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# Unveiling the Geometry of Culture: An Ethnomathematical Exploration of Transformation Geometry in Cimahi Batik Motifs

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**Abstract:** Mathematics played an essential role in daily life. However, mathematics learning in schools was often less connected to students' real-life contexts, so many of them struggle to understand mathematical concepts. Relating mathematics to everyday life was necessary for students to understand its relevance and benefits. This research aimed to explore the cultural values and concepts of transformation geometry embedded in Cimahi batik motifs. The method used in this study was ethnographic, with the research conducted in Lembur Batik, Cimahi, West Java, Indonesia. The research framework in ethnomathematics adopted four key questions to inform the framework used to facilitate research, “Where should observations be made from?, "How is the observation process carried out?” "What are the results of these observations?", and “What is the meaning of it?. The investigator served as the instrument in the data-gathering process and used triangulation involving interviews, observations, and literature review. Analysis occurred in three stages: data condensation, data display, and drawing of conclusion. The study found that Cimahi batik motifs embody cultural values that reflect the identity of the Cimahi community. Moreover, these motifs employed concepts of transformation geometry, such as translation, reflection, rotation, and dilation. The distinctive feature of these findings is the association between the motif beauty of Cimahi batik and the use of transformation-geometry concepts derived from local culture. This is what makes the batik motif from Cimahi a valuable context for learning mathematics, particularly geometry. This has significant implications for the growth of ethnomathematics, as it means that geometrical concepts can be incorporated into local cultural frameworks within situational mathematics learning grounded in indigenous cultural knowledge.

**Keywords:** culture, transformation geometry, ethnomathematics, Cimahi batik motif.

## ▪ INTRODUCTION

Mathematics is a subject taught at all stages of education because it is vital and relevant across various aspects of daily life (Golding, 2018; Howker & Black, 2025; Murphy & Ingram, 2023). As a product of human thought, mathematics is inseparable from the cultural influences in which humans live and develop (Batiibwe, 2024; Suherman & Vidákovich, 2025; Sunzuma & Umbara, 2025; Utami et al., 2020). There are numerous problems with mathematics learning in Indonesia, particularly in making the subject engaging and accessible to students. Traditional approaches often fail to connect with students' daily lives, leading them to perceive mathematics as abstract and complex (Tanujaya et al., 2017). Mathematics is often taught formally, with standard rules, and is considered rigid, thereby making it independent of the community's socio-cultural context (Brianza et al., 2024; Clivaz & Miyakawa, 2020; Di Martino et al., 2023; Thomas et al., 2024). Hence, learning mathematics is not a process of transferring information, but rather an experience in which material is not deeply remembered, and students do not even realize the application of mathematics in their daily lives (Prahmana et al., 2021). The absence of cultural context in mathematics learning also affects students'

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motivation and achievement levels in the field (Budiharso & Tarman, 2020; Meng & Liu, 2022; Suh et al., 2025).

To solve problems in mathematics learning, there should be a link between math content and students' daily lives. One way to make mathematics more useful and meaningful for students is to ask them to seek out experts in mathematics within their cultural environment (Batiibwe, 2024; Pratama & Yelken, 2024; Suherman & Vidákovich, 2025). A possible source of relevant and motivating educational material could be found in the students' everyday life -in local culture- which represents a potential resource to understand, see, and observe procedures related to mathematics taught at school. Math that belongs to students' culture and experiences is better understood by them (Pratama & Yelken, 2024). Unfortunately, the way mathematics is taught in Indonesia is currently heavily influenced by other countries. Simultaneously, this rich local cultural heritage can be used to teach in ways that make learning more contextualized and experience-based for students.

Ethnomathematics is a response to the way mathematics education was overly focused on content and ignored the cultural aspects of students' lives. Ethnomathematics can be implemented differently in the learning process depending on students' cultural backgrounds (Mania & Alam, 2021; Suh & Calabrese, 2025). According to Prahmana (2022), ethnomathematics plays a significant role in connecting formal mathematics with students' real-life situations. By drawing on the cultural values and practices that constitute society, teachers and students can construct conceptions of mathematics as ideas, ways of thinking, and activities valued within social life. The incorporation of culture into the teaching and learning of mathematics can enhance students' learning experiences and reduce unsatisfactory learning practices (Rezeki et al., 2021; Shultz et al., 2024).

Batik is a symbol of cultural identity that plays a significant role in the daily lives of Indonesians and in ceremonial events. The government of Indonesia announced October 2 as International Batik Day in Batik's Indonesian home base, a designation that has been held annually ever since. This statement demonstrates deep respect for batik as a heritage to be maintained and preserved (Budi et al., 2024; Krisnawati et al., 2019). Besides contributing to the culture, the batik motif is associated with the geometric concept of transformation, as it involves a pattern that is regularly repeated (Prahmana & D'Ambrosio, 2020).

A few other studies have conducted ethnomathematical explorations of different batiks in Indonesia. Fakhriyah et al. (2025) found that Sidomukti Batik is a potential medium for learning concepts in geometric transformations, plane geometry, and congruence and perpendicularity. Nurcahyo et al. (2024) found that Truntum Batik embodies the ideas of geometric transformation, line connection, and planar geometry. Uula et al. (2024) found that Sidomulyo Batik involves the notions of transformation geometry, plane geometry, and congruence. According to Fauziah et al. (2025), the content of geometric transformation, plane geometry, and similarity and congruence can be found in a Kopi Pecah Batik. Prahmana and D'Ambrosio (2020) found that Yogyakarta Batik employs concepts of geometric transformation, plane geometry, and tessellation. Faiziyah et al. (2021) found that Solo Batik features geometric transformations, line relationships, and tessellation. Khasanah et al. (2025) identified that Javanese Batik includes numerical patterns. Jaya et al. (2021) found that the pattern of Central Sulawesi

Batik exhibits fractal and geometric transformations. This series of studies shows that Indonesian batik colour mathematics has rich geometric concepts. These studies also imply that Indonesian batik motifs are full of mathematical ideas, especially geometry. Not only do the results of this study indicate that batik has potential cultural value in mathematics learning (by transforming abstract concepts into concrete experience and engaging students), but it also emphasizes its cultural significance in education. Unfortunately, to date, no research has been conducted on Cimahi batik, so this study can complement similar research elsewhere and deepen the understanding of ethnomathematics in Indonesian batik. Exploration of Cimahi Batik offers a new perspective, as its motifs are rooted in five main themes: Cireundeu, Ciawitali, Pusdik, Curug Cimahi, and Kujang, each representing the city's geographical, social, and cultural characteristics. This diversity of themes creates motifs distinct from other regional batiks, as they combine natural elements, local wisdom, and Cimahi's distinctive military identity. Thus, this study broadens the understanding of the concept of geometry and the cultural values contextually manifested in batik motifs.

