

Ethnomathematics of Banten Batik: An Exploration of the Baluwarti, Kasunyatan, and Paseban Motifs

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INFO ARTICLES

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Abstract: This study aims to explore the ethnomathematics elements embedded within the visual structures of Batik Banten, specifically focusing on the Baluwarti, Kasunyatan, and Paseban motifs at the Batik Banten Mukarnas production center. Utilizing a qualitative descriptive method with an ethnographic approach, data were gathered through direct observation, documentation, and interviews with local cultural experts and batik artisans. The results reveal that, beneath the historical and philosophical ornaments of Batik Banten, lies a sophisticated application of geometric concepts. The Baluwarti motif demonstrates line symmetry and tessellation, reflecting the structural layout of palace walls. The Kasunyatan motif embodies concentric circles and rotational symmetry associated with meditative practices. Meanwhile, the Paseban motif exhibits parallel lines and rectangular congruence symbolizing a royal audience hall. This research underscores that traditional batik making inherently incorporates mathematical thinking, offering a bridge between cultural preservation and mathematics education.

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INTRODUCTION

Mathematics is often viewed as an abstract, formal discipline, disconnected from the realities of people's daily lives. This dichotomous view creates a gap between the formal mathematical concepts taught in educational institutions and the local wisdom that thrives within communities. To bridge this gap, d'Ambrosio introduced the concept of ethnomathematics—the study of the relationship between mathematics and culture. Through the lens of ethnomathematics, mathematical reasoning is not confined to academic texts. Still, it is also manifested in cultural artifacts such as traditional architecture, woven crafts, traditional clothing, and traditional fabric motifs including batik.

Banten, as one of the regions with a glorious history of Islamic civilization in the Indonesian archipelago, possesses a rich cultural heritage reflected in the decorative patterns of its batik fabrics. The revival of modern Banten batik is rooted in an in-depth study of ceramic shards from ancient sites excavated by archaeologists at the Surosowan Palace. These historical fragments have been visually reconstructed into batik motifs rich in philosophical meaning. Today, Banten Batik is preserved by local artisans, including those at the Mukarnas Banten Batik production center. The Mukarnas studio plays a crucial role in maintaining the authenticity of Banten's distinctive forms and colors—which tend to be soft (pastel), gray, and brown reflecting the base colors of those ancient clay shards.

Among the dozens of decorative patterns produced, the Baluwarti, Kasunyatan, and Paseban motifs hold particular historical significance. The ornaments in these three motifs are directly derived from place names and their spatial-spiritual functions during the Banten Sultanate. Visually, the arrangement of ornaments in these three motifs displays precise geometric regularity, pattern repetition, and spatial balance that are highly consistent with the principles of plane geometry. This phenomenon raises a research question regarding the geometric structures that form the ornaments in these three batik pieces and how the concept of ethnomathematics interprets them. Although research on Banten Batik from historical, anthropological, and fine arts aesthetic perspectives has been extensive, studies that specifically analyze its ornamental structures through a formal mathematical approach remain very limited. Most of the ethnomathematics literature in Indonesia is still dominated by Javanese batik (such as that from Yogyakarta and Surakarta). There is a clear research gap in mapping the geometric aspects of the Banten Batik tradition, particularly in the authentic production of Banten Mukarnas Batik. Therefore, this research is important to document the intuitive mathematical insights of traditional artisans while also serving as an effort to revitalize Banten's culture through the lens of formal science.

METHOD

This study employs a qualitative descriptive approach, drawing on ethnographic methods. The ethnographic approach was chosen to describe, analyze, and interpret cultural elements holistically—in this case, the mathematical concepts underlying the creation of Banten Batik. The research was centered at the Mukarnas Banten Batik creative industry, located in Serang City, Banten Province. This location was chosen because the Mukarnas studio is one of the pioneers that has consistently preserved traditional motifs reconstructed through archaeological findings.

