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LEARNING GEOMETRY AND VALUES FROM PATTERNS: ETHNOMATHEMATICS ON THE BATIK PATTERNS OF YOGYAKARTA, INDONESIA

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Abstract

In general, many people still view mathematics as a subject that is far from reality and culture in everyday life. Historically, in fact, mathematics is very close to daily life and was developed by humans in response to the surrounding phenomena. Indonesia has diverse cultures, including in Yogyakarta. This culture can be used to explore mathematical concepts as a transformational effort to bring mathematics closer to the reality and perception of its people. Besides, we can use culture as the basis of learning mathematics in schools. Therefore, this study seeks to explore a mathematical concept of geometry transformation in the Yogyakarta batik pattern. This is an ethnography study. The research data were collected through observations, literature studies, and interviews with the batik culture practitioner and artist to understand the batik techniques and moral, historical, and philosophical values in each batik motif. This study's results indicate that in Yogyakarta batik, it uses the concept of geometry transformation in the making of Yogyakarta's unique Batik motif. Besides that, each motif or pattern also contains local values. These, namely moral, historical, and philosophical values, can be felt, reflected, and applied in daily life, such as values that teach leadership, good deeds, and so on.

Keywords: batik pattern, Yogyakarta culture, Ethnomathematics, geometry transformation, local values

Abstrak

Secara umum masih banyak orang yang memandang matematika sebagai ilmu yang jauh dari realitas dan budaya dalam kehidupan sehari-hari. Secara historis, sebenarnya matematika sangat dekat dengan kehidupan sehari-hari dan dikembangkan oleh manusia sebagai jawaban atas fenomena di sekitarnya. Indonesia memiliki budaya yang beragam, termasuk di Yogyakarta. Budaya ini dapat dimanfaatkan untuk mengeksplorasi sejumlah konsep matematika sebagai upaya transformasional untuk mendekatkan matematika dengan realitas dan persepsi masyarakatnya. Selain itu, kita dapat menggunakan budaya sebagai konteks pembelajaran matematika di sekolah. Oleh karena itu, penelitian ini berupaya menggali konsep matematis dari topik transformasi geometri pada motif batik Yogyakarta. Penelitian ini merupakan studi etnografi. Data penelitian dikumpulkan melalui observasi, studi pustaka, dan wawancara dengan praktisi dan seniman budaya batik untuk memahami teknik dan nilai moral, sejarah, dan filosofis batik pada setiap motifnya. Hasil penelitian ini menunjukkan bahwa batik Yogyakarta telah menggunakan konsep transformasi geometri dalam pembuatan motif batik khas Yogyakarta. Selain itu setiap motif atau corak juga mengandung kearifan lokal. Nilai-nilai tersebut adalah nilai moral, sejarah, dan filosofis, yang dapat dirasakan, direfleksikan, dan diterapkan dalam kehidupan sehari-hari, seperti nilai-nilai yang mengajarkan kepemimpinan, perbuatan baik, dan lain sebagainya.

Kata kunci: motif batik, budaya Yogyakarta, etnomatematika, transformasi geometri, nilai-nilai lokal

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Regarding mathematics education problems in Indonesia, a transformational effort is needed to bring mathematics closer to the reality and culture of students. In this case, Ethnomathematics, which was conceived by D'Ambrosio (2016) and based on his concerns with the conditions of mathematics education which is mechanistic, far from the reality and culture of students, can be a solution. Furthermore, Alangui

(2010) has documented that Ethnomathematics succeeded in establishing a relationship between mathematics and the reality of a society, where there originally were gaps as a result of rigid and not contextual informal education. Ethnomathematics learns and combines mathematical ideas, ways, with techniques that are practiced and developed by socio-culture or community culture (Barton, 1999; D'Ambrosio, 2007; D'Ambrosio, 2016; Rosa & Orey, 2016). Through the study of Ethnomathematics, mathematical science can also be found again originating from the different cultural roots of society, so that it can connect to and revive students' critical reasoning and dialogues and can foster students' democratic and tolerant characters by embracing cultural differences and seeing them as opportunities for mathematics education (D'Ambrosio, 2016; Zevenbergen, 2001). Therefore, from many points of view, which create various patterns, Ethnomathematics would be an instrument by which our universe could be better understood as we and others see it (Barton, 1996).

Reflecting D'Ambrosio (2016) on the origin of human knowledge, he understands that every culture develops ways, styles, and techniques to do things in response to any search for explanation, understanding, and learning of a phenomenon occurs. Humans in an area with a specific culture will respond to their environment in a way, style, and technique or develop a knowledge system that they find themselves (D'Ambrosio, 2007; D'Ambrosio, 2016; Rosa & Orey, 2016). Thus, efforts to explain and understand knowledge also depend on observation, comparison, classification, evaluation, quantification, measurement, calculation, representation, and inference in each region and culture. Each area has different culturally established ways of observing, comparing, classifying, evaluating, measuring, counting, representing, and concluding (Rosa et al., 2016; Goetzfridt, 2007).

In each different culture, mathematicians need to be aware of these arts, and techniques that are existing to express understanding, to explain and to study facts and phenomena of the natural and social environment in each of these cultures (Ascher & D'Ambrosio, 1994; Barton, 2007; D'Ambrosio, 2016). All the different knowledge systems that result from the discovery of mathematical concepts in this particular culture are called Ethnomathematics.

