Ethnomathematical Exploration of Garutan Batik Motifs

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ABSTRACT

Ethnomathematics provides benefits in linking mathematics with culture so that it can develop students' understanding of concepts. One culture that can be used is batik which has certain patterns and is philosophically related to mathematical concepts. The aim of this research is to explore mathematical concepts in Garutan batik and determine the value of mathematical philosophy in Garutan batik motifs. The research method used is qualitative with an ethnographic approach. The subjects of this research were batik craftsmen, batik managers of the Batik Garutan RM industry and mathematics teachers. The data collection techniques used were observation, interviews and documentation. The data analysis techniques used are data reduction, data presentation, and drawing conclusions. The results of this research are that in Garutan Batik there are mathematical concepts, namely geometric transformations in the form of translation, reflection and rotation. The merak ngibing batik motif is related to the concepts of translation and reflection. The bulu ayam batik motif is related to the concept of translation. The lereng kangkung batik motif is related to the concept of rotation and translation. The cupat manggu batik motif is related to the concepts of reflection, rotation and translation. The batik lereng batik motif is related to the concept of rotation and translation.

Keywords: etnomathematic; garutan batik; geometric transformations

INTRODUCTION

Mathematics is a form of culture and has actually been integrated into all aspects of people's lives wherever they are (Bishop, 1994). In essence, mathematics is a symbolic technology that grows on cultural environmental skills or activities. Mathematics is the main source of knowledge and needs of each individual, while culture is a complete unity and a comprehensive code of conduct in society and plays an important role in fostering the noble values of the nation (Ubayanti, 2016). Culture-based mathematics learning can be used as a medium for students to transform their findings into creative forms and principles related to nature. Cultural integration as part of the learning process plays an important role in mathematics education.

Local culture is one of the contexts for learning mathematics, one of which is batik fabric. Batik is the result of a combination of art and technology (Christanti et al., 2020). There are many regions in Indonesia as batik producers, one of which is the Garut Jawab Barat area which produces garutan batik. This batik displays a simple composition of motifs and colors, and has distinctive characteristics. The style of batik in Garut batik ornamental varieties is influenced by several factors such as geographical location, nature and lifestyle of the area concerned, as well as natural conditions including flora and fauna and the construction of relationships between batik areas. This is an appearance of a reflection of the socio-cultural life and philosophy of life as well as the customs of the Sundanese people.

Garut Batik is known as "Original Garutan Batik", generally made in the form of sinjang cloth which is worn on various occasions (Setiawan, 2010). Garut batik has no symbolic meaning. Even the name or theme of the ornamental variety is taken according to the orderer or user, such as for example the slope of the doctor or the slope of the sub-district because the one who orders the mother of the doctor and the mother of the sub-district head. Even if there is a Garut batik motif that has a symbolic meaning, only on the long cloth (sinjang) for the bridal ceremony. It is also general, meaning that it applies in every batik area which means for safety, harmony and the safety of the bride and groom. Therefore, the depiction of Garut batik motifs and colors is an expression of natural conditions and daily events as well as a reflection of the social life of the people of Garut from time to time. As one of the cultural riches owned by Indonesia, garutan batik can be used in the field of mathematics education by utilizing the concept of ethnomathematics.

Ethnomathematics is the study of mathematics practiced by a group of certain cultural communities such as indigenous peoples, groups of workers, children of certain age groups, and other professional workers consisting of calculating, measuring, positioning, designing, playing, and explaining activities (D'Ambrosio, 1985). Counting or counting is used to help people in representing objects that have the same value. Locating is related to the geometric idea that is usually used to determine the direction or location of an object. Measuring emphasizes people's activities in comparing an object with another, for example comparing a weight, volume, time, speed, and so on. Designing is related to human activity in seeing the patterns that develop in a society. Playing is used to see the diversity of mathematical activities in children's games which include game rules and ways of playing such as rules, procedures, plans, and so on. Explaining is used to help analyze graph patterns, diagrams, and other things that provide direction in processing a situation such as classification, story explanation, symbolic explanation, and so on. The ethnomathematics research on Garutan batik is conducted to explore the relationship between local culture and mathematical concepts embedded in the art and tradition of Garut's unique batik-making. Other reasons include: preserving local culture, utilizing mathematical values in batik, integrating culture and research, empowering local communities, and increasing awareness of cultural diversity

An example of an ancestral heritage cultural product with artistic creativity that contains mathematical elements is in batik motifs that contain two-dimensional geometric shapes. Classic batik motifs have the opportunity to be developed with the role of mathematics when designing batik motifs. The development of motifs can be done through mathematical algorithms, geometric shapes in two dimensions are displayed algorithmically (Wulandari & Puspadewi, 2016). Motifs that have been designed can be developed again to be more beautiful when combined with coloring. Dyeing for batik can be done with the role of mathematics, namely when determining the measurement of the dye that will be used to produce beautiful colors as expected.

