

Ethnomathematics: A Study of Mathematical Patterns, Shapes, and Concepts in Banten Batik Motifs Based on the Philosophical Values They Embody

Riris Miladul Idaini¹, Arsi Aisah², Fifi Afikoh³, Jaka Wijaya Kusuma⁴, Hamidah⁵,
& Vidya Ayuningtyas⁶
^{1,2,3,4,5,6} Universitas Bina Bangsa

INFO ARTICLES

Key Words:

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



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Abstract: Batik is one of Indonesia's cultural heritages that not only has aesthetic value but also contains philosophical values and mathematical concepts that can be studied through ethnomathematics. Ethnomathematics is a bridge between culture and mathematical concepts. This study aims to identify the patterns, forms, and mathematical concepts contained in Banten Batik motifs based on the underlying philosophical values. This research uses a qualitative method with an ethnographic approach. Data was obtained through observation, interviews, and documentation at the Banten Batik Center, then analyzed using data reduction techniques, data presentation, and conclusions drawn. The results of the study show that motifs in Banten Batik contain the concept of field geometry, geometric transformation, and number patterns, which are integrated with the philosophical value of each motif. The findings of the study show that Banten Batik has the potential to be used as a contextual culture-based mathematics learning resource so that it can help students understand mathematical concepts while getting to know and preserve local culture.

Abstrak: Batik merupakan salah satu warisan budaya Indonesia yang tidak hanya memiliki nilai estetika, tetapi juga mengandung nilai-nilai filosofis dan konsep matematika yang dapat dipelajari melalui etnomatematika. Etnomatematika menjadi jembatan antara budaya dan konsep matematika. Penelitian ini bertujuan untuk mengidentifikasi pola, bentuk, dan konsep matematika yang terkandung dalam motif Batik Banten berdasarkan nilai-nilai filosofis yang mendasarinya. Penelitian ini menggunakan metode kualitatif dengan pendekatan etnografi. Data diperoleh melalui observasi, wawancara, dan dokumentasi di Pusat Batik Banten, kemudian dianalisis menggunakan teknik reduksi data, penyajian data, dan penarikan kesimpulan. Hasil penelitian menunjukkan bahwa motif-motif pada Batik Banten mengandung konsep geometri bidang, transformasi geometri, dan pola bilangan, yang terintegrasi dengan nilai filosofis dari setiap motif. Temuan penelitian menunjukkan bahwa Batik Banten memiliki potensi untuk dijadikan sebagai sumber belajar matematika kontekstual berbasis budaya, sehingga dapat membantu siswa memahami konsep matematika sekaligus mengenal dan melestarikan budaya lokal.

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

How to Cite (APA 6th Style): Idaini, R. M., Aisah, A., Afikoh, F., Kusuma, J. W., Hamidah, & Ayuningtyas, V.. (2026). Ethnomathematics: A Study of Mathematical Patterns, Shapes, and Concepts in Banten Batik Motifs Based on the Philosophical Values They Embody. *Prosiding Diskusi Panel Nasional Pendidikan Matematika*, 783-792.

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INTRODUCTION

Mathematics not only thrives in the academic world, but is also present in people's everyday cultural activities. This perspective is known as ethnomathematics, which is the study of the relationship between mathematics and culture in human life. Ethnomathematics posits that mathematical concepts can actually be found in many cultural products, such as architectural structures, handicrafts, traditional games, woven fabrics, and even batik (Payadnya et al., 2024). Consequently, ethnomathematics can make learning more contextual and imbued with deeper meaning for students (Nirmalasari & Rofiroh, 2025).

A study conducted by Iskandar et al. (2022) shows that various elements of Indonesian culture contain geometric concepts that can be found in traditional houses, traditional dances, temples, mosques, woven textiles, and even batik patterns. Supported by Batiibwe (2025), who states that ethnomathematics research in various developing countries focuses on identifying and systematizing mathematical concepts embedded in local cultures. The goal is to broaden our understanding of the very nature of mathematics itself. Thus, ethnomathematics serves not only as a cultural study but also as a means to integrate local culture into modern mathematics education.

