UNVEILING THE ETHNOMATHEMATICS OF BANTUL'S NITIK BATIK: A CULTURAL AND MATHEMATICAL JOURNEY

Naila Rahma Mufida, Raekha Azka
Universitas Islam Negeri Sunan Kalijaga

Article Information

ABSTRACT

Ethnomathematics is the mathematics embedded in a culture or understood as a discipline used to understand how mathematics is adapted from a culture. The purpose of this study is to determine (1) What symmetry patterns are present in Nitik batik? and (2) What philosophical meanings are associated with the symmetry patterns in Nitik batik? These are specifically referenced for students, particularly in the context of teaching transformation geometry, by incorporating cultural elements, namely the Nitik batik motifs from Yogyakarta. Ethnomathematics, as a medium for teaching mathematics, also aims to introduce and preserve Indonesia's cultural heritage. This study employs a descriptive research method with a qualitative approach. The data used to answer the research questions were obtained from document studies, including books, journals, and internet sources. Data analysis was performed using qualitative data analysis techniques, which include three main steps: data reduction, data presentation, and drawing conclusions. The results of this study reveal that in the Nitik batik of Bantul Yogyakarta, the Jaya Kirana motif features geometric patterns of reflection and translation.

Corresponding Author:

Naila Rahma Mufida,
Universitas Islam Negeri Sunan Kalijaga, Yogyakarta, Indonesia.
Email: 21104040025@studen.uin-suka.ac.id

1. INTROUCTION

Batik in each region of Indonesia has its own unique pattern, philosophy, and characteristics that reflect the identity of that region. An example of this is the batik found in Yogyakarta, particularly in Bantul. Historically, batik was used for clothing during traditional ceremonies, according to the patterns and philosophies of specific batik motifs (Prahmana et al., 2023). To this day, batik is used as everyday clothing by the local people. Each batik motif in Yogyakarta, particularly in Bantul, has its own meaning, pattern, and function.

Aside from its philosophical meanings, batik is also known for its beautiful patterns, which are formed by symmetrical motifs. This is what has attracted researchers to study the patterns or motifs of batik. One analysis technique often used to study batik patterns is symmetry analysis (Carspecken & Walford, 2021; Prahmana, 2021). However, despite significant studies on ethnomathematics, especially in relation to batik patterns, there is a gap in examining the specific mathematical properties, particularly symmetry, embedded in regional batik motifs. While existing research has explored the philosophical and cultural meanings of batik, there is limited exploration of how these motifs can be effectively integrated into mathematics learning, especially in terms of symmetry and geometric transformations (Lindemann & Stolz, 2018; Umbara et al., 2021).

The batik patterns in Yogyakarta are composed of repeated geometric shapes, creating uniform motifs. In Yogyakarta, one type of batik is batik Nitik, originating from the Bantul region. From a mathematical perspective, this enriches the understanding of batik as a form of culture and places it in the context of formal, informal, and non-formal mathematical education. This aligns with the concept of ethnomathematics (Suherman et al., 2021; Werdiningsih & Junaedi, 2018). This study aims to bridge this gap by providing a detailed analysis of symmetry in batik Nitik from Bantul, offering new insights into how this cultural element can enhance the understanding of mathematical concepts in educational settings. Furthermore, it will contribute to the preservation of traditional knowledge while making it relevant in contemporary mathematical education.

Ethnomathematics is mathematics within a culture, or a science used to understand how mathematics is adapted from a culture. Ethnomathematics provides an opportunity for cultures, especially batik, to be used in mathematics education. Therefore, many studies have conducted ethnomathematical research on batik, such as studies by (Faiziyah et al., 2020; Orey & Rosa, 2021; Susiana et al., 2020). Based on the explanation provided, the aim of this study is to conduct an ethnomathematics study on batik Nitik from Bantul, Yogyakarta, using symmetry analysis. To achieve this aim, the study has two research questions: (1) What symmetry patterns are present in batik Nitik? and (2) What philosophical meanings are present in the batik Nitik patterns that contain symmetry?

2.   METHOD
2.1 Research Design

The research is conducted using a qualitative descriptive approach, which aims to describe the phenomena that occur by collecting factual data from the field (Sugiyono, 2016). This research focuses on batik fabric from Yogyakarta, specifically the Kawung motif, and the mathematical aspects embedded in these designs. The descriptive qualitative design allows for an in-depth exploration of the batik motifs, providing a clear understanding of the patterns, philosophical meanings, and their relevance to the study of symmetry within a cultural and mathematical context. The goal is to examine the various mathematical features of these motifs, particularly symmetry, and how they align with traditional and cultural practices in Yogyakarta.