Indonesia, rich and diverse in culture, has an opportunity to improve the mathematics education system in Indonesia through transformational efforts to bring mathematics closer to students' reality and culture (Zulkardi, 2002; Abdullah, 2017). Many cultures in Indonesia can be explored to gain context for learning mathematics, including culture in the special region of Yogyakarta, known as the city of culture (Risdiyanti & Prahmana, 2018; Prahmana, 2020). In Yogyakarta, many cultural objects and practices are easily found and can be explored, such as temple buildings, palace, mosque, and batik patterns that have unique and distinctive shapes. Also, it has cultural, historical, and philosophical values that are important for shaping students' character, for example self-confidence, sympathy, empathy, respecting others, awareness of social issues and social-spirited, and responsible (Widodo, 2019). Exploration of mathematical concepts embedded in the culture of the people of Yogyakarta has been documented by several researchers (Risdiyanti & Prahmana, 2018; Rohayati, Karno, & Chomariyah, 2017; Huda, 2018; Pratikno, 2018; Bakhrodin, Istiqomah, & Abdullah, 2019; Ramadani, Praska, & Christian, 2019).

Risdiyanti and Prahmana (2018) explored the concepts of operation of numbers and 2D shapes in traditional games in Yogyakarta. Furthermore, Rohayati, Karno, and Chomariyah (2017) investigated the idea of flat building and building space in the Great Mosque of Yogyakarta. Finally, researchers studied the concept of 2D shapes, 3D shapes, and mathematical modeling found in snacks in Yogyakarta (Huda, 2018), the idea of the assemblage of the Yogyakarta royal palace soldiers (Pratikno, 2018), the concept of the matrix in the Mataram Kotagedhe Mosque building (Bakhrodin, Istiqomah & Abdullah, 2019), and the idea of geometry in the *Sekaten* ceremony in Yogyakarta (Ramadani, Paska, & Christian, 2019).

On the other hand, few researchers still explore mathematical concepts in Yogyakarta's unique and rare batik patterns. This is because these batiks' motif used in this research are only owned by people who have a high position, or their motives can only be found in museums and are rarely found in society. Whereas in the culture of people of Yogyakarta, batik is one of the patterned fabrics that must be worn as a school and civil servants' uniforms on certain days. It has become a fashion style for the people in Yogyakarta when attending official events; it is also used for casual occasions (Didik, 2017; Dian, 2017). The familiarity of batik among the public and students in Yogyakarta is an opportunity for mathematics educators to explore and use it as the context in mathematics learning. Therefore, this study aims to conduct a comprehensive study of mathematical concepts in Yogyakarta's batik patterns that can be used as starting points in learning mathematics in Yogyakarta. Besides that, each motif or pattern often incorporates local values. These, including spiritual, historical, and metaphysical principles, can be sensed, expressed, and implemented in everyday life, such as principles that teach value in leadership, good deeds, and so on. Lastly, the combination of mathematics learning and character education is one of Indonesia's education system goals, so this research's results support this.

The next section of this article describes the ethnographic research methods used to explore the data related to Yogyakarta's batik patterns that contain mathematical concepts. Explaining the results of the exploration of mathematical concepts in Yogyakarta's batik motifs is described in the discussion section. Furthermore, the findings in this study are compared with previous studies from various regions following similar contexts and procedures. Lastly, a research summary shows that mathematical concepts can be used as starting points in learning mathematics written in the conclusions section in Yogyakarta's batik patterns.

METHOD

This study used an ethnographic method, research that studies, and describes a community's culture (Spradley & McCurdy, 1989). This research method was chosen because it is in line with the objectives of Ethnomathematics, namely studying mathematical ideas, processes, and techniques in the culture from the native point of view (Ascher & D'Ambrosio, 1994; Shirley & Palhares, 2016). Research with ethnographic methods involves several activities about a culture that sees, hears, talks, and acts in different ways and in ways that they find themselves (Spradley & McCurdy, 1989). The data collection was carried out by field studies and interviewing the speakers whose selected purposively, namely Didik, a

Yogyakarta batik museum cultural practitioner, and Mrs. Dian, a batik craftsman in the Galur, Lendah, Kulon Progo batik handicraft business. A literature review on batik supplements the results of these observations and interviews. All data were documented in photos, videos, and field notes, then analyzed using the source triangulation technique, and finally described to explore each finding in this study.

In this study, we use three boundaries of the coverage area which are the basis for determining the research subject; community unity consisting of education that speaks one language or accent in the same language, community unity which is limited by the boundaries of an administrative political area and community unity which experiences one experience. the same history, as the limits that have been set in ethnographic research to show the authenticity of culture under study, there is no mixture with other cultures (Flynn, 2008). Therefore, we determined that the community unit to be studied was the original Yogyakarta people who used the same accent, that are the Javanese language, limited by the same administrative area, namely the Special Region of Yogyakarta and experienced the same historical experience, that is history when living, growing and developing in Yogyakarta.

Koentjaraningrat (2015) explains that in ethnographic research there were seven main descriptions produced by ethnographers, that is language, technology systems, economic systems, social organizations, knowledge systems, arts, and religion. In this study, the researcher will focus on one main description, that is the knowledge system because, to dissect the techniques used by the community in making batik motifs, the researcher must observe and dive into the knowledge and art systems to find the knowledge base used in the process of making batik motifs and cultural values contained in the batik motif art. Even so, it does not rule out that other cultural elements will also be studied because they are related to one another.

