of fold symmetry (at least two axes of symmetry: horizontal and vertical) and concentric circles, indicating dilation with the same center but different radii. Blue Zone (Lower Section) – The lower pattern features a repeating design consisting of a series of crown-like or tiered cube shapes at the top of the zone, followed by horizontal wavy lines and temple- or pedestal-like ornaments at the bottom, with dominant colors of dark brown, orange, and black.

2. The Tambakbaya motif is derived from the name of the administrative system governing the palace buildings where the royal guard was stationed at night.

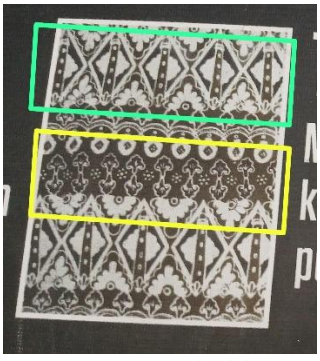


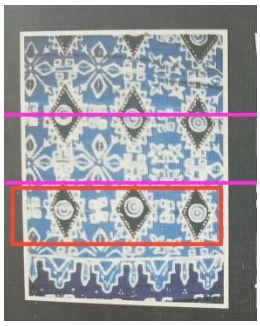
Figure 2. Tambakbaya

Tambakbaya batik is one of Banten's distinctive batik motifs that incorporates mathematical concepts. Banten has a variety of batik motifs, including Baduy Kahuripan, Tambakbaya, Ratu Kencana, Pasepan, and Gula Sakojor, each with its own philosophy and linked to mathematical concepts, particularly geometric transformations.

In the Tambakbaya batik motif, the design is arranged in a repetitive, orderly manner. The motif's repetition in both horizontal and vertical directions at fixed intervals reflects the concept of translation. Meanwhile, in the diamond-shaped motif in the top row, the left and right sides of the vertical axis mirror one another, an example of reflection. The floral ornaments in the center of the pattern display radial symmetry, indicating rotation: the motifs appear identical after being

rotated by specific angles, such as 90° or 180 °. In the concentric circles in the yellow band, dilation can also be identified—that is, proportional enlargement or reduction from the same central point. In addition to geometric transformations, Banten batik motifs also incorporate geometric elements such as plane figures—including rhombuses, rectangles, circles, and triangles—as well as graph theory concepts, specifically the star graph (star graph). In Tambakbaya batik, these two-dimensional shapes can be observed directly: rhombuses dominate the top row, circles appear as ornaments in the middle row, while triangles form at the intersections of the diagonal motif corners (Sanifah et al., 2022).

3. The Wamilahan motif takes its name from a village where artisans who split bamboo and weave mats live near the palace.



Gambar 3. Wamilahan

Wamilahan Batik: Upon close inspection, it becomes apparent that the motif is composed of various visual elements that directly represent mathematical concepts. The most prominent mathematical concept is geometric transformation. First is translation—the repetition of the motif horizontally and vertically at a fixed and regular interval. The rhombus motif with a spiral circle inside—clearly visible in the row marked with a red box—repeats to the right at consistent intervals, serving as clear evidence of translation. In Banten batik motifs, this shifting (translation) is part of geometric transformations in mathematics (Firdaussa et al., 2021).

Second, reflection, which is a condition where the left and right sides of a motif are mirror images of each other with respect to a specific axis. In Wamilahan batik, the floral ornaments at the top of the fabric exhibit strong bilateral symmetry, with the left and right sides of the motif aligning perfectly when folded along the motif's vertical axis.

Third, rotation, evident in the floral and spiral ornaments within the diamond-shaped motifs; these elements appear identical after rotation by a certain angle, indicating rotational symmetry. Fourth, dilation, which can be identified in the concentric circles that expand proportionally from a single common center within each diamond-shaped motif. The geometric transformations in Banten batik include translation, reflection, rotation, and dilation. (Firdaussa et al., 2021).

DISCUSSION

The Ratu Suba batik motif is a cultural heritage of the Sultanate of Banten that combines philosophical values and mathematical concepts. The various geometric transformations found in Ratu Suba batik include translation, reflection, rotation, and dilation. The upper zone features stacked isosceles triangles symbolizing majesty, incorporating the concepts of reflection and translation. The middle zone, with parallel curved lines and circular ornaments, symbolizes the harmony of life and incorporates the concepts of parallel lines, arithmetic sequences, and rotation. The lower zone, featuring dark-colored, tiered trapezoids or "umpak," symbolizes the steadfast character of the Banten people and incorporates the concepts of dilation and translation. Overall, the batik motifs display repeating patterns, symmetry, and proportions that reflect the connection between batik aesthetics

and geometric principles, thereby holding potential as a source for contextual mathematics learning (Firdaussa et al., 2021).

From an ethnomathematics perspective, the Ratu Suba motif contains various mathematical concepts that can be systematically analyzed. The first concept evident is plane geometry. This motif features geometric shapes such as triangles, horizontal lines, and zigzag patterns arranged repetitively. Triangles can be studied through the properties of plane figures, which have three sides and three angles. The horizontal lines illustrate the concept of parallel lines, while the zigzag patterns relate to angles and the relationships between lines. The presence of these geometric elements indicates that the Banten batik motif is constructed on the principle of formal regularity, a main area of study in geometry. (Sanifah et al., 2022).

