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Ethnomathematics Exploration Of Papua's Typical Ganasan Batik Motif From Mimika Regency As A Mathematics Learning Resource

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Abstract

Mathematics learning is often presented abstractly, making it difficult for students to relate mathematical concepts to real-life contexts. Ethnomathematics provides an alternative by integrating local culture into mathematics education. This study aims to explore the ethnomathematical concepts embedded in Papua's Ganasan Batik motifs from Mimika Regency and examine their potential as a mathematics learning resource. A descriptive qualitative approach with an ethnographic design was employed. Data were collected through participant observation, semi-structured interviews with batik artisans and motif designers, and documentation. Data analysis followed the Miles and Huberman model, while trustworthiness was ensured through triangulation and expert validation. The findings reveal that Ganasan Batik motifs contain mathematical concepts, including symmetry, geometric transformations, tessellation, geometric shapes, ratio, proportion, similarity, congruence, and geometric patterns represented in bird-of-paradise, Asmat carvings, tifa, honai, and sago motifs. These concepts align with geometry and transformation topics in elementary and junior secondary mathematics, demonstrating that Papua's Ganasan Batik is a culturally relevant and meaningful mathematics learning resource. This study contributes a framework for integrating Papuan ethnomathematics into elementary and junior secondary mathematics education by identifying geometric concepts embedded in Ganasan Batik and demonstrating their potential for the development of culturally responsive mathematics learning materials. The findings provide contextual examples that can support teachers in connecting mathematical ideas with local cultural knowledge.

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1. INTRODUCTION

Mathematics, often regarded as the foundation of all sciences, plays a crucial role in developing students' logical, critical, analytical, and creative thinking skills. Despite its fundamental importance, mathematics is frequently perceived as abstract and disconnected from students' everyday experiences, making it difficult for learners to understand the relevance and application of mathematical concepts. Conventional mathematics instruction tends to emphasize procedural knowledge and routine problem-solving rather than conceptual understanding, resulting in less meaningful learning experiences and limited opportunities for students to connect mathematics with their social and cultural environments. These challenges highlight the need for innovative instructional approaches that integrate mathematical concepts with authentic local contexts.

One promising approach is ethnomathematics, which views mathematics as a cultural product embedded in the daily practices, traditions, and knowledge systems of a community. Ethnomathematics explores how mathematical ideas are created, interpreted, and applied within particular cultural settings, enabling students to learn mathematics through contexts that are familiar and meaningful. This approach not only facilitates conceptual understanding but also promotes appreciation of cultural heritage, strengthens students' mathematical literacy, and encourages critical, creative, and reflective thinking. Consequently, integrating ethnomathematics into mathematics education provides opportunities to bridge formal mathematical knowledge with local wisdom while fostering students' cultural identity.

Among Indonesia's diverse cultural heritage, batik has become one of the most extensively studied objects in ethnomathematics because its motifs exhibit rich mathematical structures, including symmetry, geometric transformations, tessellations, proportions, and repetitive patterns. Previous studies have demonstrated ethnomathematical concepts in various regional batik traditions, such as Kalimantan Batik, Gajah Mada Sekar Batik from Tulungagung, Adipurwo Batik, Gedog Batik, and Mojokerto Batik, revealing the presence of geometric shapes, transformations, congruence, similarity, numerical patterns, and spatial reasoning. These studies confirm that batik motifs can serve as meaningful contextual resources for mathematics learning. However, research on Papua's Ganasan Batik from Mimika Regency remains extremely limited, particularly regarding the identification of mathematical concepts embedded in its motifs and their potential application as mathematics learning resources. This gap highlights the need for further investigation into Papua's local cultural heritage from an ethnomathematical perspective.

Papua's Ganasan Batik from Mimika Regency represents a unique cultural identity inspired by the natural environment, indigenous traditions, and artistic expressions of the Amungme and Kamoro communities. Unlike many Indonesian batik traditions that are dominated by floral or agricultural motifs, Ganasan Batik incorporates distinctive Papuan elements, including the bird-of-paradise, Asmat carvings, tifa drums, honai traditional houses, sago leaves, traditional arrows, rivers, and geometric indigenous ornaments. These motifs embody not only philosophical values related to harmony with nature, resilience, communal life, and cultural identity but also visual structures that reflect mathematical regularity. The arrangement of repeated ornaments, balanced compositions, proportional forms, and symmetrical patterns suggests the existence of various mathematical concepts embedded within the batik design. Consequently, Papua's Ganasan Batik offers considerable potential as a contextual resource for mathematics education while simultaneously supporting the preservation of Papuan cultural heritage.

