

Exploring the Concept of Ethnomathematics in the Patterns of Panembahan Batik, Kebalen Batik, and Paduraksa Batik

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INFO ARTICLES

Key Words:

Etnomatematika, Batik Banten, Batik Paduraksa, Batik Kebalen, Batik Panembahan.



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Abstract: Ethnomathematics is an effective way to incorporate local culture into mathematics education. Bantenese batik, as part of the region's cultural heritage, includes many designs that contain mathematical elements, but there has been little research on how mathematical ideas are displayed in the Panembahan, Kebalen, and Paduraksa batik patterns. This study attempts to discover and examine the mathematical ideas in these three batik designs. The study used a qualitative descriptive approach, collecting data through observation, written notes, and a review of existing literature. The results showed that the designs encompass geometric ideas such as flat shapes, symmetry, and transformations such as reflection and translation. The results suggest that Bantenese batik can serve as a useful tool for teaching mathematics in a way that connects to real-life contexts, helps build pride and respect for local culture, and can help students better understand mathematical ideas.

Abstrak: Etnomatematika merupakan cara yang efektif untuk mengintegrasikan budaya lokal ke dalam pendidikan matematika. Batik Banten, sebagai bagian dari warisan budaya daerah, memiliki beragam motif yang mengandung unsur-unsur matematika; namun, masih sedikit penelitian yang mengkaji bagaimana gagasan matematika ditampilkan dalam motif batik Panembahan, Kebalen, dan Paduraksa. Penelitian ini bertujuan untuk mengeksplorasi dan menganalisis gagasan matematika yang terkandung dalam ketiga motif batik tersebut. Penelitian ini menggunakan pendekatan deskriptif kualitatif dengan pengumpulan data melalui observasi, catatan tertulis, dan kajian literatur. Hasil penelitian menunjukkan bahwa motif-motif tersebut memuat gagasan matematika seperti bangun datar, simetri, serta transformasi geometri berupa refleksi dan translasi. Temuan ini mengindikasikan bahwa batik Banten dapat menjadi sarana yang bermanfaat untuk pembelajaran matematika yang mengaitkan materi dengan konteks kehidupan nyata, menumbuhkan rasa bangga dan apresiasi terhadap budaya lokal, serta membantu siswa memahami gagasan matematika dengan lebih baik.

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INTRODUCTION

Culture is a set of customs that embodies fundamental values passed down from generation to generation. These customs are inextricably linked to the application of mathematical concepts, resulting in unique and diverse cultural expressions. This is evident in the forms of cultural expressions found particularly in Indonesia, such as the arts, architectural styles, carvings, and jewelry (Fathani, 2009:87)

Indonesia is a country blessed with extraordinary cultural wealth. One of the most valuable cultural heritages of the Indonesian people is batik, a textile craft that has been recognized by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as an Intangible Cultural Heritage of Humanity since 2009. Batik is not merely patterned fabric; rather, it is a reflection of a community's identity, history, and local wisdom, captured through the strokes of the canting and the application of wax on the fabric.

Among the various batik-producing regions across the archipelago, Banten Province boasts batik with a distinctiveness that sets it apart from other regions. Banten batik emerged from the reconstruction of archaeological decorative motifs discovered during excavations at the Old Banten site in 1976. These excavations uncovered no fewer than 75 decorative motifs imprinted on pottery shards and ceramics dating back to the 17th-century Banten Sultanate. These motifs were subsequently adapted and developed into Banten batik, so that each piece of fabric serves as a textile inscription chronicling the glory of the greatest Islamic sultanate in Western Java.

Ethnomathematics is the study of mathematics that emerges or is used within specific ethnic groups. Ethnomathematics was introduced by D'Ambrosio, a Brazilian mathematician, in 1977. D'Ambrosio's definition of ethnomathematics is as follows: Linguistically, the prefix "ethno" refers to a broad social and cultural context, including language, jargon, codes of conduct, myths, and symbols. The root word "mathema" generally signifies explaining, knowing, understanding, and engaging in activities such as coding, measuring, classifying, drawing conclusions, and modeling. The suffix "-tics" derives from "techne" and carries the same meaning as "technique." Meanwhile, the term "ethnomathematics" is defined as: "mathematics as practiced among identified cultural groups such as national communities, ethnic groups, labor groups, children of specific age groups, and professional classes" (D'Ambrosio, 1985). Based on this definition, ethnomathematics has a broader meaning than simply "ethno" (ethnic); thus, ethnomathematics is defined as the cultural anthropology of mathematics and mathematics education.

Mathematics and culture are, in fact, very closely intertwined. Mathematics has played a role in people's lives and has become a part of human daily activities. "Mathematics as human activities" (Soedjadi, 2007:6). However, this connection is often unrecognized by the public, including the batik artisans themselves. The field of study that specifically examines the relationship between mathematics and culture is known as ethnomathematics. This term was first introduced by the Brazilian mathematician Ubiratan D'Ambrosio in 1977, who defined it as mathematics practiced within identifiable cultural groups, such as indigenous communities, labor groups, children of a certain age, professional classes, ethnic groups, and so on.