Cimahi has a unique and interesting standard batik, but it is not as famous as that of other regions. This batik pattern was created based on the train of thought of Atty Suharti, the wife of deceased Cimahi Mayor Itoc Tochija and former Chairperson of the Cimahi City Regional National Craft Council (Dekranasda). As the Chairperson of Dekranasda, Atty Suharti began to design batik motifs that represent Cimahi’s identity. She organized a gathering with village elders and community leaders to develop the batik designs, drawing inspiration from the region’s rich culture and history. The motifs of Cimahi batik differ from those of other regional batiks to emphasize the local uniqueness and characteristics of Cimahi City. From this formulation, 5 Cimahi batik motifs were obtained: Cireundeu, Ciawitali, Pusdik, Curug Cimahi, and Kujang, which were officially introduced in mid-2009 to coincide with the 8th Anniversary of the City of Cimahi (Hafiar et al., 2019). Cimahi batik is also worn in school uniforms, in government office attire, and as guest gifts. This also makes it better known to modern people, not only as a symbol of regional native identity but also as a cultural legacy to be preserved.

The characteristics of ethnomathematical research tend to vary across regions, as they are directly influenced by the local culture that underlies them. Cimahi batik designs are inspired by local culture, tradition, and identity. The study found that the outputs can be implemented in schools to help students understand transformation geometry concretely through batik motifs related to local culture. Batik motifs serve as a bridge between real-life experiences and abstract concepts, making it easier for students to grasp the material, relate it to their everyday lives, and preserve the nation's cultural heritage. In addition, this research contributes to enriching the treasures of mathematical and cultural knowledge, especially in the context of ethnomathematics. These results can serve as a foundation for related research on the connection between culture and mathematics, as well as a guide to the development of contextual mathematics learning. Therefore, the questions in this research are (1) What cultural values are contained in Cimahi batik motifs? Furthermore, (2) What type of transformation geometry is contained in Cimahi batik motifs?

## ▪ METHOD

### Participants

The participants in this study were Mr. Triwanto Mardi and Ms. Fauziyah Silmi from the Lembur Batik Cimahi Gallery located on Jl. Bumi Prima Block N/12, Cimahi, West Java, Indonesia, and Ms. Midjiati Ningsih, Chairperson of the Cimahi City Dekranasda, whose office is located on the 1st floor of the BITC Building, Baros, Cimahi, West Java, Indonesia. Mr. Triwanto Mardi is a craftsman and gallery owner, while Ms. Fauziyah Silmi acts as the gallery administrator. Ms. Midjiati Ningsih plays an active role in strengthening Cimahi batik's position as a cultural identity and a product of the regional creative economy. The research location was selected through purposive sampling because the Lembur Batik Cimahi Gallery is well known to the public and has a comprehensive collection of Cimahi batik. In contrast, Dekranasda Cimahi has a strategic contribution to the development of local batik. Before data collection, the researcher explained the purpose of the research and obtained permission from the gallery and the participants.

### Research Design and Procedures

This study uses ethnographic methods. The selection of this method is based on its suitability for the primary purpose of ethnomathematical research: examining the mathematical ideas contained in a culture. Through this method, researchers can study how the concepts of transformation geometry are integrated in Cimahi batik motifs. The ethnographic method allows researchers to analyze cultural practices directly. The primary purpose of this method is to study and describe a culture that emerged in a particular group of people (Nastasi, 2022).

This research refers to the ethnomathematical research framework developed by Alangui (Purniati et al., 2022). This is the basis for understanding the relationship between local cultural practices and mathematical concepts. The framework is presented in Table 1.

**Table 1.** Framework of ethnomathematics research

| Basic Question | Preliminary Answer | Key Point | Certain Activities |
|---|---|---|---|
| Where should observations be made from? | Cimahi batik motifs are one of the cultural practices that reflect the presence of mathematical practices. | Culture | Conducting interviews with batik artisans to gather information related to Cimahi batik motifs. |
| How is the observation process carried out? | Investigating the relationship between Cimahi batik motifs and the mathematical concepts contained therein. | Another way of thinking | Identifying the ideas contained in Cimahi batik motifs related to mathematical practices. |
| What are the results of these observations? | The results of the alternative thinking process that has been carried out previously. | Philosophy of mathematics | Identifying the characteristics of Cimahi batik motifs related to mathematical practices. This indicates that the motifs |

| | | | |
|---|---|---|---|
| | | | contain mathematical characteristics. |
| What is the meaning of it? | The critical role of mathematics and culture. | Anthropology | Explain the relationship between mathematical concepts and cultural elements reflected in Cimahi batik motifs. Describe the application of mathematical concepts integrated into these batik motifs. |

Table 1 shows how each question within the ethnomathematics framework operationally guides the research steps. The question "Where should observations be made from?" was answered through interviews with informants familiar with Cimahi batik motifs. "How is the observation process carried out?" was conducted by observing and analyzing geometric patterns in the batik motifs. "What are the results of these observations?" was implemented through identifying the characteristics of batik motifs that contain mathematical concepts. Meanwhile, "What is the meaning of it?" was realized through an analysis of the relationship between cultural values and the mathematical concepts found.

To ensure data validity, this study uses a triangulation approach that integrates interviews, observations, and literature reviews. Interviews were conducted with a craftsman, and also gallery owner, a gallery administrator, and the Chairperson of Dekranasda. They explained the history and cultural values of Cimahi batik, as well as the process of creating the motifs. The prepared interview transcripts were reconfirmed with participants to ensure data accuracy through member checking. Observations were made by directly observing Cimahi batik motifs in the gallery, which applies the concept of transformation geometry, namely translation, reflection, rotation, and dilation. To complement data collection, literature studies on motifs of Cimahi batik were also used as supporting instruments in this study.