The integration of Papua's Ganasan Batik into mathematics learning is consistent with the principles of Indonesia's Merdeka Curriculum, which emphasizes contextual learning, local wisdom, differentiated instruction, and the development of students' competencies and character through culturally responsive education. Learning activities based on batik motifs may involve identifying geometric shapes, analyzing symmetry and geometric transformations, investigating tessellation patterns, comparing proportions, and recognizing mathematical regularities within traditional designs. Such activities enable students to connect formal mathematical concepts with authentic cultural artifacts, thereby enhancing conceptual understanding, mathematical reasoning, problem-solving abilities, and appreciation of local culture. Moreover, incorporating Papuan cultural heritage into mathematics instruction contributes to strengthening students' cultural identity while promoting the preservation of indigenous knowledge through education.

Despite the cultural significance of Papua's Ganasan Batik, existing studies have primarily focused on its artistic and cultural values rather than its mathematical characteristics. To date, there is limited empirical evidence examining the ethnomathematical concepts embedded in Ganasan Batik motifs and their relevance to formal school mathematics. Therefore, this study aims to explore the ethnomathematical elements found in the motifs of Papua's Ganasan Batik from Mimika Regency and analyze their relationship with mathematics topics taught in elementary and junior secondary schools. The findings are expected to enrich the literature on ethnomathematics, provide culturally relevant mathematics learning resources, and support teachers in developing contextual, innovative, and culturally responsive mathematics instruction while contributing to the preservation of Papua's cultural heritage.

2. METHOD

This study employed a descriptive qualitative approach with an ethnographic design to explore the mathematical concepts embedded in the motifs of Papua's Ganasan Batik from Mimika Regency. This approach was chosen to examine the relationship between traditional batik-making practices and the mathematical ideas represented within the cultural context of the indigenous communities of Mimika. The research was conducted at Ganasan Batik production centers in Mimika Regency, Papua. The participants consisted of batik artisans, motif designers, and cultural practitioners, while the research objects were selected Ganasan Batik motifs representing Papuan cultural identity. The analysis focused on ethnomathematical elements, including geometric shapes, line and rotational symmetry, geometric transformations (translation, reflection, rotation, and dilation), tessellation, proportional reasoning, similarity, congruence, and repetitive patterns. Data were collected through participant observation, semi-structured interviews, and documentation. Participant observation was conducted for approximately two weeks to obtain an in-depth understanding of the motif design process, visual patterns, and cultural meanings embedded in Papua's Ganasan Batik. Observation was used to examine the structure and composition of batik motifs, interviews were conducted to investigate the philosophical meanings and design processes of the motifs, and photographic documentation served as supporting data for visual analysis. Data were analyzed using the interactive model of Miles and Huberman, consisting of data reduction, data display, conclusion drawing, and verification. The trustworthiness of the findings was ensured through source and methodological triangulation, as well as expert validation by specialists in ethnomathematics and culturally responsive mathematics education. This study involved X informants, comprising Y senior Ganasan Batik artisans and Z motif designers who were directly engaged in the production and development of Ganasan Batik in Mimika Regency, Papua, Indonesia. Participants were selected through purposive sampling to ensure that they possessed extensive knowledge of the cultural meanings, design principles, and production processes of Ganasan Batik. The inclusion criteria were as follows: (1) a minimum of five years of active experience in producing or designing Ganasan Batik; (2) direct involvement in creating, developing, or interpreting the motifs and their associated cultural meanings; and (3) recognition by local artisan communities or cultural stakeholders as individuals with substantial expertise in Ganasan Batik. Data collection continued until thematic saturation was achieved, indicating that no new themes or relevant information emerged from subsequent interviews.