Bishop (1988) asserts that there are six universal mathematical activities found in every culture worldwide: counting, locating, measuring, designing, playing, and explaining. Without exception, these six activities can be found in the batik-making process, ranging from calculating the proportions of motifs, placing patterns on fabric, measuring the distance between lines, to designing the composition of colors and shapes.

In the context of mathematics education, Rosa and Orey (2011) argue that the ethnomathematics approach can bridge the gap between abstract school mathematics and students' concrete cultural experiences. When students view mathematics not as a foreign discipline imposed from outside their culture, but as an integral part of their own cultural heritage, their motivation and mathematical understanding tend to increase significantly. This study aims to: (1) describe the meanings and historical-cultural contexts of the Paduraksa, Penembangan, and Kebalen motifs; (2) identify and analyze in detail the mathematical concepts contained within these three motifs; and (3) demonstrate

the relevance of these findings to mathematics learning grounded in local culture. Thus, this study is expected to enrich the body of research on ethnomathematics in Indonesia while encouraging the use of local wisdom as a source of meaningful and contextual learning.

METHOD

This research study¹ employed a descriptive qualitative method, exploring a specific activity and then describing the culture of Banten Batik in its entirety through written text. (Subekhi et al., 2021).

The observation was conducted on May 16, 2026. It took place at the Mukarmas Banten Batik Center, located in Serang City, Banten. This location was chosen because the Banten Batik Center serves as the hub for Banten Batik production. Data for this study were collected through literature review, observation, and documentation. The researcher served as the observer. The first data analysis technique involved data reduction: first, all data were collected, and then the researcher separated the important data from the unimportant data. After the data had been reduced, the researcher drew conclusions regarding the mathematical concepts present in Banten Batik.

RESULTS AND DISCUSSION

The findings of this study take the form of analyses of the motifs found in Banten batik, which depict geometric patterns and concepts of geometric transformation. Batik is a local cultural tradition of the Banten region that incorporates concepts of ethnomathematics. Banten batik features a variety of motifs and patterns that reflect the historical philosophy of Banten. The names of the motifs found in Banten batik are derived from the names of villages in the Banten region, the names of sultans, architectural forms, artifacts, and the names of buildings of the Banten Sultanate. The following are the results of a study of Banten batik patterns that contain character values and mathematical concepts.

1. Panembahan Motif

Panembahan was the title of Sultan Hasanudin during the heyday of the Banten Sultanate. The Panembahan batik motif is derived from one of the motifs developed based on archaeological research into the artifacts and spatial layout of the former Banten Sultanate.

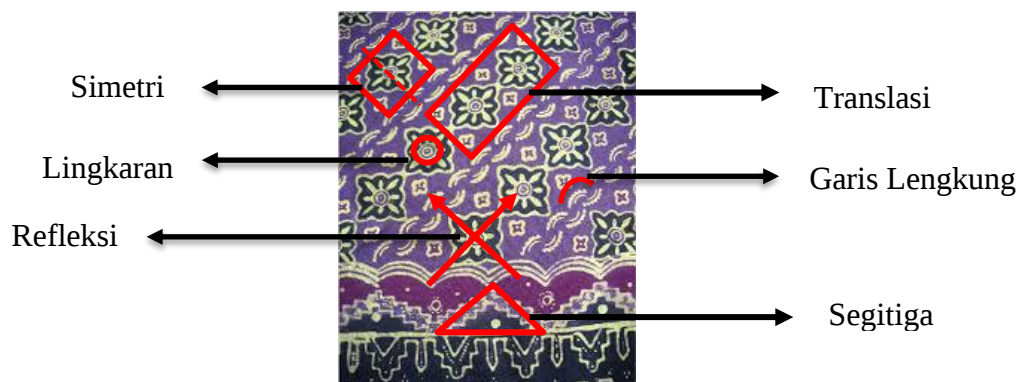


Figure 1. Panembahan Batik Motif

If we examine the mathematical concept embodied in the Panembahan motif, it is the theory of reflection, which is a geometric transformation involving the movement of an object to the position of its reflected image, similar to the behavior of a flat mirror. Essentially, reflection across the x-axis involves changing the position of an object located in Cartesian coordinates by reflecting it across the x-axis. The concept of symmetry referred to here is line symmetry. One method of creating batik motifs involves sketching them by first designing specific patterns. These sketches are usually drawn on paper.

Additionally, the Panembahan motif incorporates the concept of translation. Translation is a geometric transformation in which a shape is moved from one position to another without changing its shape, size, or orientation. The triangle in the Panembahan batik motif is an isosceles triangle with both legs of equal length, and it includes a circle. Therefore, the Panembahan motif is based on the geometric shapes of an

isosceles triangle and a circle. Upon closer inspection, this Panembahan batik motif features numerous instances of translation.

2. Motif Batik Kebalen

The motifs found in Kebalen Banten batik are derived from the urban layout of the Sultanate of Banten, where Balinese communities settled. The following are the results of a study on Kebalen batik patterns.