**Instrument**

The primary instrument of data collection in this research is the researcher, who is an active part of the process. Additionally, interview guidelines and observation guidelines are used as subsidiary tools in this study. An interview guide was used to gather information about the history of Cimahi Batik, the cultural values inherent in each motif, and the process of its creation. The interviews were semi-structured, allowing researchers to flexibly develop questions based on the context and flow of the field conversation. The observation guide is used to identify Cimahi Batik motifs that embody the concept of transformation geometry, including translation, reflection, rotation, and dilation.

**Data Analysis**

The data analysis in this study consists of three continuous stages: data reduction, data display, and conclusion (Miles et al., 2014). The data reduction stage involved selecting batik motifs that demonstrate changes in position, direction, or size related to the concepts of transformation geometry, such as translation, reflection, rotation, and dilation. Based on observations of Cimahi batik motifs, comprising five main themes, eleven motifs were selected for further analysis. The selection was made by considering

the representation of each theme and the clarity of the display of the types of transformation geometry found in the batik motifs, including translation, reflection, rotation, and dilation. The selected batik motifs visually demonstrate the types of transformation geometry and represent the five themes of Cimahi batik motifs. Several motifs were not selected because they did not clearly display the types of transformation geometry. Thus, the eleven selected motifs are considered representative of the concept of transformation geometry in Cimahi batik motifs. The data display stage includes an explanation of the cultural values of batik motifs and the applied transformational geometry concepts. Next, the conclusion stage is carried out based on the analysis of the relationship between Cimahi batik motifs and the identified transformation geometry concepts. The flowchart shown in Figure 1 visually depicts the methodological steps of this research.

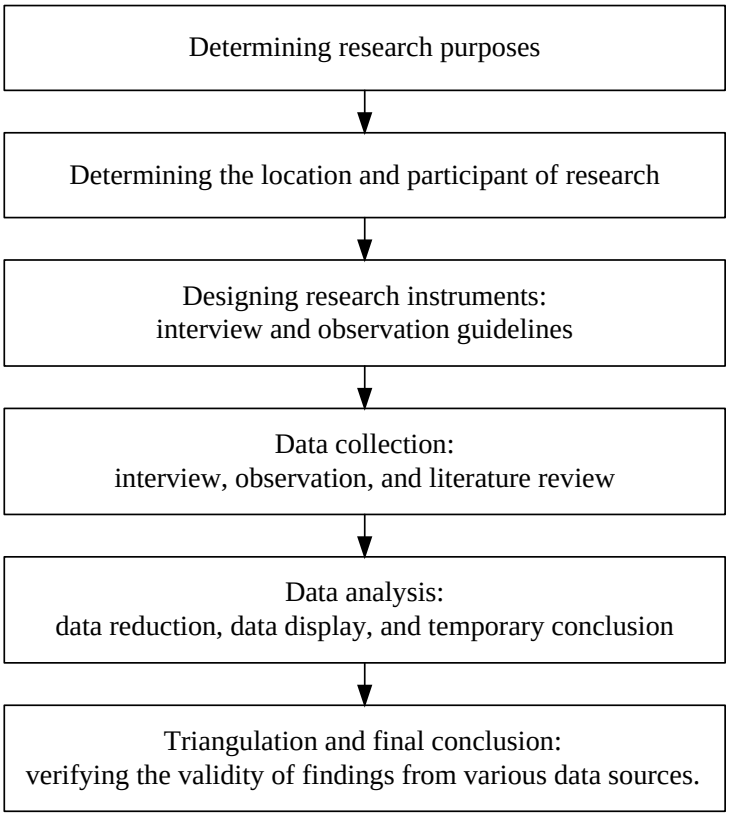



**Figure 1.** Research flow chart

## ▪ RESULT AND DISSCUSSION

The findings from ethnomathematics about the motifs of Cimahi batik indicate that they embody local cultural values and are based on transformation geometry in their application. These batik designs are the identity and cultural wealth of Cimahi City. Five main motifs, namely Cireundeu, Ciawitali, Pusdik, Curug Cimahi, and Kujang, are explicitly studied in this research because they have cultural significance and employ transformation geometry, such as translation, reflection, rotation, and dilation.

Interviews revealed that the batik produced is stamped batik, meaning it is created by repeatedly stamping the core motif onto the fabric. This process demands high

precision, as each stamp must be precise to ensure the resulting pattern remains regular and even. This uniformity and repetition reflect the application of the concept of transformation geometry, even though it is not done consciously or based on formal knowledge. As artisans, they rely on their artistic instincts to maintain the motif's beauty through symmetry, balance, and order. Therefore, mathematical patterns such as translation, reflection, rotation, and dilation that appear in the motif have no specific meaning; instead, they emerge as part of the artistic and aesthetic process of batik-making, not because of any specific rules.

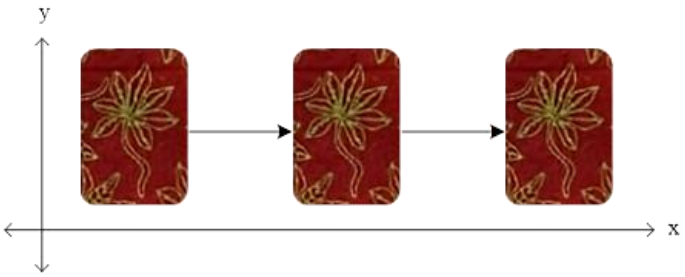
**Cireundeu Batik Motif**

The following is an excerpt from an interview with Mr. Triwanto Mardi regarding the cultural values of Cireundeu batik motifs.

R : Can you explain what cultural values are contained in the Cireundeu Batik motif?
TM : The Cireundeu Traditional Village inspires the Cireundeu motif in Leuwigajah. The local people have long relied on cassava as a staple food. Therefore, the motifs often feature cassava leaves and tubers, symbolizing food security and the local wisdom of the indigenous people.