In addition to geometric concepts, the Ratu Suba motif also demonstrates geometric transformations, specifically translation. This is evident in the regular repetition of the motif at relatively equal intervals across each section of the fabric. In mathematics, translation is the movement of a shape from one position to another without changing its form or size. The consistent repetition of patterns indicates that batik artisans have applied the principle of spatial regularity in arranging the motifs. This finding aligns with ethnomathematics research, which holds that various traditional cultural products contain concepts of geometric transformations that have evolved through communities' cultural practices. (Firdaussa et al., 2021).

Another mathematical concept found in the Ratu Suba motif is pattern symmetry—the patterns arranged within the motif demonstrate a balance between the left and right sides, reflecting the presence of fold symmetry. Additionally, the consistent repetition of shapes in certain sections of the fabric indicates a regularity that can be linked to the concept of translational symmetry. In mathematics, symmetry is a property of a figure that remains unchanged after undergoing certain transformations. The symmetry of the Ratu Suba motif creates this balance, symbolizing the harmony among humans, nature, and God (Wahyuni & Mawardi, 2026).

The Ratu Suba motif also incorporates the concepts of pattern and repetition; the recurring zigzag patterns and small ornaments arranged regularly demonstrate a regularity that can be linked to the concepts of sequences and number patterns in mathematics. Each motif is repeated according to specific rules, thereby forming a consistent visual structure. In mathematical studies, a pattern is an arrangement of objects that follows specific rules, and its continuation can be predicted.

The presence of repeating patterns in the Ratu Suba motif indicates that the people of Banten have indirectly applied mathematical thinking in the process of creating cultural works. The Ratu Suba batik motif incorporates various mathematical concepts, including plane geometry, geometric transformations (translation), symmetry, repeating patterns, ratios, and proportions. These concepts are integrated with philosophical values that reflect honor, religiosity, wisdom, and the harmony of life in Banten society.

The Tambakbaya motif derives its name from a specific part of the Banten Palace complex associated with the royal guard. As part of the Sultanate of Banten's legacy, this motif embodies vigilance, steadfastness, and responsibility in safeguarding the kingdom’s security. This philosophy demonstrates that the people of Banten in the past held discipline and dedication to their duties in high regard.

The Wamilahan motif derives its name from a village of bamboo-splitting artisans and mat weavers located within the Banten Sultanate. The philosophy behind this motif reflects the Banten people’s spirit of hard work, skill, and creativity in transforming natural resources into products of economic and cultural value. The existence of this motif also indicates that the community’s craft activities played a vital role in the social and economic life of the Banten Sultanate.

Analysis reveals that the Wamilahan motif incorporates more complex geometric transformations than other motifs. The repetition of diamond and flower motifs in both the horizontal and vertical directions indicates translation. The similarity in shape between the right and left sides of the motif demonstrates the concept of reflection, while the arrangement of floral ornaments surrounding the central point indicates rotation. Additionally, the Wamilahan motif incorporates various two-dimensional shapes—such as diamonds, circles, and triangles—arranged harmoniously.

The continuous, gap-free repetition of patterns indicates the concept of translation or tiling, which is commonly found in geometric patterns. The balance of shape and size among the motifs also demonstrates concepts of symmetry, proportion, and ratio, creating visual beauty in the batik fabric (Wahyuni & Mawardi, 2026).

Based on an analysis of these three Banten batik motifs, it can be concluded that each motif possesses distinct ethnomathematical characteristics. The Tambakbaya motif prominently features the concepts of plane figures and simple geometric patterns through rhombuses and circles. The Ratu Suba motif demonstrates a dominance of concepts such as symmetry, repetition, translation, and proportion, which are related to religious values and the harmony of life. Meanwhile, the Wamilahan motif displays more complex mathematical concepts through a combination of geometric transformations, tessellation, symmetry and measurement and proportion. These findings reinforce the view that local culture is a rich and relevant resource for mathematics learning in the context of contextual education. Integrating Banten batik into mathematics instruction can help students understand geometric concepts more concretely while fostering an appreciation for the region's cultural heritage. These findings align with the theory of ethnomathematics, which states that cultural practices contain mathematical activities that can serve as a bridge between school mathematics and real life.

CONCLUSION

Based on the research findings, it can be concluded that Banten batik motifs—particularly Ratu Suba, Tambakbaya, and Wamilahan—incorporate various mathematical concepts that can be studied through an ethnomathematics approach, such as planes of symmetry and repeating patterns, as well as geometric transformations like translation, reflection, rotation, and dilation. Each motif has distinct mathematical characteristics, yet all exhibit a sense of balance and patterns that reflect the Banten people's mathematical thinking in creating their cultural works. In addition to their high aesthetic and philosophical value, these three motifs can serve as a source of contextualized mathematics learning, helping students understand geometric concepts more concretely while fostering an appreciation for local cultural heritage. These findings reinforce the view that culture and mathematics are closely related and can be integrated into learning to create an education.

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