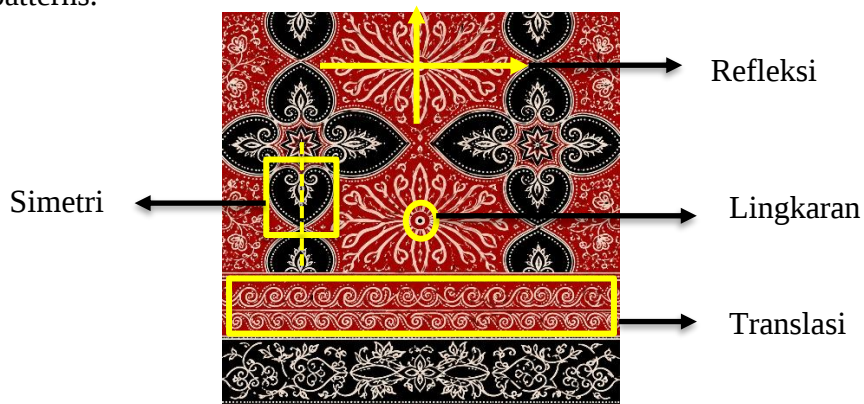


Figure 2. Kebalen Batik Motif

If we examine the mathematical concept contained in the Panembahan motif, it is the theory of reflection, which is a geometric transformation involving the displacement of an object to the position of its reflected image, similar to the behavior of a flat mirror. Additionally, there is a circle located at the center of the reflection. A circle is the set of points on a plane that are equidistant from a fixed point called the center. The Kebalen batik motif also incorporates the theory of translation, where translation is a geometric transformation performed by shifting a shape from one position to another without altering its shape, size, or orientation. There is also the concept of symmetry, specifically fold symmetry. One method of creating batik motifs involves sketching them by first designing specific patterns. Thus, from the explanation above, it is clear that the Panembahan batik motif incorporates various mathematical concepts. These concepts include symmetry, transformations (reflection, translation), and plane figures.

3. Batik Paduraksa

A traditional Banten batik fabric featuring the Paduraksa motif, which depicts the gate of the Kaibon Palace—a symbol of honor. The following is the result of a study on the Paduraksa batik pattern.

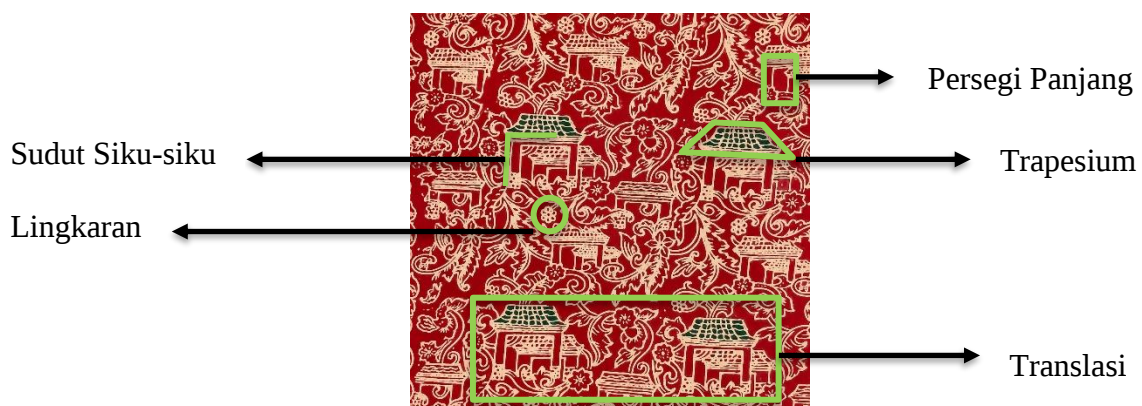


Figure 3. Paduraksa Batik Motif

If we examine the mathematical concepts contained in the paduraksa motif, we find the theory of translation, in which translation is a geometric transformation performed by shifting a shape from one position to another without changing its shape, size, or orientation. In addition, there are elements of plane figures, such as circles forming the floral motifs, trapezoids serving as the roof

of the Kaibon Palace gate, and rectangles forming the gate pillars of the Kaibon Palace. Beyond these plane figures, there are also right angles formed in the Kaibon Palace gate. Of course, there are many other mathematical elements found in other Paduraksa batik motifs. Thus, the creation of Paduraksa batik motifs fundamentally incorporates the concepts of transformation and plane figures. In fact, a single batik motif contains not just one but many different plane figures.

CONCLUSION

Based on the results and discussion above, it can be concluded that the Panembahan, Kebalen, and Paduraksa batik styles of Banten contain many mathematical elements, including concepts of geometric symmetry, transformations (reflection and translation), plane figures (triangles, circles, rectangles, and trapezoids), and angles. In addition to serving as a source of information on the batik-making traditions of the Banten cultural community, this research can also be used as a tool for designing realistic mathematics instruction in universities or schools in general. Ethnomathematics can convey mathematical concepts while fostering character development in students as an effort to introduce and preserve the nation's cultural identity in step with the times. Ideas for further exploration include delving deeper into the batik-making process to more fully identify the numerical concepts within it and pose more in-depth questions so that information can be obtained in line with the results and discussion.

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