The Cireundeu batik motif not only carries cultural values but also employs the concept of transformation geometry. Figure 2 shows that the Daun Singkong batik motifs undergo a shift. Therefore, mathematically, the Daun Singkong batik motif involves a single type of transformation geometry, namely translation, as illustrated in Figure 3. Meanwhile, Figure 4 shows that the Daun Singkong Kecil batik motifs undergo a shift and rotation around a specific point. Therefore, mathematically, the Daun Singkong Kecil batik motif involves two types of geometric transformations: translation and rotation. Rotations occur by 0°, 90°, 180°, and 270° around the center point (0,0), as illustrated in Figure 5.

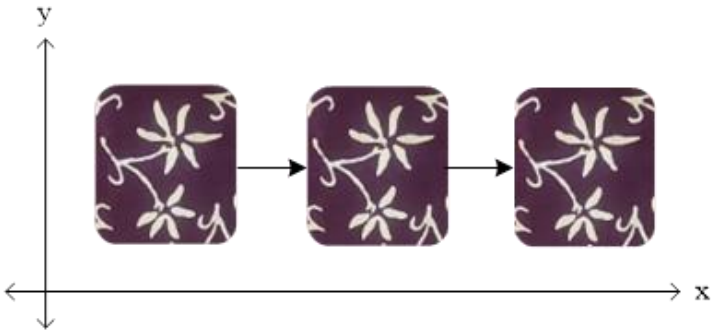
**Figure 2.** Cassava leaf batik motif



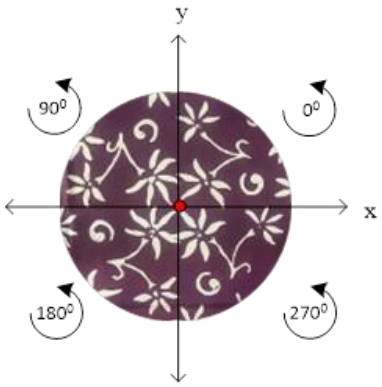

Translation

**Figure 3.** Transformation geometry in daun singkong batik motif

**Figure 4.** Small cassava leaves batik motif




Translation




Rotation

**Figure 5.** Transformation geometry in daun singkong kecil batik motif

**Ciawitali Batik Motif**

The following is an excerpt from an interview regarding the cultural values of Ciawitali batik motifs with Mr. Triwanto Mardi.

R : Can you explain what cultural values are contained in the Ciawitali Batik motif?
TM : The Ciawitali motif originates in Ciawitali Village in North Cimahi, once known for its bamboo forests. Therefore, this motif is created using the shapes of bamboo leaves and stems to represent the natural richness and balance maintained by the local community.

The Ciawitali batik motif not only carries cultural values but also employs the concept of transformation geometry. Figure 6 shows that the Bambu Anyam batik motifs appear to shift. So, mathematically, the Bambu Anyam batik motif exhibits a transformation geometry, namely translation, as shown in Figure 7. Meanwhile, the Bambu Angklung batik motifs are shifted as seen in Figure 8. Consequently, mathematically, the batik motif itself, Bambu Angklung, is a type of transformation geometry image that only has one type, namely translation, as shown in Figure 9.

**Figure 6.** Bambu anyam batik motif


Translation

**Figure 7.** Transformation geometry in Bambu anyam batik motif

**Figure 8.** Bambu angklung batik motif


Translation

**Figure 9.** Transformation geometry in bambu angklung batik motif

**Pusdik Batik Motif**

The following is an excerpt from an interview with Mr. Triwanto Mardi regarding the cultural values of Pusdik batik motifs.

R : Can you explain what cultural values are contained in the Pusdik Batik motif?
TM : The Pusdik motif was created because Cimahi is home to numerous military education centers. These institutions lend the city a strong identity. Therefore, the motif features images depicting military education activities, symbolizing Cimahi's identity as a military city.

The Pusdik batik motif not only carries cultural values but also employs the concept of transformation geometry. Figure 10: The Tank batik motifs undergo a shift, a reflection, a rotation around a specific point, and a change in size. Therefore, mathematically, the Tank batik motif involves four types of geometric transformations: translation, reflection, rotation, and dilation. Rotations occur by 180° around the center point (0,0), as illustrated in Figure 11. Meanwhile, Figure 12 shows that the Peluru dan Roda Tank batik motifs shift and rotate around a specific point. Therefore, mathematically, the Peluru dan Roda Tank batik motif involves two types of geometric transformations: translation and rotation. Rotations occur by 0°, 90°, 180°, and 270° around the center point (0,0), as illustrated in Figure 13.