The primary instrument in this study was the researcher herself (human instrument), supported by interview guidelines, a documentation camera, and visual observation sheets. Data collection was conducted in three main stages. First, direct observation of fabric swatches and pattern masters featuring the Baluwarti, Kasunyatan, and Paseban batik motifs to analyze their visual characteristics. Second, in-depth interviews were conducted with Banten cultural experts, the owner of the Mukarnas studio, and senior batik artisans to explore the philosophical and historical aspects, as well as the pattern-making process. Third, a documentary study of historical texts on Banten and the results of

archaeological excavations related to the toponyms of the motifs under study. The collected data was then analyzed using interactive analysis techniques, including data reduction, data presentation, and concluding. During the data reduction stage, the researcher filtered the visual aspects of the batik that represented geometric shapes. Data presentation was carried out by overlaying digital images of batik motifs with geometric guidelines using digital image analysis software to clarify the two-dimensional shapes contained within them. Finally, inductive conclusions were drawn to formulate the concept of ethnomathematics regarding the objects of study.

RESULT

Based on field observations and visual analysis at Batik Banten Mukarnas, the Baluwarti, Kasunyatan, and Paseban batik motifs exhibit very strong geometric characteristics. The primary structural elements of these motifs are not arranged randomly but follow symmetrical patterns and consistent basic geometric shapes. A summary of the visual characteristics and historical elements of these three motifs is presented in Table 1 below. Some practical tips:

Table 1. < Visual Characteristics of Banten Batik Motifs >

Motif Name	Sources of Historical Inspiration	Dominant Colors	Distinctive Features
	Ornamental patterns on the tiles and walls of the Surosowan Palace fortress.		
Baluwarti	Meditation hall and residence of the Sufis in the Kasunyatan area.	The onion is somewhat dull, with earthy brown and golden yellow tones.	The geometric pattern resembles a fence or shield, with bold, intricate details forming a protective formation.
Kasunyatan	The layout of the hall where audiences with the king were held in the Sultanate of Banten.	Olive green, cream, and cement gray.	The composition of concentric patterns with circular decorative details symbolizes a sense of reverence and tranquility that is both static and dynamic.
Paseban	Sources of Historical Inspiration	Brick red, dark brown, and dark indigo blue.	Symmetrical rectangular or diamond-shaped ornaments symbolize order, the four cardinal directions, and justice.

The data in Table 1 show a sharp yet harmonious visual differentiation among the three motifs. In the Baluwarti motif, the visual structure is dominated by bold lines forming rectangles and parallelograms arranged in a repetitive pattern (tessellation), representing the physical sturdiness of a fortress protecting the royal palace.

In contrast to Baluwarti, the Kasunyatan motif emphasizes the softness of curved, circular forms. The layered pattern of concentric circles illustrates the spiritual levels of humanity within the Sufi tradition. Meanwhile, the Paseban motif prioritizes linear spatial order, composed of rows of congruent rectangles. This visual structure of the Paseban motif reflects the order and discipline that must be observed within the palace hall. Overall, this visual interpretation confirms that Banten batik artisans possess a high degree of geometric sensitivity in blending spatial aesthetics with historical philosophical meaning. Below is a visualization of the geometric elements in the Baluwarti, Kasunyatan, and Paseban motifs:



Figure 1. Baluwarti Motif



Figure 2. Kasunyatan Motif



Figure 3. Paseban Motif

Based on the results of visual analysis, the three Banten batik motifs exhibit distinct yet complementary geometric characteristics that define Banten's cultural identity. The Baluwarti motif features a predominance of two-dimensional shapes—specifically, parallelograms and rhombuses—arranged in a repetitive pattern to form a tessellation. This arrangement creates an impression of strength and order, representing the defensive function of the Surosowan Palace fortress. The consistent repetition of the pattern demonstrates the application of the concepts of translation and reflection in the motif's design.

The Kasunyatan motif features geometric patterns dominated by concentric circles and rotational symmetry. Circles sharing the same center are arranged harmoniously, creating a visual focal point within the motif. Additionally, the repetition of ornamental elements around the circles indicates a regular rotational pattern that produces a balance of form. These characteristics reflect the spiritual values and tranquility that form the philosophy of the Kasunyatan area.

Meanwhile, the Paseban motif features geometric patterns consisting of congruent rectangles arranged in a regular grid. The presence of parallel lines and right angles highlights a strong concept of orthogonality. This pattern creates an impression of discipline, order, and systematic organization, consistent with the function of the Paseban as a formal meeting space within the Banten Sultanate. Overall, these three motifs define the distinctive character of Banten Batik through the application of different geometric concepts. The Baluwarti motif emphasizes tessellation and symmetry; the Kasunyatan motif highlights concentric circles and rotational symmetry; while the Paseban motif emphasizes congruence and grid regularity. The presence of these geometric elements demonstrates that Banten Batik not only possesses aesthetic and historical value but also incorporates mathematical concepts that can be utilized as a resource for contextual geometry education.