2.2 Data Source

The data for this study is sourced from multiple documents, including books, academic journals, and online resources. These sources provide both primary and secondary data about batik Yogyakarta, especially regarding the Kawung motif, which is one of the most iconic traditional motifs used in Yogyakarta batik. The study will focus on gathering detailed information about the philosophy behind the Kawung motif, its historical background, and the cultural significance of the motif in traditional ceremonies. These documents will also provide references for understanding the mathematical elements of symmetry embedded in the batik designs, particularly in relation to the Keraton Surakarta's batik used in traditional ceremonies.

2.3 Measurement

The research does not rely on numerical measurements but instead on qualitative observations and document analysis. To answer the research questions, the study uses visual analysis and pattern identification to explore the mathematical aspects of batik, especially symmetry. Specifically, the research focuses on identifying and categorizing the symmetry patterns in the batik Kawung motifs. These patterns are measured based on their geometrical properties, such as reflection, rotation, and translation, using two-dimensional symmetry diagrams. This method allows for the detailed examination of the symmetrical elements within the batik motifs, which are then analyzed in the context of both mathematical and cultural meanings.

2.4 Data Analysis

Data analysis is conducted using qualitative analysis techniques that involve three main steps: data reduction, data display, and conclusion drawing (Abzalov, 2016).

Data Reduction: In this stage, the data from various sources, including books, journals, and online resources, is summarized and organized to answer the research questions. The focus is on the philosophical meanings of the batik motifs and the specific types of batik from Keraton Surakarta used in traditional ceremonies that contain symmetry patterns. The data is filtered and refined to highlight relevant information for the study.

Data Display: The reduced data is then presented descriptively to provide a clear and detailed view of the various symmetry patterns in Keraton Surakarta batik. This includes identifying and classifying the symmetry motifs used in traditional ceremonies and mapping these patterns using two-dimensional symmetry flow diagrams. This step helps to visually represent the patterns and identify the corresponding mathematical principles within the designs.

Conclusion Drawing: The final stage involves drawing conclusions based on the displayed data. This step aims to identify the types of symmetry present in several Keraton Surakarta batik motifs used in traditional ceremonies, categorized by their symmetry patterns. Additionally, the philosophical meanings embedded in each batik motif are analyzed, revealing the mathematical insights within the cultural context of the batik. This step provides a comprehensive understanding of the relationship between mathematics and culture in batik designs.

3. RESULT AND DISCUSSION

Batik Nitik, when compared to other types of batik, has distinct characteristics in terms of motif arrangement and the canting technique used. The motif arrangement in Batik Nitik consists of a combination of lines and dots that resemble a woven pattern. The motifs found in Batik Nitik are derived from plants or flora, with no fauna motifs incorporated. Another distinctive feature of Batik Nitik that sets it apart from other batik types is the absence of a mold for the fabric. The fabric for Batik Nitik is only marked with diagonal lines of 3x3 centimeters, and the motif is created directly from the application of wax in the form of lines and dots that form a pattern.

In this discussion, the focus will be on the unique canting technique used in Batik Nitik, which is not found in other batik styles. The process of creating Batik Nitik is divided into four main stages. The first stage involves drawing guiding lines on the fabric. This is the initial step in determining the Batik Nitik motif. These guiding lines serve as a reference for the canting process, which uses wax to outline the design. Below is an elaboration of the process of drawing these guiding lines. The process begins by folding the fabric into a triangle and marking each corner with a pencil. This step ensures that the fabric is precisely prepared for the subsequent stages. After the folding and marking, the craftsman uses a pencil to draw diagonal lines at regular intervals of 3x3 centimeters. These lines serve as the framework for the motif, guiding the placement of the wax to create the characteristic pattern of Batik Nitik.

Once the guiding lines are in place, the next steps involve applying wax using a canting tool, following the lines and dots that will eventually form the intricate design. The canting process requires great precision, as the wax is applied to create the base for the design, which will later be colored using natural dyes. The unique feature of Batik Nitik lies in the meticulous and structured arrangement of these lines and dots, which mimic a woven texture, giving the batik its signature look.

Figure 1. Folding and Marking the Corners of the Fabric

Second, join each corner with a line to create a diagonal.

Figure 2. Creating a Guideline

Third, make a square/rhombus line starting from the diagonal line to the entire surface of the fabric.