**Figure 10.** Tank batik motif

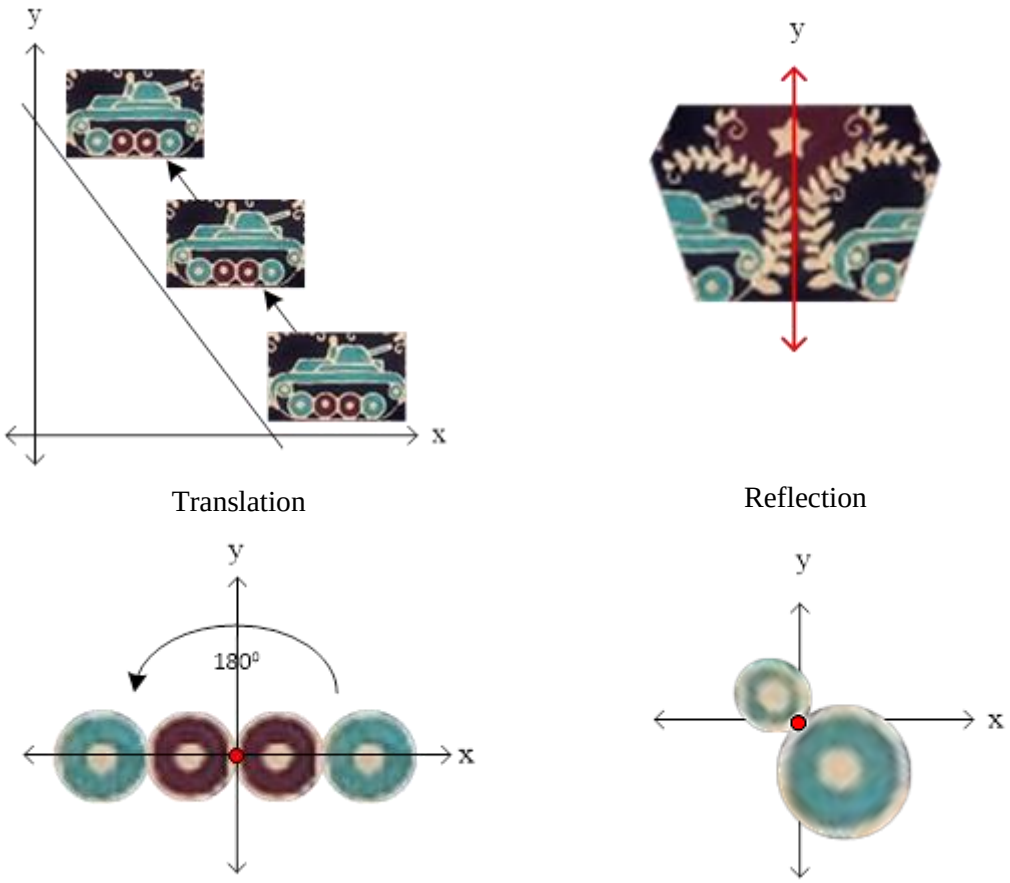



**Figure 11.** Transformation geometry in the tank batik motif

**Figure 12.** Peluru and roda tank batik motif

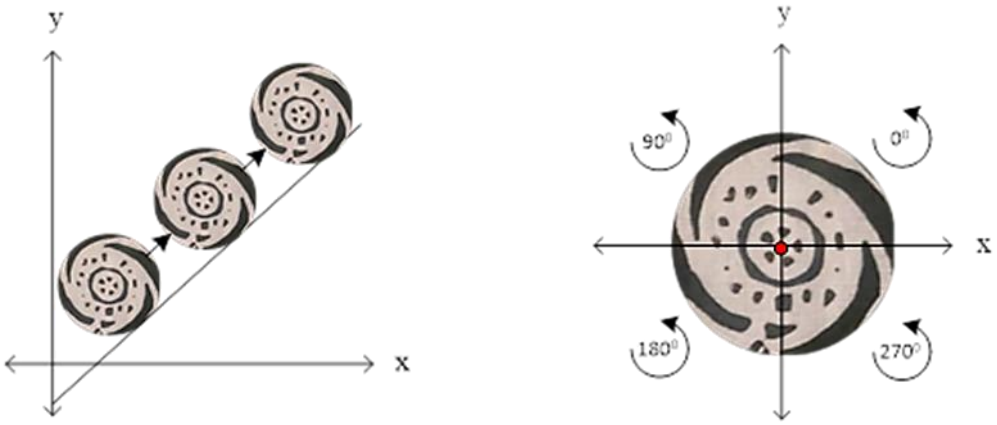



**Figure 13.** Transformation geometry in peluru and roda tank batik motif

**Curug Cimahi Batik Motif**

The following is an excerpt from an interview with Mr. Triwanto Mardi regarding the cultural values of Curug Cimahi batik motifs.

R : Can you explain what cultural values are contained in the Curug Cimahi Batik motif?

TM : The Curug Cimahi motif is taken from a waterfall that has long been a source of pride for the people of Cimahi. Although now located in West Bandung, residents still view it as an icon of Cimahi. Therefore, the motif depicts a waterfall to reflect the area's natural beauty.

The Curug Cimahi batik motif not only carries cultural values but also employs the concept of transformation geometry. Figure 14 shows that the Curug Cimahi batik motifs undergo a shift. Therefore, mathematically, the Curug Cimahi batik motif involves a single type of transformation geometry, namely translation, as illustrated in Figure 15.

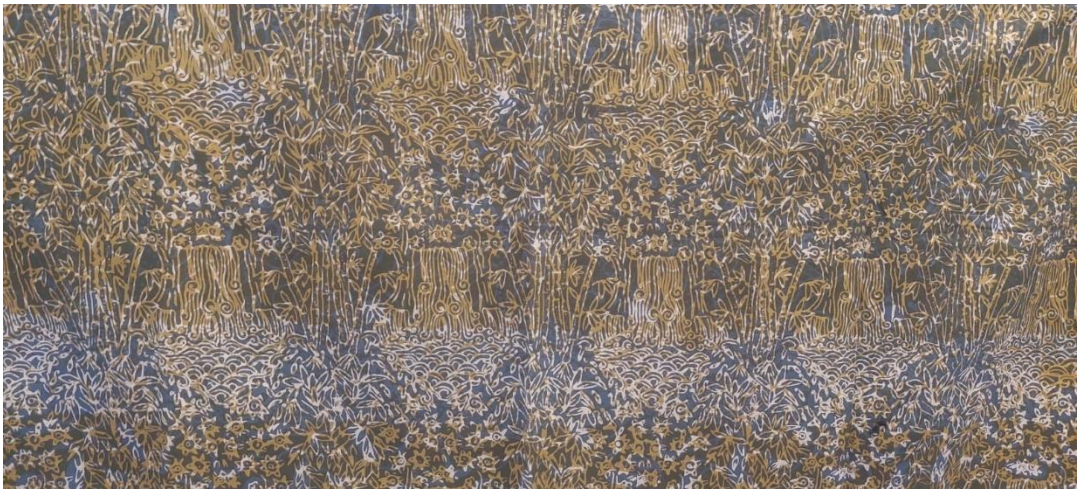
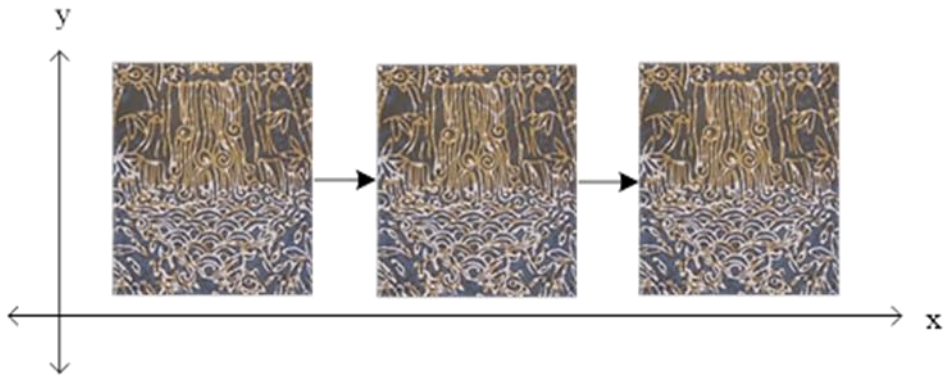