In conducting ethnographical exploration, researchers begin with four general questions that are the essence of ethnographic principles, that is "where to start looking?", "how to look?", "how to recognize that you have found something significant?", "how to understand what it is?". Based on these four general questions, the research stages are organized in Table 1.

Table 1. Design of Ethnography Research

General Questions	Initial Answers	Starting Point	Specific Activity
Where to start looking?	In the activities of making batik motif carried out by the people of Yogyakarta where there are mathematical practices in it.	Culture	Conducting interviews with people who have knowledge of Javanese culture in the Yogyakarta community or those who make batik motifs in Yogyakarta.
How to look?	Investigating the QRS (Quantitative, Relational,	Alternative thinking and	Determine what QRS ideas are contained in

	Spatial) aspects of the making batik motif activities of the people of Yogyakarta related to mathematics practice.	knowledge system	making batik motifs activities of the people of Yogyakarta related to mathematics practice.
What it is?	Evidence (Results of alternative thinking in the previous process)	Philosophy of mathematics	Identifying QRS characteristics in the activity of making batik motifs in Yogyakarta society related to mathematics practice. It shows that the activity of making batik motifs for the people of Yogyakarta does have a mathematical character seen from the elements of knowledge and art systems used in everyday life.
What it means?	Valued important for culture and important value patterns for mathematics	Anthropologist	Describe the relationship between the two systems of mathematical knowledge and culture. Describe mathematical conceptions that exist in the activity of making batik motifs for the people of Yogyakarta.

Data collection was carried out by field studies and interviews with informant; Mrs. Dian, the owner of a handicraft batik business in Galur Village, Lendah District, Kulon Progo Regency to see, explore and clarify comprehensively how to make batik motifs along with the basis of knowledge and art used in making batik motifs. Also, we conducted interviews with Mr. Didik, the cultural practitioner at the Yogyakarta Batik Museum, to explore and clarify the cultural values that exist in Yogyakarta batik motifs. The data collection results were analyzed using the source triangulation technique to comprehensively explore the relationship between the mathematical knowledge system and the batik motif culture and to

see the mathematical conceptions that exist in the Yogyakarta batik motif activity. Lastly, the findings are described in the results of this study.

RESULTS AND DISCUSSION

The results showed that in the culture of people of Yogyakarta, there is a patterned cloth or known as batik, which is used in certain traditional events such as pregnancy, marriage, death ceremonies, and so on in the culture of the people of Yogyakarta. In addition, batik has also become a fashion style among people. The Yogyakarta people often use batik when attending official events, or even now, batik is commonly used for casual occasions (Didik, 2017; Dian, 2017). The Yogyakarta provincial government sets batik clothes as mandatory uniforms on certain days in state schools, so students are very familiar with Yogyakarta's typical batik. Currently, every district in Yogyakarta has developed batik with motifs based on each region (Dian, 2017). However, despite the many new modern batik motifs, the Yogyakarta batik pattern or the Ngayogyakarta palace batik pattern, which is the legacy of the Mataram Kingdom's ancestors, is still preserved today. In ancient times, the ancestors made batik patterns carefully. Each style has a visualization of moral values and ideals to be conveyed to the wearer or the general public who see it. Besides, it turns out that in the making of batik patterns they used batik techniques including concepts of geometrical transformation such as mirroring (reflection), shift (translation), rotation, and resizing (dilation), which they learned by self-teaching, based on their experience, creativity, and also cultural traditions. Furthermore, a more detailed explanation of each pattern is as follows.

Values and geometry transformation of Babon Angrem pattern

Babon Angrem or incubating hen is a batik that is usually used by the Yogyakarta people during the seven-month ceremonial for pregnant women. This batik motif symbolizes the love and patience of a mother to her child, who hope the trait can be inherited or imitated later. So, the value that can be taken from the *Babon Angrem* batik pattern is that when you become a parent, you have to give love to the child and be patient in educating the child during his/her growth and development (Didik, 2017; Efianingrum, 2011; Kusrianto, 2013). Besides, in making *Babon Angrem* batik, it used the concept of geometrical transformation in the form of a vertical reflection as shown in Figure 1.

Figure 1. Geometry transformation of *Babon Angrem* pattern (Risdiyanti & Prahmana, 2020)

Values and geometry transformation of Parang Barong pattern

Parang Barong is a batik pattern that was usually used by the aristocrats or used by the king for religious rituals and meditations. However, in its development, this batik can also be used by anyone. The motif in *Parang Barong* batik depicts weapons and power as the power possessed by a knight. The value that can be taken from this *Parang Barong* motif is when one become a knight or leader, he will have the weapon and power that will be his strength, and it should be used for the good and wealth of the people (Didik, 2017; Efianingrum, 2011; Kusrianto, 2013). Also, in making *Parang Barong* pattern, it used the concept of geometrical transformation in the form of translation as in Figure 2.