To enhance the trustworthiness of the findings, member checking was conducted following the preliminary data analysis. The researchers presented their initial interpretations of the mathematical concepts and cultural meanings embedded in the batik motifs to the participants for review and verification. The informants confirmed the accuracy of the interpretations, provided clarifications where necessary, and suggested minor refinements to ensure that the final analysis accurately reflected both the cultural significance of the motifs and the mathematical ideas represented within them.

3. RESULTS

Research Findings

The findings were obtained through visual observations, documentation, and interviews concerning Papua's Ganasan Batik motifs from Mimika Regency, which prominently feature cultural and natural symbols of Papua, including the bird-of-paradise, Asmat carvings, tifa drums, honai traditional houses, sago leaves, traditional arrows, and indigenous geometric ornaments. The analysis focused on three representative batik motifs selected because they exhibit consistent visual structures and well-organized repetitive patterns. The results indicate that these motifs embody a variety of ethnomathematical concepts that can be systematically identified. Specifically, the motifs demonstrate the presence of two-dimensional geometric shapes, symmetry, geometric transformations, tessellation, ratio and proportion, similarity, congruence, spatial organization, and repetitive geometric patterns. These mathematical elements are integrated into the arrangement of cultural ornaments and decorative patterns, reflecting both the artistic values and the mathematical reasoning employed by Papuan batik artisans. The following sections present a detailed analysis of the ethnomathematical concepts identified in each selected Ganasan Batik motif and discuss their relevance as contextual resources for mathematics learning.

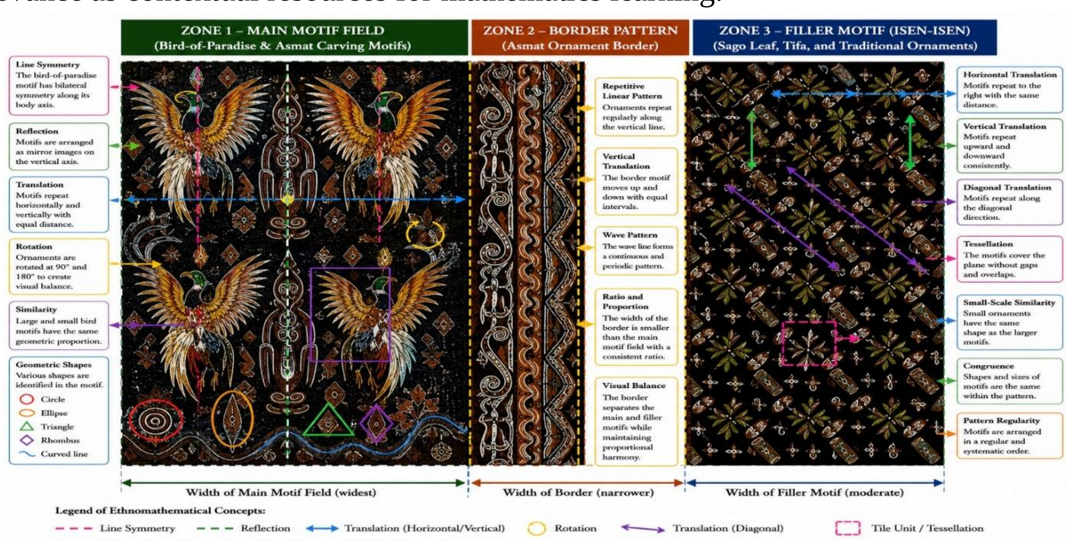


Figure 1. Ganasan Batik Motif 1

Figure 1 illustrates Papua's Ganasan Batik Motif 1 from Mimika Regency, which is systematically organized into three main zones: the main motif field, the border pattern, and the filler motif (isen-isen) field. This spatial organization demonstrates the mathematical concept of plane partitioning, where the fabric is intentionally divided into sections with different proportions and specific visual functions. Zone 1, the main motif field, occupies the largest area and features repeated cultural motifs inspired by the bird-of-paradise, Asmat carvings, and traditional Papuan ornaments. The arrangement exhibits bilateral (line) symmetry, geometric regularity, and repeated motifs organized in rows and columns. Several geometric elements, including circles, ellipses, triangles, rhombuses, and curved lines, can be identified within the motif composition. The repeated placement of motifs at equal intervals represents horizontal and vertical translations, while the continuous arrangement of motifs across the fabric illustrates the mathematical concept of tessellation, where the surface is covered without gaps or overlaps.