**Figure 14.** Curug Cimahi batik motif




Translation

**Figure 15.** Transformation geometry in the curug Cimahi batik motif

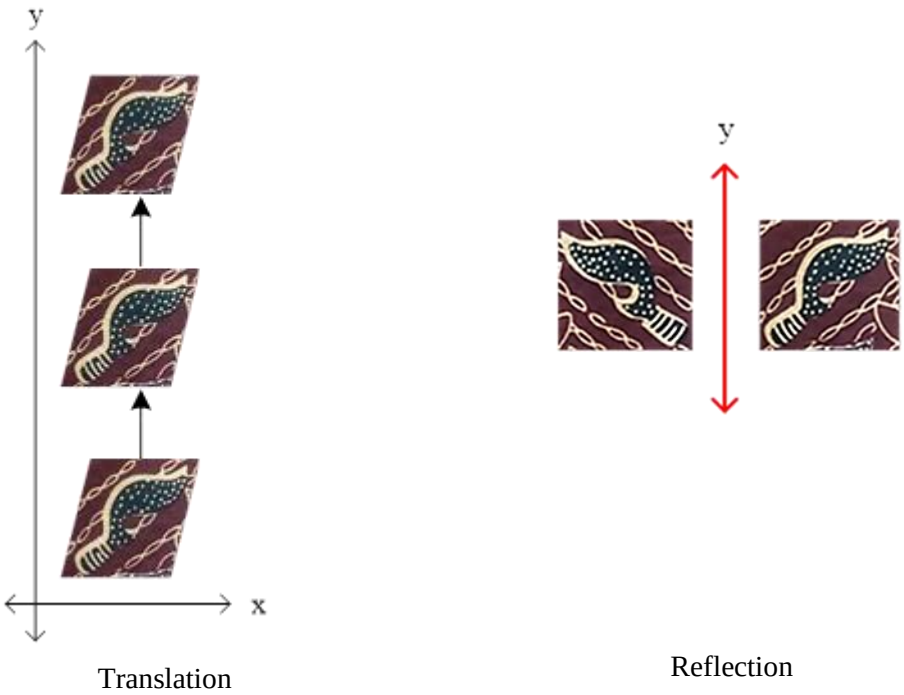
**Kujang Batik Motif**

The following is an excerpt from an interview with Mr. Triwanto Mardi on the cultural values of Kujang batik motifs.

R : Can you explain which cultural values are represented in the Kujang Batik motif?
TM : The kujang motif is taken from a traditional West Javanese weapon. This demonstrates Cimahi's deep ties to Sundanese culture. Cimahi batik features two patterns featuring the kujang: Rereng Kujang and Kujang Cakra. Both depict the kujang as a symbol of Sundanese cultural identity.

The kujang batik motif not only carries cultural values but also employs the concept of transformation geometry. Figure 16 shows that the Rereng Kujang batik motifs undergo a shift and a reflection. Therefore, mathematically, the Rereng Kujang batik motif involves two types of geometric transformations: translation and reflection, as illustrated in Figure 17. Meanwhile, Figure 18 shows that the Kujang Cakra batik motifs undergo a shift, a reflection, a rotation around a specific point, and a change in size. Therefore, mathematically, the Kujang Cakra batik motif involves four types of transformations: translation, reflection, rotation, and dilation. Rotations occur by 0°, 90°, 180°, and 270° around the center point (0,0), as illustrated in Figure 19.