The cultural heritage of batik art is still in great demand and preserved by the Javanese people. In Garut there are several typical batik motifs that have been inherited from generation to generation to date. Some Garutan batik motifs can be used as a medium to introduce mathematical concepts such as geometric transformation concepts so that it is easier to understand abstract mathematical concepts such as translation, rotation, reflection,

and dilation. The most commonly encountered batik motifs from garutan batik include motif batik merak ngibing, bulu ayam, lereng kangkung, cupat manggu, dan motif batik lereng. If we pay attention, there is actually ethnomathematics in the form of the concept of geometric transformation. But because Garutan Batik motifs are more varied, if we look carefully, not all Garutan Batik motifs have a mathematical concept in the form of the concept of geometric transformation when viewed based on the definition of geometric transformation itself.

Transformation geometry is one of the mathematical materials that is quite challenging so that sometimes students get bored easily (Hutajulu, et al., 2023). Therefore, ethnomathematical media, one of which is batik, is needed to increase student motivation (Faiziyah et al., 2021). Based on this, it is necessary to conduct ethnomathematical exploration on garutan batik motifs.

This research offers novelty in the context of education by utilizing Garutan batik motifs as a medium for culturally-based mathematics learning. It enriches contextual learning approaches that are relevant to the students' local environment, helping them understand mathematics in a more engaging and applicable way. Although batik has been widely studied, the focus on the mathematical relationships within the distinctive motifs of Garutan batik remains limited. This study seeks to identify specific mathematical patterns unique to Garutan batik, such as geometric shapes, principles of repetition, and symmetry designs. This novelty is expected to make a significant contribution to the fields of ethnomathematics, education, and cultural preservation, as well as to promote Garutan batik as a cultural heritage with profound scientific dimensions.

RESEARCH METHODS

The research method used is qualitative descriptive which is used to describe and analyze information as a whole with research procedures that produce descriptive data. The data used in this study is written data that describes the mathematical ideas contained in the Garutan Batik motif. This study uses an ethnographic approach used to obtain a description of the culture contained in the garutan written batik motif. Ethnographic research is carried out in a natural environment with the direct involvement of researchers, so that they experience with community groups in daily life. Through an ethnographic approach, this research is expected to find out about ethnomathematics in garutan batik motifs.

The technique of taking research subjects uses the purposive sampling technique, which is selected with certain considerations and objectives. The criteria determined by the researcher as a research subject are those who are involved in the activities being researched, know and understand information related to the research. Based on this, the subjects in this study are: Garutan RM Batik industry managers, Garutan RM Batik industry batik craftsmen, and Mathematics Teachers. The object of this research is five types of batik motifs, namely: Motif Batik Merak Ngibing, Motif Batik Bulu Ayam (Bulu Hayam), Motif Batik Lereng Kangkung, Motif Batik Cupat Manggu (Buah Manggis), and Motif Batik Lereng.

The data collection technique was carried out by observation, documentation, and interviews with the research subjects. Observation and documentation were carried out in the Garutan Batik Industry as well as conducting interviews with managers and craftsmen to

obtain information related to Garutan batik. Next, interviews were conducted with mathematics teachers to confirm the relationship between the garutan batik motif and the geometry of transformation. Data analysis techniques are carried out by data reduction, data presentation, and conclusion drawing. Data analysis is conducted by examining batik motifs using mathematical concepts such as identifying the types of symmetry used (reflection, rotation, translation), recognizing geometric shapes such as triangles, circles, or repeating patterns, and analyzing pattern repetition and the principles of tessellation. Subsequently, the motifs are grouped based on their mathematical complexity, for example, motifs with simple symmetry, motifs with fractals, or motifs with combined geometric patterns, and these motifs are then connected to local cultural concepts as explained by the artisans.

RESULTS AND DISCUSSION

In this typical Garutan batik, the creation of the motif is made by including philosophical values depicted in each pattern. In addition, it turns out that in making Garutan batik motifs, the concept of geometric transformation is used in the form of reflection, translation, and rotation. The explanation is as follows:

1. Philosophy and Mathematical Concept Value in the Batik Merak Ngibing Motif

Figure 1. Batik Merak Ngibing

Merak Ngibing motif is a batik motif native to Garut, West Java. As the name suggests, "Merak Ngibing" forming two peacocks side by side with wide-open wings depicting dancing peacocks. Ngibing or dancing symbolizes the customs and culture of the Priangan people who are harmonious, peaceful and also full of joy. Peacocks symbolize the beauty of nature. Merak Ngibing motif describing Priangan cultural customs that synergize with nature. Merak Ngibing It is usually worn at formal, customary, and wedding events. Due to the dynamic nature of batik from West Java, it is not fixated on certain rules. The technique of making this batik motif uses the writing method.

Merak ngibing motif It is related to the mathematical concepts of translation and reflection. In making this motif, the craftsman actually uses mathematical concepts, but because in making it uses writing techniques, so the resulting motif does not have the same size and shape. Unlike the stamp technique, it must have the same size and shape because one image element is stamped so that it produces another image element.