Zone 2 functions as the border pattern, separating the main motif from the filler motif. The border consists of repeated Asmat-inspired ornamental patterns arranged vertically, demonstrating linear translation, periodic repetition, and proportional spacing. The continuous wave-like and geometric border creates visual rhythm while maintaining structural balance between the two adjacent zones. Besides serving an aesthetic function, the border provides proportional transitions that contribute to the harmony of the overall batik composition.

Zone 3 represents the filler motif (isen-isen) field, which contains smaller decorative motifs such as sago leaves, tifa drums, and traditional Papuan ornaments arranged densely throughout the fabric. These motifs exhibit horizontal, vertical, and diagonal translations, producing consistent repetitive patterns. Their uniform size reflects the mathematical concepts of similarity, congruence, and proportionality, while their systematic arrangement demonstrates small-scale tessellation. Compared with the larger motifs in Zone 1, the filler motifs illustrate the concept of dilation (scale transformation) through proportional differences in size while preserving similar geometric characteristics.

Overall, the ethnomathematical annotations of Papua's Ganasan Batik from Mimika Regency demonstrate that the batik motifs embody not only artistic and cultural values but also a wide range of mathematical concepts, including plane geometry, symmetry, geometric transformations (translation and dilation), tessellation, periodic patterns, ratio and proportion, similarity, congruence, and geometric regularity. These mathematical concepts emerge naturally through traditional Papuan batik-making practices and provide authentic cultural contexts for mathematics education. Therefore, Papua's Ganasan Batik has considerable potential as a culturally responsive mathematics learning resource, particularly for teaching geometry, geometric transformations, pattern recognition, proportional reasoning, and spatial visualization in elementary and secondary school mathematics.