**Figure 16.** Rereng kujang batik motif




Translation Reflection

**Figure 17.** Transformation geometri in rereng kujang batik motif

**Figure 18.** Kujang cakra batik motif

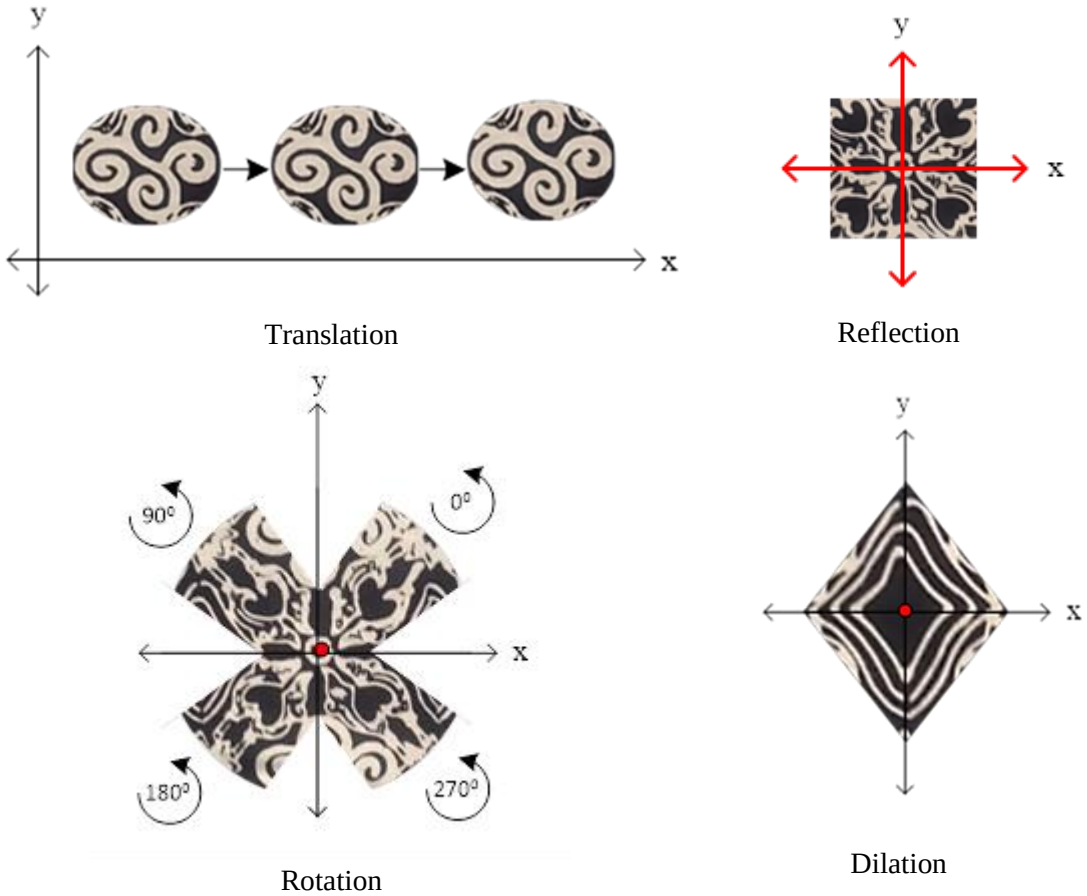



**Figure 19.** Transformation geometry in the kujang cakra batik motif

**Mixed Batik Motif**

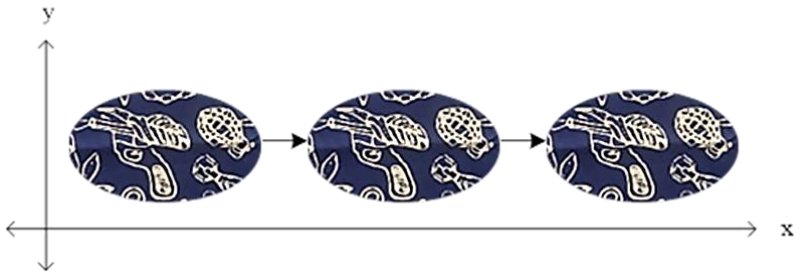
The following is an excerpt from an interview with Mr. Triwanto Mardi regarding the cultural values of mixed batik motifs.

R : Can you explain what cultural values are contained in the mixed Batik motif?

TM : This mixed motif is created by combining several typical Cimahi motifs into one pattern. The goal is to demonstrate diversity while maintaining harmony. Thus, through this motif, Cimahi is depicted as a city rich in cultural values and characters.

The mixed batik motif not only carries cultural values but also employs the concept of transformation geometry. Figure 20 shows that the Pistol, Granat, and Daun Singkong batik motifs undergo a shift. Therefore, mathematically, the Pistol, Granat, and Daun Singkong batik motifs involve a single type of transformation, namely translation, as shown in Figure 21. Meanwhile, Figure 22 shows that the Daun Singkong and Kujang batik motifs undergo a shift. Therefore, mathematically, the Pistol, Granat, and Daun Singkong batik motifs involve a single type of transformation, namely translation, as illustrated in Figure 23.

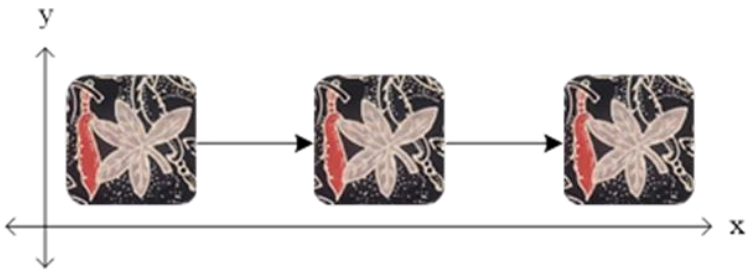
**Figure 20.** Pistol, granat, and daun singkong batik motif




Translation

**Figure 21.** Transformation geometry in pistol, granat, and daun singkong batik motif

**Figure 22.** Daun singkong and kujang batik motif




Translation

**Figure 23.** Transformation geometry in daun singkong and kujang batik motif

All motifs are not only beautiful but also have the value of local culture, representing the identity and wisdom of Cimahi society. Furthermore, the Cimahi motifs of batik also include geometric transformation concepts such as reflections, translations, rotations, and dilations. The use of transformation geometry in Cimahi batik motifs demonstrates that craftsmen employed mathematics in creating patterns and motifs. Therefore, the results of this study are not only beneficial for deepening our understanding of mathematics and culture, but also useful as a reference for developing context-based mathematics learning materials grounded in local culture, especially Cimahi culture.

Cimahi batik motifs have cultural significance and can be integrated into the teaching and learning of mathematics to help students experience a close relationship among themselves as learners, their environment, and their own culture. The infusion of those social values not only maintains cultural heritage but also plays an important role in building students' character (Sakti et al., 2024). Students can value and respect their own culture when they understand its values (Öztürk & Akcil, 2022). They can also love their culture by fostering a sense of pride and actively participating in its preservation (Abidin et al., 2023; Khasanah et al., 2025). Character education integrated into culture becomes more relevant and easier to understand when tailored to students' backgrounds. Thus, the nation's cultural identity can be strengthened by using batik as a teaching resource in mathematics.

Geometry is a branch of mathematics that is significant and relevant to everyday life (Jablonski & Ludwig, 2023). However, many students in Indonesia struggle to learn geometry (Adha et al., 2024; Baidowi & Alsulami, 2025; Purniati et al., 2022). This difficulty is generally caused by the presentation of material that is abstract and less closely tied to students' cultural context or environment (Zainovi et al., 2025). Geometry is closely tied to culture, and students' cultural backgrounds should be taken into account when teaching geometry in schools (Sunzuma & Maharaj, 2019). One way to implement this is by using batik motifs, an Indonesian cultural heritage rich in geometric concepts. Through this integration, students will gain a deeper understanding of geometric concepts in a real-world context.