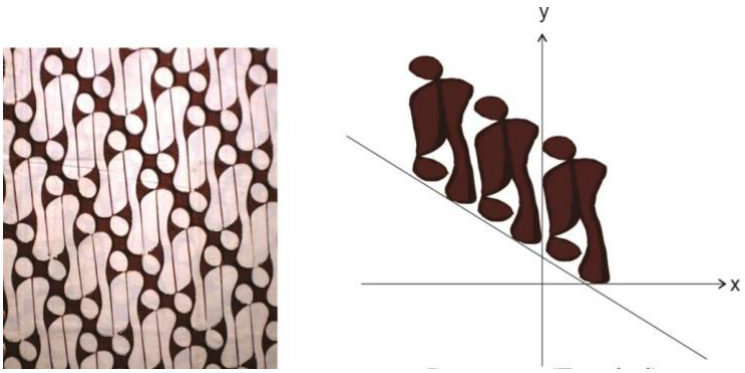


Figure 2. Geometry transformation of *Parang Barong* pattern (Risdiyanti & Prahmana, 2020)

Values and geometry transformation of Parang Klitik pattern

Parang klitik is a batik pattern usually only worn by royal Princesses, but in its development *parang klitik* batik can be used by anyone. This batik motif illustrates the behavior of a princess who is delicate and wise. Thus, the value that can be taken from the motive of *parang klitik* that is a daughter or woman should always have a gentle and knowledgeable temperament in attitude (Didik, 2017; Efianingrum, 2011; Kusrianto, 2013). Besides, in making *parang klitik* pattern, it used the concept of geometric transformation in the form of reflection and translation as in Figure 3.

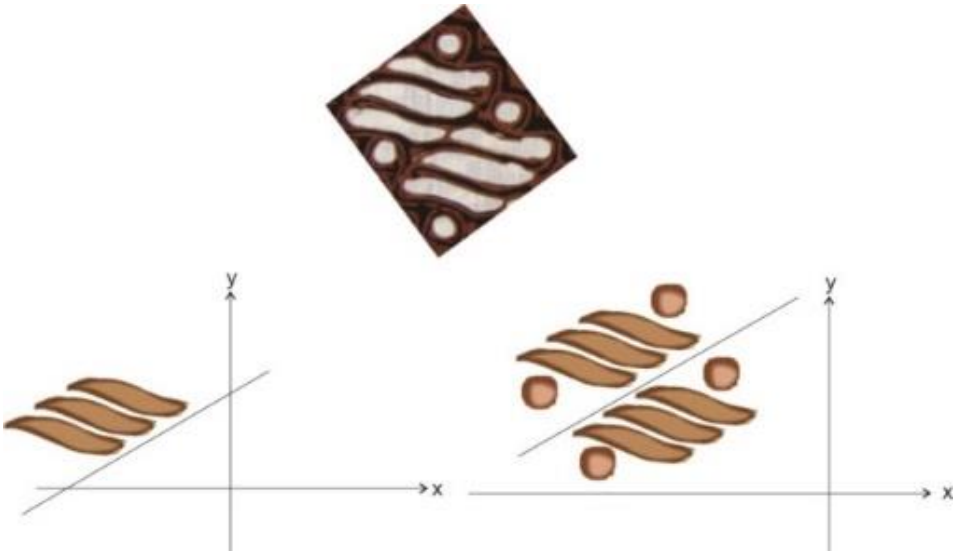


Figure 3. Geometry transformation of *Parang Klitik* pattern (Risdiyanti & Prahmana, 2020)

Values and geometry transformation of Sidomukti pattern

Sidomukti is a batik pattern that symbolizes the fulfillment of hope and a prayer. *Sidomukti* comes from the word "*sido*" which means it really happened or fulfilled the desire and comes from the word "*mukti*" means happiness and wealth. The value that can be taken from this *Sidomukti* batik is that if you want to get satisfaction and wealth, you should always pray to God and expect His blessing only (Didik, 2017; Efianingrum, 2011, Kusrianto, 2013). In addition, in making batik motifs *Sidomukti* pattern, it used the concept of geometrical transformation in the form of reflection and translation as in Figure 4.