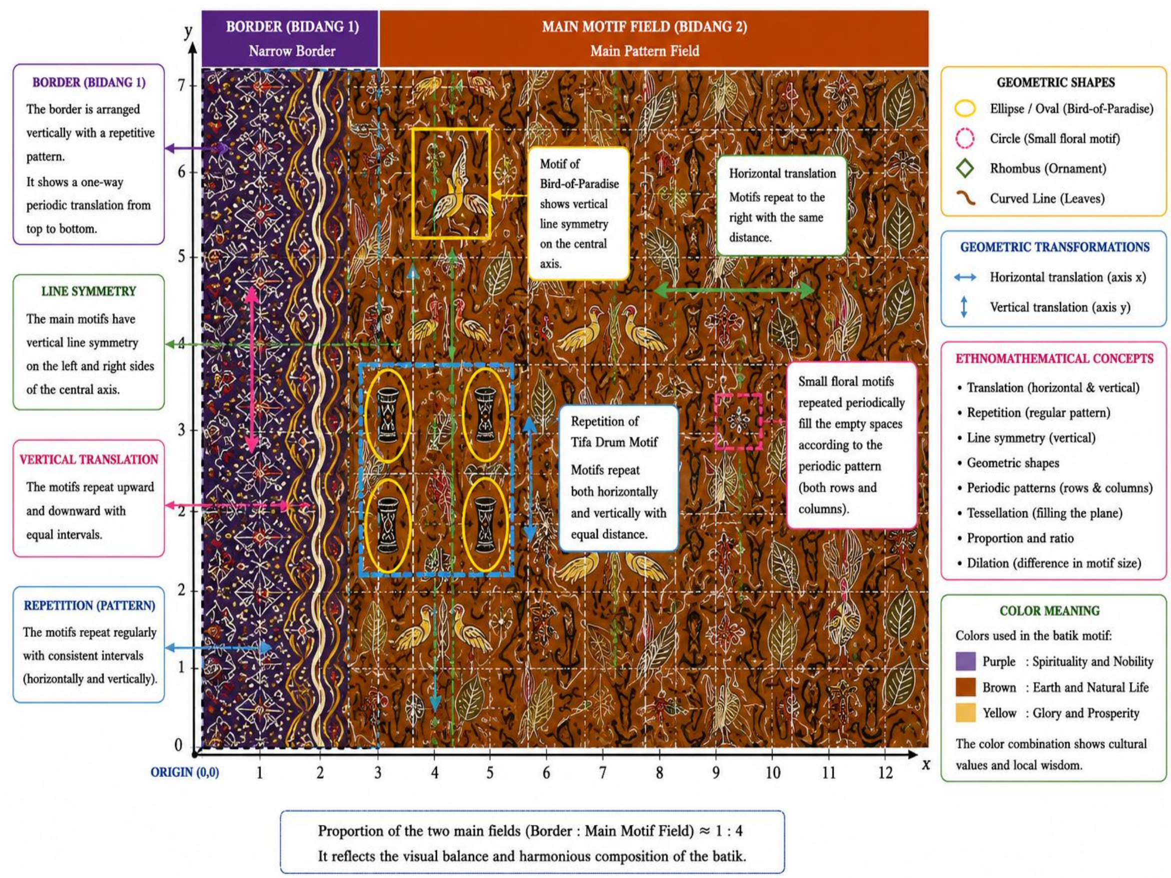
Figure 2. Ganasan Batik Motif 2

Figure 2 illustrates Papua's Ganasan Batik Motif 2 from Mimika Regency, which consists of two vertically arranged main sections with contrasting background colors: a golden-yellow field on the left and a black field on the right. Together, these sections create a unified visual composition through the repetition of Papuan cultural motifs, including the bird-of-paradise, tifa drums, sago leaves, traditional floral ornaments, and indigenous geometric decorations, each arranged with distinct structural characteristics. From a mathematical perspective, the batik fabric is divided into two primary fields of nearly equal width, demonstrating the concepts of plane partitioning, ratio, and proportionality, with an approximate 1:1 proportional relationship. Narrow ornamental borders positioned between the two sections serve as visual separators while reinforcing the balance and harmony of the overall composition.

The left field, with its golden-yellow background, is dominated by relatively small motifs of bird-of-paradise feathers, sago leaves, traditional flowers, and indigenous ornaments distributed densely with varying orientations. The repeated arrangement of these motifs resembles non-rigid tessellation, as the motifs are repeated continuously without forming perfectly symmetrical configurations. Nevertheless, the overall composition maintains visual regularity through consistent spacing and repetitive placement. Geometrically, this section contains circles, ellipses, rhombuses, curved lines, and leaf-shaped figures, while several motifs exhibit partial line symmetry. Repetition through translation with limited variations in orientation can be observed throughout the field, producing a dynamic yet organized visual pattern. The narrow ornamental border along the edge displays a one-directional periodic pattern created by repeated Asmat-inspired geometric motifs, functioning as both a decorative element and a structural boundary.

The right field, characterized by its black background, presents larger motifs of the bird-of-paradise, tifa drums, sago leaves, and traditional Papuan ornaments, arranged in a more systematic and organized manner than those in the left field. The motif composition incorporates elliptical shapes, rhombuses, curved lines, and floral geometric elements, while the principal motifs exhibit clear vertical line symmetry, particularly in the arrangement of the bird-of-paradise and surrounding ornamental components. The repeated motifs are organized through horizontal and vertical translations, producing a controlled tessellation with relatively uniform spacing and consistent proportions. Compared with the left field, this section demonstrates stronger geometric regularity and greater structural consistency in both motif size and spatial arrangement.

The difference in motif size between the two fields illustrates the mathematical concept of dilation (scale transformation). Motifs in the left field are smaller and more densely distributed, whereas those in the right field are larger and arranged with wider spacing while preserving similar geometric characteristics. Overall, Papua's Ganasan Batik Motif 2 from Mimika Regency embodies numerous ethnomathematical concepts, including plane partitioning, geometric shapes, line symmetry, geometric transformations (translation and dilation), tessellation, periodic patterns, ratio and proportion, similarity, congruence, and geometric regularity. These mathematical ideas emerge naturally through the traditional batik-making practices of Papuan artisans and demonstrate the potential of Papua's Ganasan Batik as a culturally responsive mathematics learning resource, particularly for teaching geometry, geometric transformations, symmetry, patterns, proportional reasoning, and spatial visualization in elementary and secondary mathematics education.