Figure 3. Creating a Box Line as a Stake Line

Fourth, batik by dotting. In the process of batik Nitik, the position of the wax is not drawn slowly, but by pressing it per dot until the wax that comes out is a dot per-slow.
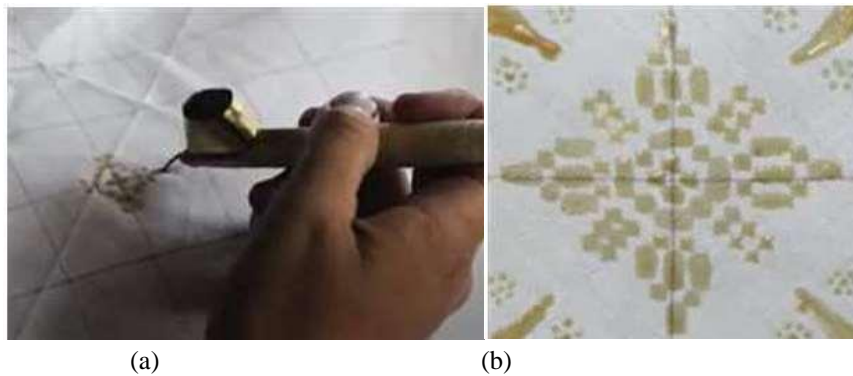

(a)   (b)

Figure 4. Batik Nitik Printing Process
(a) printing process, (b) Printing result

Yogyakarta's typical nitik batik has several geometric motifs or patterns arranged to form a regular pattern. Some of the motifs include the following:

Figure 5. Circle Pattern Nitik Batik Pattern
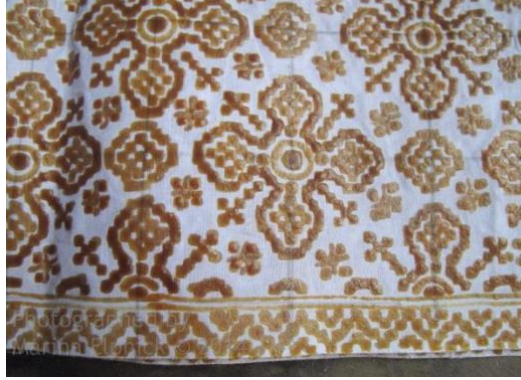

Figure 6. Square Pattern Nitik Batik Pattern

Figure 7. Nitik Batik Pattern with Floral Pattern

Several types of motifs on nitik batik along with the philosophical meaning of each motif are as follows:

1. Nitik Rengganis Batik.

Figure 8. Nitik Batik with Rengganis Motif

The motif is in the form of a circle with small compositions filling the space and looks beautiful. Batik Rengganis is said to have been created to appreciate Dewi Rengganis. The motif is in the form of a circle with small compositions filling the space. Nitik Rengganis is interpreted as a manifestation of the depiction of beauty, flexibility, and agility of the leader of the princesses (Lodra & Mariasa, 2018).

2. Nitik Jaya Kirana Batik.

Figure 9. Nitik batik with Jaya Kirana motif

The motif is rectangular in shape. In the middle, it depicts rays of light depicted with dots (ceceg) and lines. The word jaya means victorious, mighty, and lucky. While kirana means radiant. This pattern reflects and depicts the authority of the famous or brilliant (Gultom et al., 2020).

3. Nitik Kuncup Kanthil Batik

Figure 10. Nitik batik with the Kuncup Kanthil motif

This motif has an important motif in the form of a description of the kanthil flower buds arranged in four directions and framed by ceceg-ceceg that form a diagonal. Kanthil flowers are often used for offerings or ritual activities that are spiritual. This pattern depicts the beauty of kanthil flowers with the hope that people will always be faithful to the sangkan paraning dhumadi, namely God Almighty (Brunner, 1996). By looking at the steps in making nitik batik and the patterns that form the pattern on one of the batik motifs, namely the jaya kirana motif, we can integrate it with the geometric transformation of the batik as follows:

1. Mirroring/reflection

Reflection is moving a geometric shape or object with a distance that has the same value between the point of displacement and the mirror and the starting point with the mirror (Anriana et al., 2023). The reflected object will produce a shadow of the object caused by a mirror, the reflection results depend on the axis that is the mirror in the Cartesian plane (Yosopranata et al., 2018). If a geometric shape is reflected against a certain line, it will produce the same shadow as the initial shape. The application of the concept of reflection or mirroring in the Jaya Kirana motif nitik batik can be seen in the image below.
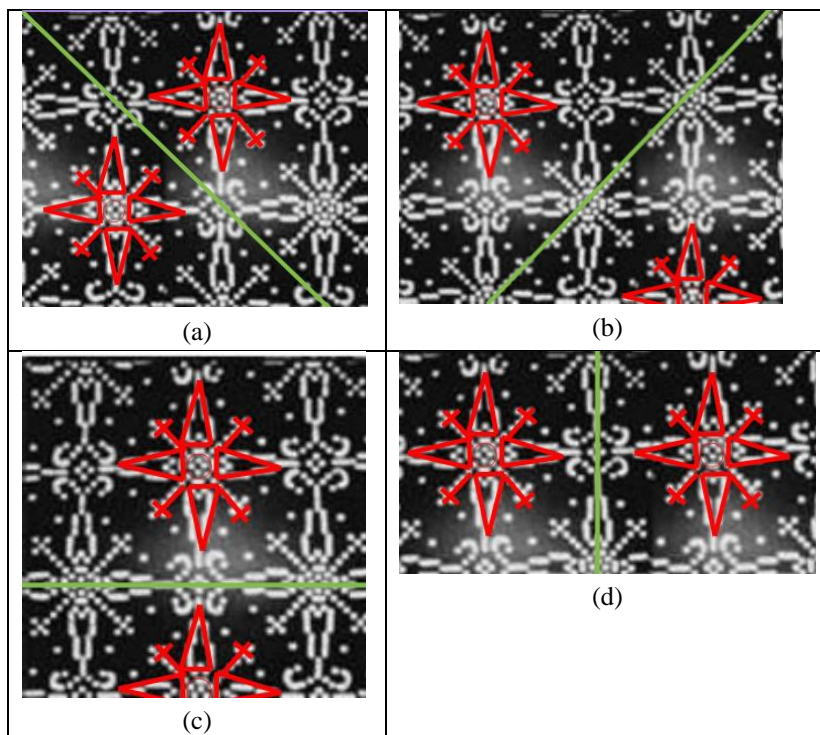