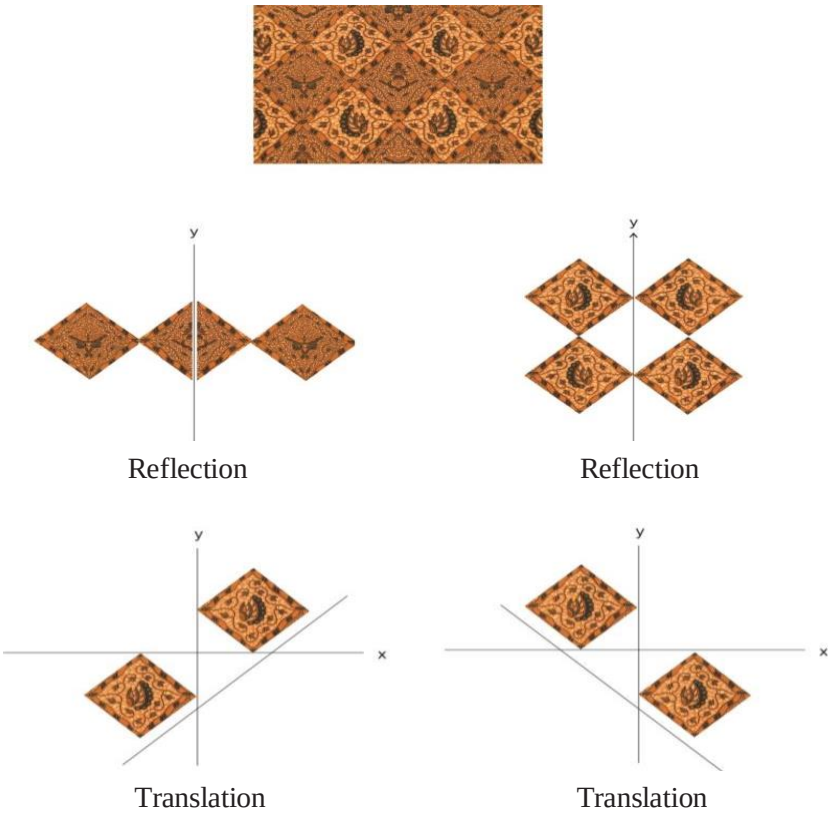


Figure 4. Geometry transformation of *Sidomukti* pattern (Risdiyanti & Prahmana, 2020)

Values and geometry transformation of Semen Bondhat pattern

Semen Bodhat is a batik pattern that was initially only used by royal servants. However, in its current development, *Semen Bondhat* batik can also be used by anyone. The *Semen Bodhat* batik motif illustrates the inner and outer peace in life. The value that can be taken from the *Semen Bodhat* motif is that in living a life, you should always look for physical and spiritual friendship (Didik, 2017; Efianingrum, 2011; Kusrianto, 2013). In addition, in making the Batik motif of *Semen Bondhat* batik, techniques have been used by using the concept of geometric transformation in the form of reflection and rotation, as shown in Figure 5.

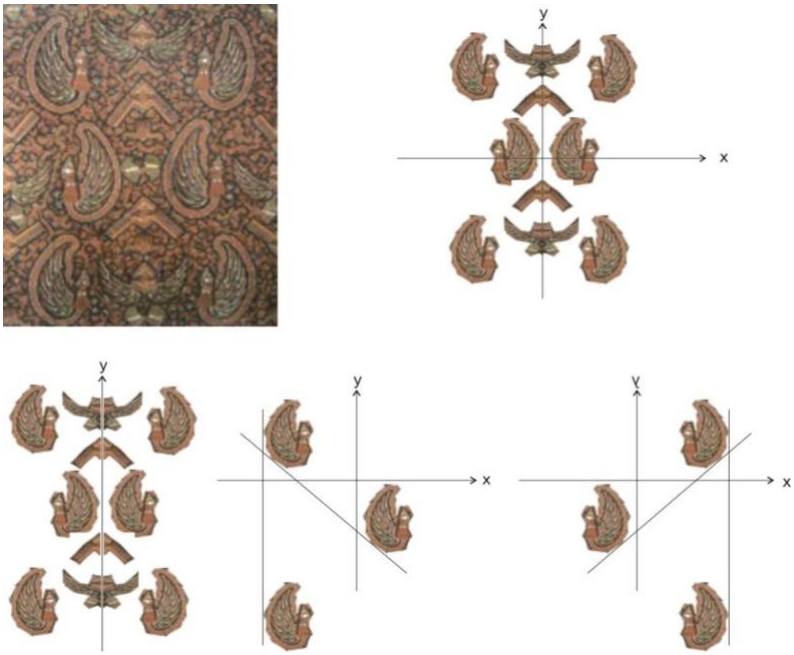


Figure 5. Geometry transformation of *Semen Bodhat* pattern (Risdiyanti & Prahmana, 2020)

Values and geometry transformation of Sidoluhur pattern

Sidoluhur is a batik pattern illustrating the qualities of a leader. In *Sidoluhur* batik, several ornaments become the main motives, including building ornaments that adorn the leader's expectations to be in a high and noble position with dignity and respect. Garuda ornaments describe the nature of the courage of a leader inherited from *Suryabrata* (sun). Bird ornament that is depicting a noble character of a low-profile leader. This trait is inherited from the nature of the *Bayubrata* (wind). Flower ornament describes the beauty and happiness gained from a firm, stable foundation, and strong life determination. The ship's decoration is depicting a broadminded leader and calmness in leading and in living a life. Butterfly ornament represents a fair and humanist (Didik, 2017; Efianingrum, 2011; Kusrianto, 2013). The value that can be taken is when becoming a leader, you should emulate the qualities implied in the meaning of each ornament in this *Sidoluhur* batik motif to be able to become a trustworthy leader and be able to prosper the people. In addition, in making *Sidoluhur* batik, it used the concept of geometrical transformation in the form of reflection and rotation as shown in Figure 6.