Gambar 3. Ethnomathematical Analysis of Papua's Ganasan Batik Motif 3 from Mimika Regency

Figure 3 illustrates Papua's Ganasan Batik Motif 3 from Mimika Regency, which is organized into two vertical sections consisting of a narrow border on the left and a main motif field on the right.

This arrangement demonstrates the mathematical concept of plane partitioning, where the fabric is divided into two regions with different proportions and distinct visual functions. The border occupies a relatively small area and serves as a decorative frame, whereas the main motif field dominates the composition through the systematic repetition of Papuan cultural motifs. The unequal sizes of these two sections create asymmetrical visual balance, producing a harmonious composition despite their different proportions.

The left section functions as a decorative border composed of small Asmat-inspired geometric ornaments arranged periodically along the vertical direction. The motifs are repeated at regular intervals, representing one-dimensional translation along the vertical (y) axis. Compared with the motifs in the main field, the border motifs are smaller in size, illustrating the mathematical concept of scale comparison (dilation). In addition to its decorative role, the border establishes a clear visual boundary between the edge of the fabric and the central motif field while maintaining proportional continuity throughout the composition.

The main motif field is densely filled with repeated bird-of-paradise, tifa drum, sago leaf, and traditional Papuan ornamental motifs arranged systematically across the fabric. These motifs occupy the entire surface without gaps or overlaps, demonstrating the concept of non-polygonal tessellation. Each motif unit consists of geometric elements such as ellipses (or ovals), circles, rhombuses, and curved lines, which together form harmonious decorative patterns. The uniformity of motif size and shape reflects the mathematical concepts of similarity and congruence, while the repeated arrangement in rows and columns illustrates horizontal and vertical translations with consistent spacing. The repeated organization of these motifs also forms a periodic pattern, indicating strong geometric regularity throughout the batik composition.

In addition to translation, several principal motifs, particularly the bird-of-paradise and tifa drum, exhibit partial line symmetry, which can be observed in the balanced arrangement of ornamental elements surrounding their central axes. The coordinate grid superimposed on the figure highlights the directions of horizontal translation along the x-axis and vertical translation along the y-axis, allowing the spatial relationships among motifs to be analyzed systematically from a mathematical perspective.

Overall, Papua's Ganasan Batik Motif 3 from Mimika Regency embodies a rich variety of ethnomathematical concepts, including plane partitioning, geometric shapes, line symmetry, geometric transformations (horizontal and vertical translations), non-polygonal tessellation, periodic patterns, similarity, congruence, ratio and proportion, scale transformation (dilation), and asymmetrical visual balance. These mathematical concepts emerge naturally through the traditional batik-making practices of Papuan artisans and demonstrate the significant potential of Papua's Ganasan Batik as a culturally responsive mathematics learning resource. The motifs provide authentic contexts for teaching geometry, geometric transformations, symmetry, tessellation, proportional reasoning, and spatial visualization in elementary and secondary mathematics education while simultaneously promoting the preservation and appreciation of Papua's cultural heritage.

Discussion

The findings of this study demonstrate that Papua's Ganasan Batik motifs from Mimika Regency consistently embody ethnomathematical concepts reflected in their visual structures, repetitive patterns, and spatial organization. The three selected motifs exhibit systematic geometric arrangements and varying degrees of mathematical regularity while maintaining distinctive artistic characteristics rooted in Papuan culture. These findings indicate that traditional batik-making is not merely an artistic activity but also represents a cultural practice through which mathematical knowledge is intuitively developed and transmitted across generations. This result supports D'Ambrosio's ethnomathematics theory, which argues that mathematical thinking naturally emerges within cultural practices rather than exclusively through formal education. Similarly, Sianturi et al. (2022) emphasized that traditional artistic activities preserve implicit mathematical knowledge through experience and cultural inheritance.