(a)   (b)   (c)   (d)

Figure 11. Reflection of the Nitik Jaya Kirana Batik Motif
(a) Reflection on the Gradient Axis m=-y/x; (b) Reflection on the Gradient Axis m=y/x; (c) Reflection on X; (d) Reflection on the Y Axis

2. Shift / translation

Translation (shift) is a transformation by moving all points on a plane with the same distance and direction (Anoegrajekti et al., 2018). In mathematics, if there are two points A and B, then if A' and B "are the results of the shift, then if A' and B' are the results of the shift, then $\overrightarrow{AB} = \overrightarrow{A'B'}$ dimana $\overrightarrow{AB}$ dis read as vector AB (directed line segment). A vector or directed line segment is a vector is a quantity that has a value and direction. Vectors are depicted as arrows (directed line segments) (Suwandi, 2012). In the Jaya Kirana motif, the dilation or shift pattern can be seen in the motif below:

In the itama motif, which is diagonal below, it can be dilated or shifted to form a pattern.

Gambar 12. Motif Utama

Translation or shifting is done as many as n scales or vector directions to form a motif pattern as in the image below. Translation is also done downwards with the same magnitude ratio, so that it can form the same motif harmony.
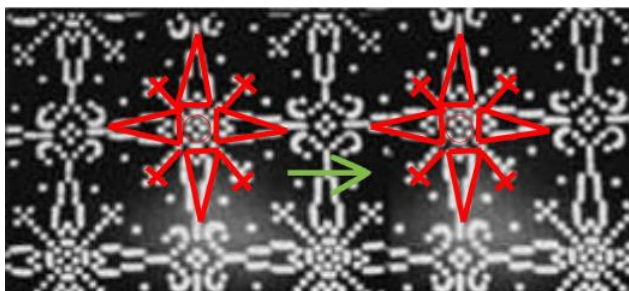

Figure 13. Translation Geometry Pattern Application

4. CONCLUSION

The creation of Batik Nitik with the Jaya Kirana motif is closely connected to geometric elements, as it involves the application of transformation (translation) and reflection (symmetry). The shape patterns in the Jaya Kirana Batik Nitik motif can serve as a valuable learning resource for students, particularly in understanding geometric concepts. In addition, students can gain insights into geometry by exploring how geometric transformations are applied in art. This knowledge can help students produce their own artistic works while simultaneously deepening their understanding of geometry in real-world contexts.

By examining the Jaya Kirana motif, students will also increase their awareness of the presence of mathematics within cultural expressions, especially in the Batik Nitik art form. This could serve as an effective teaching strategy to improve students' comprehension of mathematical concepts and spark their interest in learning by demonstrating how mathematics integrates with culture. Furthermore, this exploration can motivate students to see the practical applications of abstract concepts in their daily lives, fostering an appreciation for both mathematics and traditional art.

The findings from this study suggest that integrating cultural elements such as Batik Nitik into mathematics education can serve as a powerful pedagogical tool. It encourages students to approach mathematics not just as an abstract subject but as something relevant to their culture and surroundings. Future research should investigate further how other regional cultural motifs, across different forms of Indonesian traditional arts, can be used as learning resources for other mathematical concepts such as symmetry, proportion, and spatial reasoning.

Additionally, further studies should explore the impact of such cultural integration on students' motivation and engagement in mathematics. Research can also examine whether such approaches help bridge the gap for students who find traditional math instruction challenging. Lastly, conducting similar studies across different educational levels, from primary to higher education, would provide insights into the

scalability and adaptability of this teaching method, ultimately enhancing both mathematics and cultural education.

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