One of Indonesia's cultural heritages, which holds great potential for study from an ethnomathematics perspective, is batik. Various studies have shown that batik motifs contain mathematical patterns, shapes, and concepts such as plane geometry, symmetry, geometric transformations, similarity, and repeating patterns (Roesdiana & Juandi, 2024). In addition to its aesthetic value, batik also holds historical and philosophical significance that reflects a region's cultural identity. Therefore, batik motifs can serve as a medium for exploring the relationship between mathematics and culture in greater depth.

Banten batik is one of Indonesia's traditional batik styles that evolved from the historical legacy of the Sultanate of Banten. Its motifs—such as Surosowan, Sabakingking, Panjunan, Kaibon, and Ratu Pacar—derive their names from places, buildings, or historical relics that hold significant value in the history of the Sultanate of Banten. Each motif not only displays a distinctive arrangement of patterns and visual forms but also embodies philosophical values that represent the wisdom, leadership, spirituality, and social life of the Banten community (Sanifah et al., 2022). These philosophical values cannot be separated from the visual forms of the motifs when viewed from the perspective of ethnomathematics (Jainuri & Haryadi, 2025), which serves as a representation of the cultural meanings intended to be conveyed. Therefore, Banten batik is a fascinating subject for study because it incorporates mathematical elements intertwined with cultural values.

Several previous studies have revealed the presence of mathematical concepts in various batik motifs across Indonesia. (Roesdiana & Juandi, 2024) found that batik motifs contain numerous concepts of geometric transformations, three-dimensional shapes, and various other mathematical concepts that can be utilized in mathematics education.

Research by Sanifah et al. (2022) also indicates that Banten batik motifs incorporate concepts of geometry, translation, reflection, and specific mathematical patterns. However, most of these studies have focused solely on identifying mathematical shapes or concepts, without delving deeply into the philosophical values embedded within Banten batik motifs.

This situation highlights a research gap. Ideally, ethnomathematics research not only identifies the mathematical concepts contained within a cultural artifact but also explains the relationship between these mathematical concepts and the underlying cultural meanings. (Rosa & Orey, 2011) explain that the essence of ethnomathematics lies in the interconnection between cultural practices and the mathematical concepts that develop within them. Therefore, research is needed that can integrate the analysis of patterns, forms, mathematical concepts, and philosophical values into a single comprehensive study. The novelty of this research lies in its examination of the connection between the mathematical elements in Banten Batik motifs and the philosophical values embedded within them, thereby providing a more complete picture of the relationship between mathematics and culture. This research is important because it can contribute to both education and cultural preservation. From an educational perspective, the research findings can be utilized as a resource for culture-based

mathematics learning that supports contextual learning and strengthens students' cultural identity. From a cultural perspective, this research can enrich the scientific documentation of the philosophical and mathematical values contained in Banten Batik. Based on this, this study aims to identify mathematical patterns and forms in Banten Batik motifs, explain the mathematical concepts contained within them, and analyze their connection to the philosophical values embodied in each Banten Batik motif. Since this study is exploratory and qualitative in nature, it does not employ hypotheses but focuses on the description and interpretation of the phenomena discovered.

METHOD

This study employs a qualitative approach using ethnographic methods to examine the mathematical patterns, forms, and concepts found in Banten batik motifs, along with their connection to the philosophical values embedded within them. According to Alhazmi & Kaufmann (2022), qualitative research is used to deeply understand and interpret the meanings contained within a cultural phenomenon. Meanwhile, ethnography focuses on the study of culture and mathematical activities that develop within a society (Skukauskaitė & Sullivan, 2022). The ethnographic approach allows this study to obtain a more comprehensive picture of the relationship between culture and the mathematical concepts found in Banten batik motifs (Aini, 2022). The subject of this study is Banten batik motifs, which possess identifiable philosophical values and mathematical elements. The motifs examined include the Sabakingking, Singayaksa, and Ratu Pacar motifs, selected based on the availability of philosophical information and the clarity of their mathematical elements. The research was conducted at the Banten Batik Center, located at Jalan Bhayangkara No. 5, Cipocok Jaya Village, Cipocok Jaya Subdistrict, Serang City, Banten Province. This location was chosen because it serves as the center for the production and preservation of Banten Batik, providing information on various Banten Batik motifs. Through observation, documentation, and literature review, data were collected on the variety of Banten Batik motifs, their philosophical meanings, and the batik-making process. The collected data were then analyzed to identify the patterns, shapes, and mathematical concepts present in Banten Batik motifs, and their relationship to the philosophical values underlying the creation of these motifs was interpreted. This approach aligns with ethnomathematics research, which views mathematics as an integral part of a community's culture and one that can be found in various local cultural activities and products (Berbasis et al., 2022).