One of the most prominent ethnomathematical features identified in Papua's Ganasan Batik is the partitioning of the fabric into functional visual regions, including the main motif field, border pattern, and filler motif (isen-isen). These regions are intentionally designed with different widths and spatial proportions, illustrating mathematical concepts related to plane partitioning, ratio, proportion, and visual balance. Although the motif compositions are not always perfectly symmetrical, they demonstrate asymmetrical balance, where harmony is achieved through careful arrangement of motif size, spacing, orientation, and density. These findings are consistent with previous ethnomathematics studies, which reported that batik artisans intuitively apply proportional reasoning and spatial organization to achieve aesthetically balanced compositions without relying on formal mathematical calculations.

Unlike batik traditions inspired by agricultural products or floral ornaments, Papua's Ganasan Batik derives its visual identity from the natural environment and indigenous cultural heritage of the Amungme and Kamoro communities. Motifs such as the bird-of-paradise, tifa drum, Asmat carvings, sago leaves, traditional arrows, and indigenous geometric ornaments exhibit consistent geometric characteristics. The bird-of-paradise motif demonstrates line symmetry, proportional body structures, and repeated ornamental elements, while Asmat-inspired motifs display repetitive geometric arrangements through translation and periodic patterns. Likewise, the repeated arrangement of tifa drums and sago leaves reflects concepts of similarity, congruence, geometric transformation, and proportional scaling. The continuous repetition of these motifs forms tessellation-like patterns that cover the fabric systematically without disrupting the overall visual harmony.

The repeated arrangement of motifs throughout the fabric clearly illustrates the application of geometric transformations, particularly horizontal, vertical, and diagonal translations, while variations in motif size represent dilation (scale transformation). The consistency of repeated motifs also demonstrates periodicity, similarity, congruence, and spatial regularity, indicating that Papuan batik artisans possess strong spatial reasoning and geometric intuition developed through traditional craftsmanship rather than formal mathematical instruction. This finding reinforces the argument that mathematical concepts are embedded naturally within indigenous artistic practices and transmitted through cultural knowledge and practical experience.

Based on the analysis of the three Papua's Ganasan Batik motifs, this study identified numerous ethnomathematical concepts directly related to mathematics topics taught in elementary and junior secondary schools. These concepts include plane geometry, geometric shapes, symmetry, geometric transformations, tessellation, similarity, congruence, ratio and proportion, periodic patterns, scale transformation (dilation), and spatial reasoning. The strong correspondence between these concepts and the school mathematics curriculum suggests that Papua's Ganasan Batik can serve as an authentic and culturally relevant mathematics learning resource. Through contextual learning activities involving observation, analysis, classification, and exploration of batik motifs, students can connect abstract mathematical ideas with meaningful cultural experiences while simultaneously developing cultural awareness.

Table 1. Relationship between Ethnomathematical Elements in Papua's Ganasan Batik Motifs from Mimika Regency and School Mathematics Topics

No.	Ethnomathematical Element	Evidence in Papua's Ganasan Batik Motifs	School Mathematics Topic	Education Level
1	Plane partitioning	Division into main motif, border, and filler motif (*isen-isen*)	Plane geometry	Elementary & Junior Secondary
2	Geometric shapes	Circles, ellipses, rhombuses, triangles, and curved lines in Papuan motifs	Plane geometry	Junior Secondary
3	Line symmetry	Bilateral symmetry in bird-of-paradise and traditional ornaments	Symmetry	Elementary & Junior Secondary
4	Translation	Horizontal, vertical, and diagonal repetition of motifs	Geometric transformations	Junior Secondary
5	Tessellation	Continuous filling of the fabric without gaps	Tessellation and plane geometry	Junior Secondary
6	Dilation	Differences in motif size while maintaining similar forms	Dilation and scale	Junior Secondary
7	Ratio and proportion	Proportional relationships among motif fields and ornaments	Ratio and proportion	Elementary & Junior Secondary
8	Periodic patterns	Regular repetition of border and filler motifs	Patterns and sequences	Junior Secondary
9	Similarity and congruence	Repeated motifs with consistent shapes and proportions	Similarity and congruence	Junior Secondary
10	Asymmetrical visual balance	Different field sizes creating harmonious compositions	Ratio and proportion	Junior Secondary

Table 1 demonstrates that Papua's Ganasan Batik motifs from Mimika Regency contain diverse ethnomathematical elements closely aligned with mathematics topics taught in schools. These findings suggest that Ganasan Batik can function as a culturally responsive mathematics learning resource, enabling students to understand mathematical concepts through authentic representations of Papuan cultural heritage.