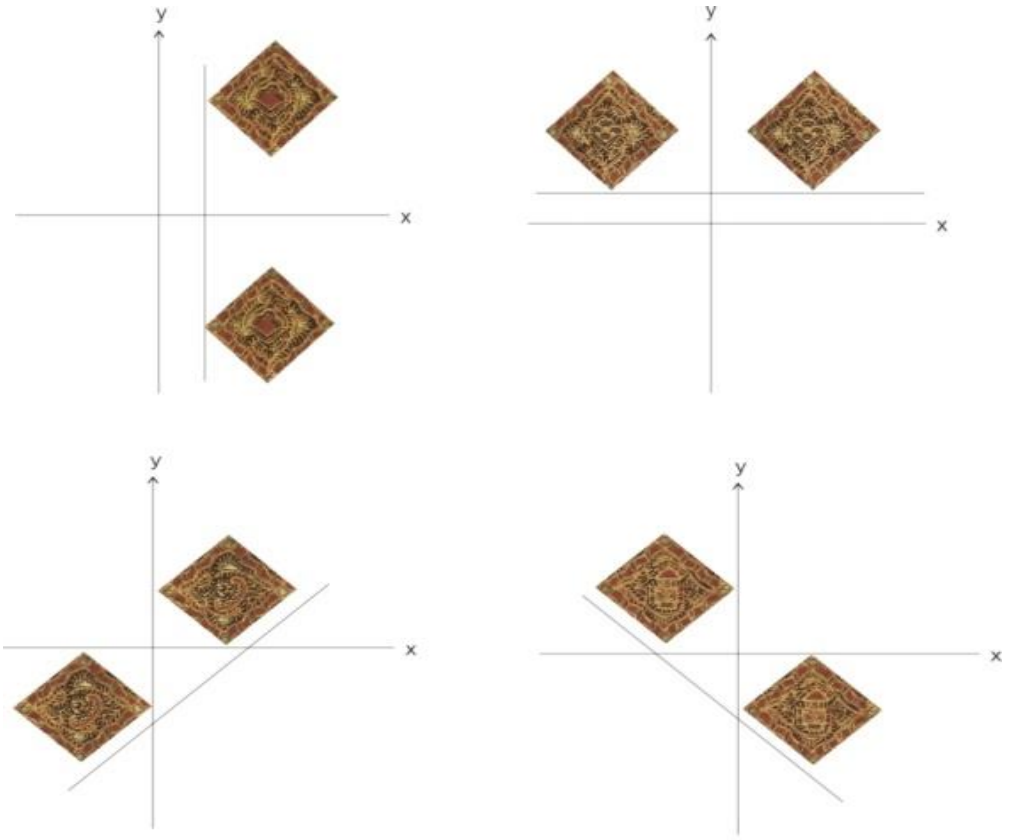
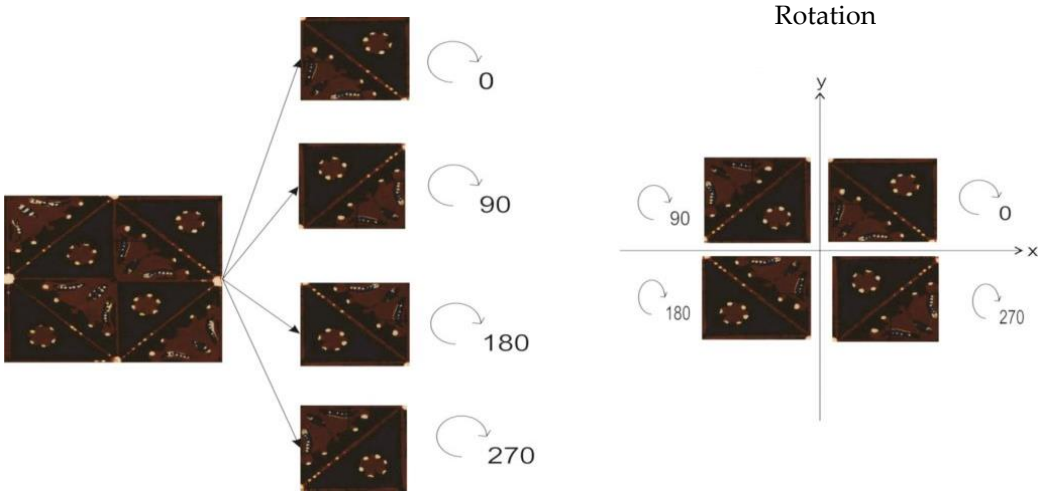


Figure 6. Geometry transformation of *Sidoluhur* pattern (Risdiyanti & Prahmana, 2020)

Values and geometry transformation of Soblog pattern

Soblog is a batik pattern that illustrates determination, accuracy, and patience. Thus, the value that can be taken in the *Soblog* batik motif is that if you have a desire or dreams, then try to achieve it with full determination, accuracy, and patience (Didik, 2017; Efianingrum, 2011; Kusrianto, 2013). In making batik motifs *Soblog* batik, it used the concept of geometric transformation in the form of reflection and rotation, as shown in Figure 7.



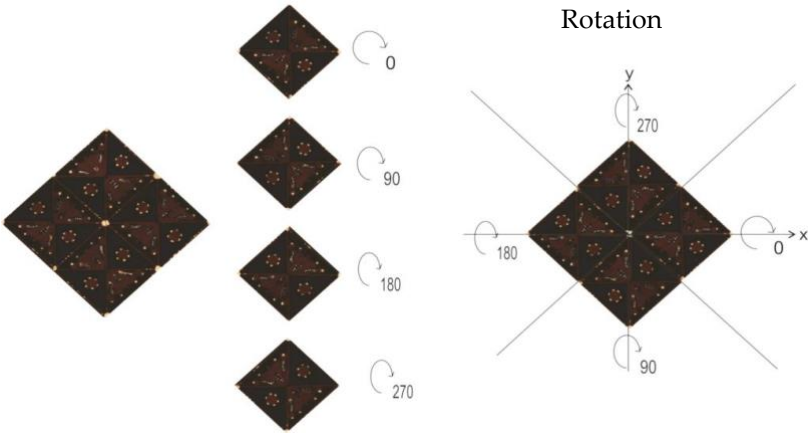


Figure 7. Geometry transformation of *Soblog* pattern (Risdiyanti & Prahmana, 2020)

Values and geometry transformation of Sidowirasat pattern

Sidowirasat is a batik pattern that was usually used by parents in their children's marriages. The *Sidowirasat* batik motif illustrates that parents always give advice and guide the bride and groom to start a marriage. Thus, the value that can be taken from this *Sidowirasat* motive is that when a child has chosen to marry, parents have genuinely let go of their children, but parents are still there to guide and give advice in their marriage (Didik, 2017; Efianingrum, 2011; Kusrianto, 2013). In addition, in making batik motifs *Sidowirasat* pattern, it used the concept of geometric transformation in the form of reflection and translation as in Figure 8.