RESULT

This study describes the philosophical values and mathematical concepts embodied in Banten batik motifs. The motifs analyzed in this study include the Sabakingking, Singayaksa, and Ratu Pacar motifs. Each motif was examined based on its philosophical meaning and the mathematical elements that can be identified from an ethnomathematics perspective.

1. Motif Batik Banten Sebangkingking



Figure 1. Banten Batik with the Sebangkingking Motif

The Sebangkingking motif is one of the Banten batik motifs whose name derives from the title of Panembahan Sultan Maulana Hasanuddin, the founder of the Sultanate of Banten. This motif embodies a philosophy that symbolizes Sultan Hasanuddin's leadership, courage, decisiveness, and wisdom in establishing and governing the Sultanate of Banten. These values are reflected in the orderly and harmonious arrangement of the ornaments, which depict the orderliness of the governmental system and the balance between power and responsibility. From an ethnomathematics perspective, the regularity of the shapes and patterns found in the Sebangkingking motif indicates the presence of mathematical activities that have developed within Banten culture. The Sebangkingking motif features two-dimensional geometric shapes. In Figure 1, these geometric shapes are clearly visible in the motif's main elements—repeating rhombus shapes. Triangles and squares are also present in the supporting ornamental elements, serving to create visual balance.

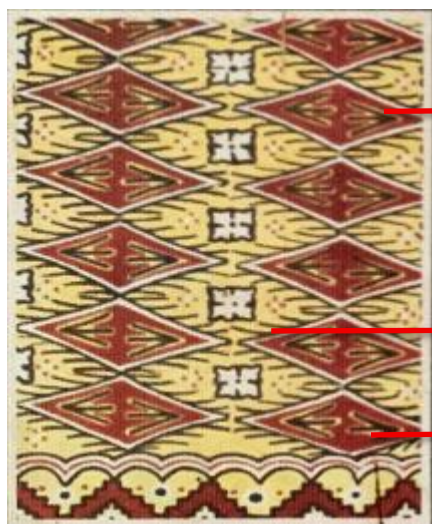


Figure 2. Geometri Bidang pada Motif Sebangkingking



Figure 3. Belah Ketupat



Figure 4. Persegi



Figure 5. Segitiga

The use of geometry in Sebangkingking motifs demonstrates that the process of creating batik motifs is inseparable from the application of systematically arranged geometric concepts. Well-organized two-dimensional geometric patterns produce orderly designs that reflect philosophical values of leadership emphasizing order and harmony. Additionally, Sebangkingking batik incorporates geometric translation in its motifs. The geometric concepts of translation identified are translation and reflection. The use of translation and reflection creates the visual regularity that characterizes batik motifs while reinforcing the philosophical meaning of balance and order in life.



Figure 6. Reflection (Rotation) in the Sebangkingking Pattern

The reflection is evident in the symmetry of the pattern with respect to a certain axis, resulting in a balance of form between the left and right sides, as shown in Figure 6.



Figure 7. Shift (Translation) in the Sebangkingking Motif

Meanwhile, in Figure 7, translation is evident in the repetition of motif shapes that shift regularly in the same direction and by the same distance.

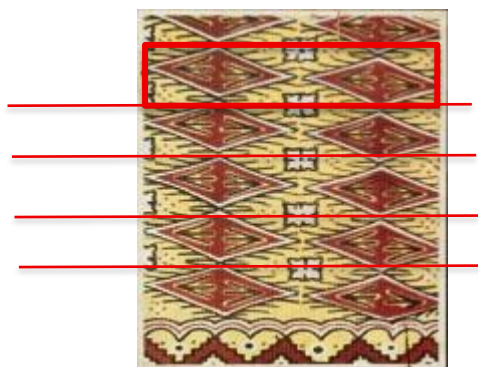


Figure 8. Number Patterns in the Sebangkingking Motif

Furthermore, in Figure 8, the sebangkingking batik motif demonstrates the application of number patterns, which can be observed through the repetition of motif elements arranged in an orderly manner. If one examines the number of motifs in each row or column, a regularity becomes apparent that reflects the concept of number patterns. These patterns reflect the repetitive nature that is one of the main characteristics or defining features of batik motifs, a feature also found in Banten batik.