DISCUSSION

The Baluwarti motif was historically inspired by the name of the sturdy defensive fortress of the Surosowan Palace. According to the results of archaeological reconstruction by Tjandrasmita & Najib (n.d.), the visual patterns on these ancient Surosowan pottery shards feature a rigid structural composition designed to depict boundary walls. From an ethnomathematics perspective, the visual structure of the Baluwarti motif incorporates concepts of geometric transformations, specifically reflection and translation. The motif's primary ornamentation consists of closely arranged rectangles and rhombuses that form a seamless tessellation.

This finding aligns with the conceptual framework (D'Ambrosio, n.d.) which states that cultural groups transform symbols from their environment into intuitive mathematical forms. Mathematically, this tessellation concept requires precise angle calculations so that each corner of the quadrilaterals can meet perfectly at a single coordinate point. This repeating parallelogram structure symbolizes density and total protection of the sultanate's seat of government.

The Kasunyatan motif represents the settlements of the Sufis and the places of contemplation (meditation) for the scholars of the Banten Sultanate. Mathematically, a visual analysis of the Mukarnas design reveals that this motif explores the concepts of circular geometry, rotational symmetry, and simple fractals. As examined by (Sianturi et al., 2022) regarding the mathematical exploration of Banten decorative patterns, circular and rhombus elements often dominate motifs rooted in spiritual philosophy. The central ornament of Kasunyatan is a set of concentric circles—that is, two or more circles sharing the same center but having different radii.

Surrounding these concentric circles are stylized flower petals arranged according to the principle of n -fold rotational symmetry (typically 4- or 8-fold). Consistent with the analysis of batik pattern similarities examined by (Mammadov et al., 2023), the geometric regularity in traditional textile ornaments reflects universal order (cosmic order). Religious philosophical values and Sufi peace radiate from the center of this circle. In Sufi thought, this center symbolizes God (the One), while the outer circle symbolizes the manifestation of living beings moving in a circular path—performing tawaf or zikir—to reach the one true center.

The Paseban motif is derived from the name of the palace hall where ministers and guards gathered to audience with the king. The visual characteristics of this motif are highly linear, incorporating geometric concepts such as congruence and similarity in rectangular plane figures.

The Paseban pattern consists of a matrix of identical (congruent) rectangular squares arranged vertically and horizontally. The boundary lines in the Paseban motif form right angles (90 degrees), illustrating the concept of orthogonality or perpendicular lines.

The idea of pattern formation (making patterns) and spatial measurement in this traditional society aligns with the ethnomathematics studies of the Sundanese and Banten peoples by Muhtadi et al. (2019), which affirm that local communities' activities in designing spaces and ornaments always involve mature pre-practical mathematical reasoning. The precision of this rectangular grid reflects the social structure and adherence to the hierarchical order of the sultanate's bureaucracy. The uniformity of the rectangles' dimensions (congruence) in Paseban ethnomathematics symbolizes

the equality of all people before the law and the sultanate's rules before they enter the king's main chamber. The application of geometric concepts in the three Banten Batik motifs above demonstrates a significant cultural contribution to the development of science. Artisans at the Mukarnas Banten Batik production center have proven that, even without using formal compasses or rulers, they are capable of producing works with high geometric accuracy through visual-spatial intelligence passed down through generations.

CONCLUSION

Based on the results of the analysis and discussion, it can be concluded that Banten Batik is not merely a piece of fabric with an aesthetic pattern, but rather a cultural artifact that embodies a complex system of mathematical reasoning. Through an ethnomathematics study, it was found that the Baluwarti, Kasunyatan, and Paseban motifs produced by Batik Banten Mukarnas incorporate concepts of formal geometry that are applied intuitively by the artisans. These concepts include division and parallel lines in the Baluwarti motif, concentric circles and rotational symmetry in the Kasunyatan motif, and the congruence of rectangles and orthogonal lines in the Paseban motif. All of these geometric forms are harmoniously integrated with the philosophical values of the royal palace fortress, Sufi spirituality, and the etiquette of the sultanate's ceremonial hall. This finding makes an important scientific contribution to integrating local wisdom into contextual mathematics education, while also strengthening strategies for preserving the cultural heritage of the Indonesian archipelago through a scientific approach.

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