Compared with many Indonesian batik traditions, Ganasan Batik exhibits distinctive visual characteristics through its use of stylized bird-of-paradise silhouettes, Asmat-inspired carving lines, tifa and honai forms, and sago-leaf patterns arranged in repeated geometric compositions. While many classical Javanese batik traditions also incorporate geometric motifs, Ganasan Batik places stronger visual emphasis on repeated triangular, radial, and tessellating arrangements, making mathematical concepts such as symmetry, tessellation, and geometric transformations more readily observable within the pattern structure. These characteristics do not imply that Ganasan Batik is mathematically richer than other batik traditions; rather, they highlight its particular potential as a contextual resource for mathematics learning, where geometric relationships can be identified and explored directly through culturally meaningful visual representations. Overall, this study confirms that Papua's Ganasan Batik from Mimika Regency possesses substantial ethnomathematical potential that can enrich mathematics education. The embedded mathematical concepts—including plane geometry, symmetry, geometric transformations, tessellation, similarity, congruence, ratio, proportion, periodic patterns, and spatial reasoning—provide meaningful contexts for teaching mathematics while preserving indigenous cultural values. Integrating Papua's Ganasan Batik into mathematics instruction not only promotes students' conceptual understanding and mathematical literacy but also strengthens cultural identity and appreciation for Papuan heritage. Furthermore, these findings provide a foundation for developing culturally responsive teaching materials, learning media, and instructional designs that bridge formal mathematics with authentic cultural experiences, making mathematics learning more meaningful, reflective, and socially relevant.

4. CONCLUSION

The findings of this study demonstrate that Papua's Ganasan Batik motifs from Mimika Regency embody a wide range of ethnomathematical concepts reflected in their visual structures, spatial organization, repetitive patterns, and geometric forms. The identified mathematical elements include plane partitioning, geometric shapes, line symmetry, geometric transformations (translation, reflection, rotation, and dilation), tessellation, ratio and proportion, periodic patterns, similarity, congruence, and asymmetrical visual balance. These concepts emerge naturally through the traditional batik-making practices of the Amungme and Kamoro communities, where mathematical knowledge is intuitively developed through cultural experience and transmitted across generations. The three batik motifs analyzed exhibit consistent geometric structures and systematic pattern repetition, demonstrating the integration of mathematical reasoning within Papuan artistic traditions. Cultural motifs such as the bird-of-paradise, Asmat carvings, tifa drums, honai traditional houses, sago leaves, and indigenous ornaments illustrate the application of geometric transformations, proportional relationships, tessellation, and spatial organization. These findings confirm that Papua's Ganasan Batik represents not only an important cultural heritage but also a valuable source of mathematical knowledge relevant to formal education. Furthermore, the study indicates that Papua's Ganasan Batik has strong potential as a culturally responsive mathematics learning resource, particularly for teaching geometry, geometric transformations, symmetry, tessellation, similarity, ratio and proportion, and spatial reasoning at the elementary and junior secondary levels. Integrating Papuan cultural heritage into mathematics instruction can enhance students' conceptual understanding, mathematical literacy, cultural awareness, and appreciation of local traditions while creating more meaningful, contextual, and culturally relevant learning experiences. The findings of this study have practical implications for mathematics education by demonstrating the potential of Ganasan Batik motifs as culturally meaningful contexts for ethnomathematics-based learning. The identified geometric concepts may serve as references for developing instructional resources, including student worksheets, classroom activities, and thematic learning modules that integrate local cultural knowledge with geometry topics in elementary and junior secondary education. Such learning resources could encourage students to explore mathematical ideas, including symmetry, tessellation, and geometric transformations, through authentic cultural contexts while fostering appreciation of Papuan cultural heritage. Future research is recommended to design, implement, and empirically evaluate these instructional materials in classroom settings to examine their effectiveness in enhancing students' mathematical understanding, engagement, and cultural awareness.

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