2. Singayaksa Banten Batik Motif

The Singayaksa motif is one of the Banten batik motifs; its name is derived from the place where Sultan Maulana Hasanuddin performed the istikharah prayer before building the Surosowan Palace. Thus, this motif carries philosophical significance related to religiosity, wisdom, prudence in

decision-making, and humanity's reliance on God's guidance. These values reflect the character of the people of Banten, who deeply value religious teachings in their daily lives. The motif can be seen in Figure 9.



Figure 9. Banten Batik with the Sebangkingking Motif

As can be seen in Figure 2.1, the Singayaksa motif features several geometric shapes, such as rhombuses and flower-like shapes, arranged symmetrically. There are also circles, triangles, and squares; these shapes serve as the main elements that make up the entire motif.

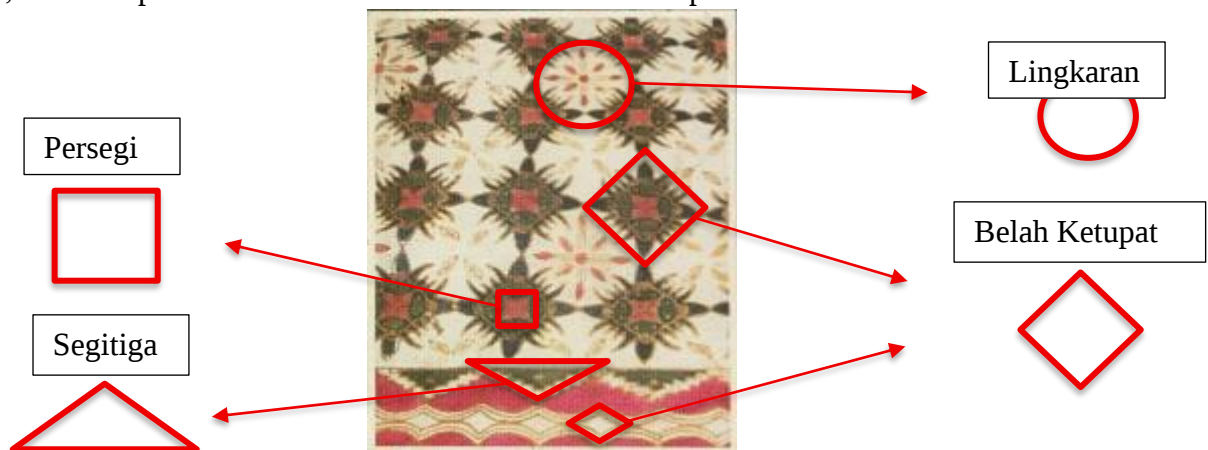


Figure 10. Plane Geometry in the Sebangkingking Motif

The presence of flat shapes in the patterns indicates that geometric elements are used to create balance and visual beauty. The use of symmetrical shapes also reinforces the impression of order, which is a hallmark of Banten batik.