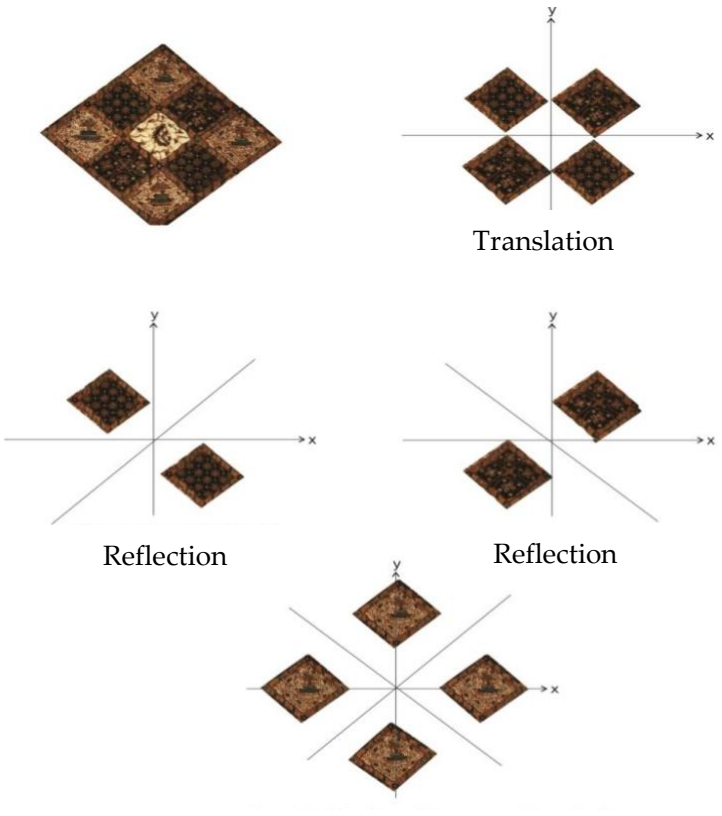


Figure 8. Geometry transformation of *Sidowirasat* pattern (Risdiyanti & Prahmana, 2020)

The results of the exploration of mathematical concepts in making Yogyakarta batik motifs show that Yogyakarta society has used the concept of geometric transformation that they learned by themselves and these creative ideas emerged from their experiences in determining the forms of Yogyakarta batik motif (Didik, 2017; Dian, 2017). Based on the history, before Indonesia's independence, Indonesia consisted of kingdoms including in Yogyakarta there was the Mataram kingdom (Didik, 2017). The culture of the Mataram kingdom community believes in an ideology, values, norms, manners, and ethics that are inherent in the daily life of the community and they have a desire that what they believe is also believed by future generations so that social order will not go far of the social order during the kingdom. Therefore, they try to pass down their ideology, their beliefs through any media including through Yogyakarta's unique batik motifs (Didik, 2017). The results of the research showed that in every Yogyakarta batik motif, it contained moral messages containing ideology, values, norms, ethics and ethics that govern how to relate to humans, how to relate to nature, how to lead and others in living life (Didik, 2017).

Indonesia has extracted Ethnomathematics from various places and cultural activities in Indonesia, such as the concept of sets and number operations in the process of determining the sacred day in Sambeng village, Cirebon (Abdullah, Maulidia, & Amelia, 2019), the concept of geometric transformation in Balinese woven handicrafts (Puspadewi & Putra, 2014), the idea of a 2D shapes in the Jamik Mosque building in Bengkulu city (Lusiana, Afriani, Ardy, & Widada, 2019), the symmetry concept and circles on the Marawis musical instrument (Marina & Izzati, 2019), the concept of comparative value in the activities of cocoa farmers in Temuasri Sempu Banyuwangi Village (Aprilianti, Sunardi, & Yudianto, 2019), and the concept of 2D shapes on Tapis fabric and Lampung Traditional House (Loviana, Merliza, Damayanti, Mahfud, & Islamuddin, 2020). The findings of Ethnomathematics exploration have also been applied in mathematics learning in several schools in Indonesia. It has been proven that mathematics learning based on mathematics can change students' views about the relationship between mathematics and reality and their culture. When students understand such a relationship, students experience lower math anxiety.

Until today, we see that many Indonesian students experiencing mathematics anxiety. We see that this experience is related to not associating mathematics in reality and culture. Among the feelings they experienced are feeling of scared, that mathematics is distant to their life, a feeling of meaningless in life, and unable to understand the benefit of learning mathematics to solve problems in daily life (Karnilah, Juandi, & Turmudi, 2013; Hendriana, Prahmana, & Hidayat, 2019).