Some mathematicians have studied batik motifs to teach geometry. The study concluded that integrating batik motifs could enhance students' mathematical skills. Some of them are improving critical thinking ability (Cahyadi et al., 2025), mathematical reasoning skills (Andriyani et al., 2024), mathematical conceptual understanding skills (Andriani & Septiani, 2020), creative thinking skills (Asiatun et al., 2019; Faiziyah et al., 2020), mathematical literacy (Kholid & Husodo, 2025), and mathematical problem-solving skills (Adinata et al., 2019). The batik motifs serve as a representation to help students comprehend the abstract idea of geometry. Cimahi batik motifs have a wealth of patterns that reflect various geometric concepts. Thus, the Cimahi batik motifs can be used in mathematics instruction, especially geometry, to improve students' mathematical skills and strengthen the relationship between mathematics and cultural values.

Every culture has its own mathematics, and its environmental culture influences what is created in relation to the adoption and expansion of mathematical ideas. This aligns with D'Ambrosio's view (Fernandes et al., 2023) that everyone has a distinct mathematics, different from others', because it merges with the culture they are part of. In this sense, batik workers enrich mathematics with their products in the form of batik

motifs. These motifs are not only attractive, but also apply geometric concepts. So, batik motifs are a concrete example of the presence of Mathematics in daily life and are melded with culture. These motifs are also an amalgamation of how aesthetics meets mathematical intelligence, a development that occurred locally.

Mathematics cannot be separated from culture, as it is closely related to everyday life and develops from human responses to events in their environment (Batiibwe, 2024). Therefore, the development of the mathematics curriculum should consider the alignment between mathematics content and cultural context (Lidinillah et al., 2022). Teachers are expected to understand students' cultural backgrounds to integrate these elements into the mathematics learning process (Harding-DeKam, 2014; Suh & Calabrese, 2025; Thomas et al., 2024). The application of ethnomathematics to learning helps students more easily understand mathematical material while also gaining an understanding of and appreciation for their own culture (Suh & Calabrese, 2025). Batik holds a significant place in the daily lives of Indonesians and is commonly worn in a wide range of activities, whether formal or informal.

The goal of ethnomathematics is to connect mathematical concepts to real-life contexts, making learning more relevant and meaningful for students (Batiibwe, 2024; Pathuddin et al., 2021; Suherman & Vidákovich, 2025; Sunzuma & Umbara, 2025). In this case, the learning of transformation geometry can be contextualized through the use of Cimahi batik motifs that represent various transformations, such as translation, reflection, rotation, and dilation. Table 2 shows the cultural values and the types of transformation geometry in the Cimahi batik motif.

**Table 2.** The cultural values and the types of transformation geometry in cimahi batik motifs

| Motif Name | Cultural Values | Types of Transformation Geometry | Dominant Type of Transformation Geometry |
|---|---|---|---|
| Cireundeu | Food security and local wisdom | Translation, rotation | Translation |
| Ciawitali | The wealth of nature and the balance of the environment | Translation | Translation |
| Pusdik | Cimahi City is a military city | Translation, reflection, rotation, dilation | Translation, rotation |
| Curug Cimahi | The beauty of nature | Translation | Translation |
| Kujang | Sundanese cultural identity | Translation, reflection, rotation, dilation | Translation, reflection, |
| Mixed | Diversity and harmony | Translation | Translation |

The different types of geometric transformations in various Cimahi batik motifs can serve as a basis for developing systematic, tiered learning materials for mathematics instruction in schools. Motifs with simple translations can be used in the initial stages to introduce the concept of shape transfer without changing size. Motifs with reflections can be used to introduce the concept of mirroring a shape against a specific line without changing its size or shape, but by producing a change in direction. Motifs with rotations can be used to introduce the concept of rotating a shape around a specific point at a

specific angle without changing its size or shape. Motifs with dilations can be used to introduce the concept of changing a shape's size while maintaining its similarity. Through this sequence of learning based on the complexity of transformations, teachers can guide students from a concrete understanding to an abstract understanding of the geometric concept of transformation. Activities such as identifying the types of transformations in motifs or designing new motifs by combining transformations can strengthen conceptual understanding while fostering an appreciation of local cultural values.

This research was conducted at the Cimahi Batik Lembur, which has a complete collection of typical Cimahi batik motifs. However, to obtain a broader range of motifs, further research is recommended in several other galleries. Cimahi batik motifs have great potential as a context for learning the concept of transformation geometry, so teachers need to understand the cultural meaning embedded in the motifs and relate them to abstract geometric concepts. In the learning process, teachers need to provide contextual, inclusive explanations so that students from diverse cultural backgrounds can understand and appreciate the local cultural values that underlie the Cimahi batik motif, thereby making learning more meaningful and fostering a love for the nation's cultural heritage.

## ▪ CONCLUSION

This research makes a specific and original contribution by uncovering the relationship between the cultural values of Cimahi batik motifs and the concept of transformation geometry. These findings enrich the study of ethnomathematics in local contexts and open up opportunities to integrate mathematics learning with regional cultural wisdom. Cimahi batik motifs, namely Cireundeu, Ciawitali, Pusdik, Curug Cimahi, and Kujang, embody cultural values that reflect the identity of the people of Cimahi City. The Cirendeu pattern tells about food security and local wisdom. The Ciawitali emblem symbolises the wealth of nature and balance with the environment. The primary reason is that Cimahi City is a military city. The Cimahi Waterfall motif symbolizes the beauty of nature. Meanwhile, the kujang motif represents an important aspect of Sundanese cultural identity. Besides being rich in cultural values, these batik motifs also incorporate the concept of transformation geometry, including translation, reflection, rotation, and dilation. This demonstrates that Cimahi batik artisans have indirectly incorporated the concept of transformation geometry into their design process. From an educational viewpoint, concrete examples are still needed for 9th-grade junior high school students to understand abstractions of mathematical concepts. Therefore, batik motifs closely tied to their lives can serve as a bridge to geometry learning, making Cimahi batik motifs a potentially relevant and contextual learning resource at the junior high level. This research is an initial contribution to the development of ethnomathematical studies in Indonesia. Further research could be conducted through quasi-experiments to compare culture-based learning using Cimahi batik motifs with conventional learning, and to explore batik motifs from various regions to enrich ethnomathematics studies in Indonesia. More broadly, cultural integration in learning strengthens cultural identity, fosters pride in local heritage, and enhances students' ability to relate their learning to their environment and culture.

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