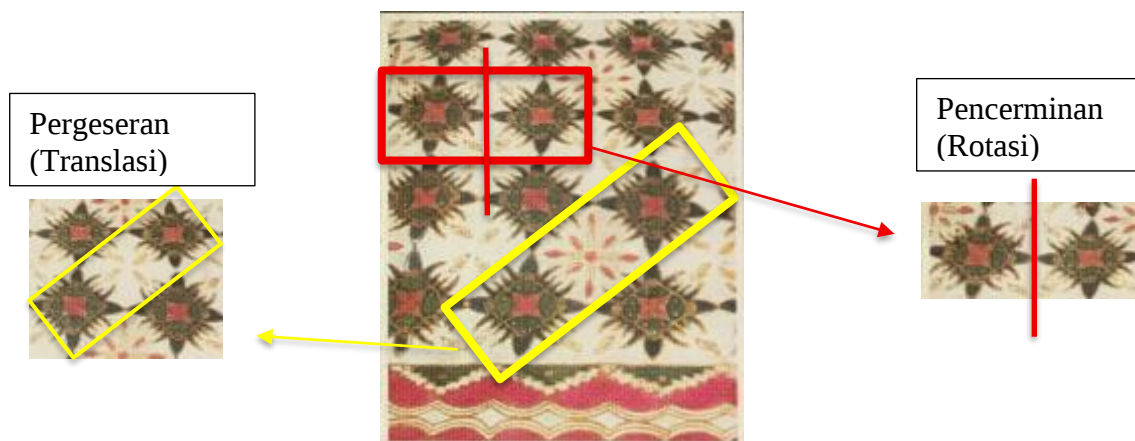


Figure 11. Plane Geometry in the Sebangkingking Motif

In Figure 11, geometric transformations—including reflection and translation—are found in the Singayaksa batik motif. Reflection is evident in the similarity between the left and right sides of the motif. Translation is evident in the sequential repetition of the pattern. Both geometric transformations demonstrate that mathematical principles are used in the creation of batik patterns, which produce the regularity that characterizes batik motifs—a regularity that reflects consistency and continuity.

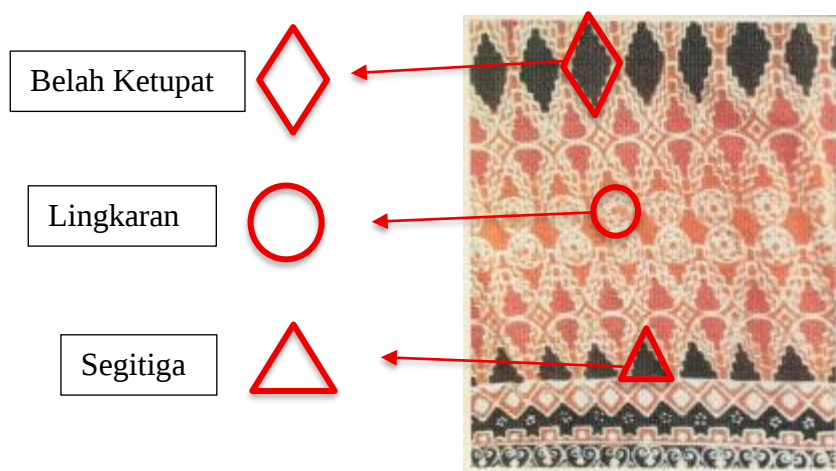
3. Banten Batik Motif: Ratu Pacar

The Ratu Pacar motif is a Banten batik motif named after a descendant of the Banten Sultanate who was involved in maritime activities. This motif symbolizes the courage, fighting spirit, resilience, and perseverance of the people of Banten as they navigate life. This philosophy reflects the character of coastal communities dynamic and open to change, yet steadfast in preserving their cultural identity.



Figure 12. Banten Batik with the Ratu Pacar Motif

When viewed from Figure 12 through the lens of ethnomathematics, the Ratu Pacar motif contains various geometric elements that demonstrate the connection between culture and



mathematics.

Figure 13. Geometry of the Ratu Pacar Motif

In Figure 13, the Ratu Pacar motif incorporates several geometric shapes arranged harmoniously to form a visually appealing pattern. The diversity of geometric shapes demonstrates that this motif draws on various fundamental concepts of geometry to create a balanced and aesthetically pleasing composition.

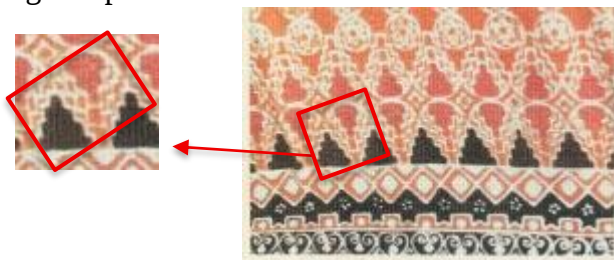


Figure 14. Similarity in the Ratu Pacar Motif

In Figure 14., the Ratu Pacar motif incorporates the concept of similarity, as seen in several ornaments that share the same shape but differ in size. These shapes maintain corresponding proportions of sides and angles, thereby fulfilling the characteristics of similar figures. This concept reflects an intuitive understanding of the principles of proportion as applied in cultural works.