The results of this study and previous research on the exploration of Ethnomathematics in Indonesian culture can be one of the transformative efforts to bridge mathematics with the reality and perception of students in learning mathematics. Thus, students can see that mathematics is close to the culture around them, and students can finally take on the meaning of the mathematical concepts they learn to apply in their daily lives (Abdullah, 2017; Risdiyanti & Prahmana, 2018; 2020). To be more attuned to

life in modem democratic communities, if there are aspirations to change mathematics instruction, then this aspect of mathematics education needs to be better understood to be better taught (Bishop, 2007).

Changes in students' views about the relationship of mathematics with reality and culture around them after learning mathematics using the context of the exploration of Ethnomathematics were shown from previous researchers. They have succeeded in designing mathematics learning by using the context of the exploration of Ethnomathematics. They have proven to increase students' understanding and make students feel that the mathematics they learn is meaningful. These results are similar to findings of several previous research (Nasrullah & Zulkardi, 2011; Wijaya, Doorman, & Keijzer, 2011; Risdiyanti, Prahmana, & Shahril, 2019). Nasrullah and Zulkardi (2011) explored learning number operations using "*bermain satu rumah*" game, a traditional game from South Sulawesi, Indonesia. Furthermore, Wijaya, Doorman, and Keijzer (2011) are intended to contribute to developing and formulating a local instruction theory on linear measurement in second grade of primary school in Indonesia through Indonesian traditional games namely playing *gundu* and *benthic*. Lastly, Risdiyanti, Prahmana, and Shahril (2019) produced social arithmetic learning designs using the Kubuk Manuk game.

Ethnomathematics exploration is not only carried out by researchers and educators in Indonesia, but also by researchers in many countries. The examples are exploring the concept of numbering in traditional game of Vhaveda tribe, Afrika Selatan (Nyoni, 2014), mathematical modeling in the Brazil's largest carnaval (de Freitas Madruga & Biembengut, 2015), mathematical modeling in braids craft of Argentina society (Albanese, 2015), number operations, symmetries, mathematics symbol and measurement concept in some traditional game of Boudin Arab Tribe such as Ta'ab Stick game, Mozkat-5 stone game and Sega game (Fouze & Amit, 2017), concept of circle and transformation of the plate motifs used in the culture of quill acing as tribe in Southern Colombia, Amerika (Araújo, 2015). Atweh et al (2007) conducted a study on Ethnomathematics in Community Bank to determine pedagogical interventions that must be done to overcome difficulties in credit handling and product control management in Community Bank. This shows that researchers in many countries in the world have realized the importance of restoring mathematics to its origins and exploring Ethnomathematics in the culture of society in each country. They do not only explore but also conduct studies on the curriculum in their respective countries and try to see the opportunities and effectiveness of including Ethnomathematics in the educational curriculum.

Several studies on Ethnomathematics in the educational curriculum, such as research by Gonçalves & Pires (2014) which studies the curriculum in professional high school in Brazil and possibilities to including Ethnomathematics inside it. Pinto (2017) reviewed the draft Base Nacional Commun Curricular (BNCC) in Brazil which is the curriculum accompanied by traditions that was always updated in accordance with the social condition in which their traditions emerged. Ethnomathematics were included in this curriculum. Osorio (2016) discuss the importance of the indigenous Gunadule school curriculum min alto Cayman, South America considering the sociocultural, Ethnomathematics, and inculturation perspective. Dos Santos and da Silva (2016) showed that at the Quilomba School in Brazil there is a need

to provide access to mathematical knowledge with Ethnomathematics collaboration. In Indonesia, Ethnomathematics is just being explored. Researchers are trying to make a mathematics learning design based on Ethnomathematics, but has not yet reached the stage of trying to introduce it to the government through the education curriculum. We believe that this needs to be done to see the success of the Ethnomathematics-based application of mathematics learning in Indonesia. We believe that it can overcome some of the problems that students encounter in learning mathematics such as math anxiety, misconceptions, misunderstandings, disinterest in mathematics and others.

There is no question that mathematics is and must be practiced as an essential part of human understanding. There is also no question that its position is currently a restricted version of its potential in many countries and cultures. Education in mathematics is intended to encourage mathematics comprehension for everyone. The status and roles of mathematics in our society need to be modified to emerge in this situation. An ethnomathematical understanding of mathematics education helps this transition (Barton, 1996).

CONCLUSION

Ethnomathematics in Indonesia does not only stop at cultural exploration and experiments on mathematics learning in several schools but also in the future, we can introduce it to mathematics education curriculum in Indonesia. The people of Yogyakarta have used the concept of geometry transformation in making batik patterns such as in the Babon Angrem, Parang Barong, Parang Klitik, Sidomukti, Semen Bondhat, Sidoluhur, Soblog, and Sidowirasat motifs. Knowledge of the concept of geometrical transformation has been used and self-studied by the people of the Mataram kingdom in Yogyakarta. Despite mathematical contents, batik has moral, historical, and philosophical values in each style that can be felt, reflected, and applied in daily life, such as values in leadership, good deeds, and so forth. A comprehensive study of the culture of the Yogyakarta community to discover the concept of geometry transformation can be used as a starting point in mathematics teaching and learning activities in Yogyakarta. It can be implemented to improve understanding of geometry transformation for students who live in rural and urban areas.

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