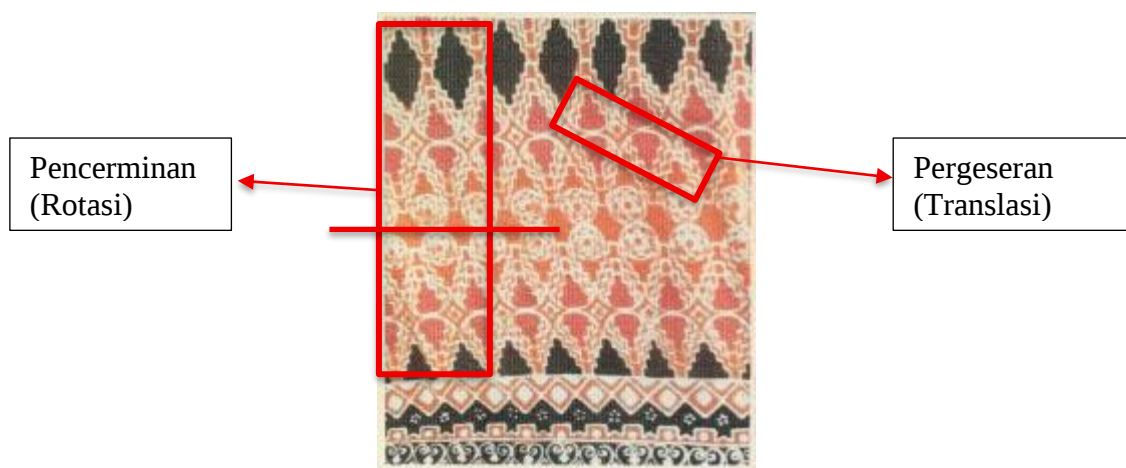


Figure 15. Geometric Transformations in the Ratu Pacar Motif

The geometric transformation concepts found in this motif are reflection and translation. Reflection is evident in the symmetry of shapes relative to a specific axis. At the same time, translation occurs when shapes are shifted in a regular pattern, maintaining the same distance and direction as the original. The use of reflection and translation creates visually interesting variations without disrupting the overall harmony of the motif.

The results of this study show that the Sebakingking, Singayaksa, and Ratu Pacar motifs contain various mathematical concepts examined from an ethnomathematics perspective. These concepts include plane geometry, geometric transformations, number patterns, as well as congruence and similarity. These results address the research question that Banten batik motifs not only possess aesthetic and cultural value but also contain mathematical structures reflected in their shapes, patterns, and arrangements. This finding aligns with the view (Orey & Rosa, 2022) that mathematics is an integral part of cultural activities that evolve and are passed down within a community.

The Sebakingking motif incorporates concepts of plane geometry, such as rhombuses, squares, and triangles, as well as concepts of translation and number patterns. The orderly arrangement of shapes and the repetition of motifs indicate the presence of mathematical aspects in the process of creating batik motifs. The mathematical regularity in the Sebakingking motif also aligns with its philosophical values, which symbolize leadership, steadfastness, and order, highlighting the close relationship between mathematical structure and the cultural meaning embedded in this motif. The Singayaksa motif demonstrates concepts of plane geometry, reflection, and translation. The presence

of reflection and translation provides visual balance, while plane geometry indicates the principle of proportionality in the arrangement of the motif. This balance in the pattern also aligns with the philosophical values of Singayaksa, which reflect religiosity, compassion, and wisdom in decision-making. Meanwhile, the Ratu Pacar motif incorporates concepts of plane geometry in the form of triangles and rhombuses, geometric transformations such as reflection and translation, as well as similarity. The concept of translation indicates a change in size without altering the motif's basic shape, whereas similarity demonstrates the ability to maintain the proportions of a shape across different scales. These findings support the view (Mendrofa & Mendrofa, 2026) that ethnomathematics serves as a bridge connecting mathematical concepts with the cultural practices of a community, thereby enabling mathematics to be understood through the context of daily life and local cultural heritage. In line with what Firdausa et al (2021) stated, the mathematical concepts found in Banten batik motifs can be integrated into instruction as a more contextual and meaningful learning resource. Teachers can implement Banten batik motifs as a culture-based resource for mathematics instruction because they contain mathematical concepts related to plane geometry, geometric transformations, number patterns, similarity, and congruence. In this way, students can understand mathematical concepts while simultaneously learning about, appreciating, and preserving local culture, as well as understanding the philosophical values contained in each batik motif. This can also help strengthen students' character through an understanding of Indonesia's cultural values, thereby making mathematics learning more meaningful and relevant to students' daily lives.

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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