The mathematical concept in Merak Ngibing batik is inspired by the beauty and elegance of a dancing peacock. The Merak Ngibing motif often features mirror symmetry,

where the design on one side of the peacock's body reflects the other. This is evident in the shapes of the wings, tail, or feather patterns. The expansive feather patterns forming a circle in the tail area often demonstrate rotational symmetry, creating a sense of balance and harmony in the design. Peacock feathers in this motif typically utilize smooth curved lines to create a dynamic and aesthetic effect. The feathers are often depicted with geometric elements such as circles (representing the "eyes" of the feathers), ellipses, or teardrop shapes repeated throughout. This motif employs repetition of elements like feathers, dots, or lines arranged systematically, reflecting the principle of repetition in mathematics.

2. The Value of Philosophy and Mathematical Concepts on Batik Bulu Ayam Motif
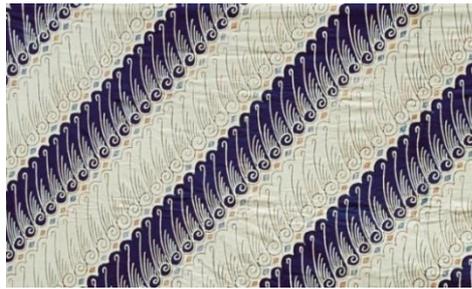

Figure 2. Bulu Ayam Motif

From the name, it is very clear that the image that appears on this piece of batik cloth is a chicken feather. Initially, this motif was taken from one of the animals, namely the chicken because this animal is an animal that has a very close relationship with the community, and in the Garut countryside it is said that in the past many chickens roamed around, and scattered their feathers around the craftsmen. The motif of chicken feathers or hayam feathers, is inspired by the natural conditions, flora and fauna of Garut and is a pattern inspired by the state of the environment around the artisans. Some craftsmen of course add diagonal geometric motifs for sweeteners and not only about the hayam feather motif. It is not uncommon for motif sweeteners in the form of flowers that are given bright and calm natural colors. In terms of color and diagonal composition, hayam batik is a type of garutan batik that uses many colors to beautify it. This batik motif making technique uses the stamp method.

The mathematical concept contained in this motif is the concept of translation. It is said to be translational because all points on the translated image element move in the same direction and distance, the area of the original object is equal to the area of the shadow object, the shadow is the same and is in line with the original object, and can be expressed in pairs of numbers, where the number shows the distance of the displacement or shift.

In this motif, there is also the concept of geometric transformation, namely translation in each chicken feather motif as seen in Figure 3 below.
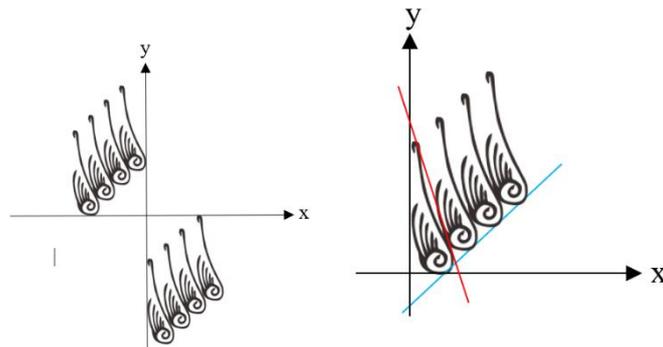
Figure 3. The Concept of Translation on Batik Bulu Ayam Motif

3. The Value of Philosophy and Mathematical Concepts on Batik Lereng Kangkung Motif

Figure 4. Lereng Kangkung Motif

This motif is inspired by kale plants that grow on the slopes of plantations in Garut and from the beautiful rows of kale plants found in the hilly areas. In this motif, it usually uses a blue base color, as well as a stalk motif and several small slightly elongated leaves that resemble kale leaves. In addition, the color combinations in the motifs also have bright and diverse color combinations, including beige, red, black to white. The technique of making this batik motif uses the writing method.

This kale slope batik motif is related to the mathematical concept, namely rotation and translation. In making this motif, the craftsman actually uses mathematical concepts, but because in making it uses writing techniques, so the resulting motif does not have the same size and shape. Unlike the stamp technique, it must have the same size and shape because one image element is stamped so that it produces another image element.

4. The Value of Philosophy and Mathematical Concepts on Batik Cupat Manggu Motif

Figure 5. Cupat Manggu Motif

Cupat Manggu Motif inspired by fruits. Batik motifs do not only consist of flowers, vegetables, leaves, grains, trees, grass, and parts of plants, but also consist of fruit motifs

such as the cutat manggu batik motif or mangosteen fruit. The motif is also very unique, with a depiction of the shape of the mangosteen fruit which is said to have been a fruit agricultural commodity in Garut in the past. The motif is said to be inspired by the mangosteen fruit plantation area in the Cikajang area, West Java. This batik motif making technique uses the stamp method.

The mathematical concept seen in this motif is the concept of reflection. It is said that reflection is because the figure or object being mirrored does not change in shape and size, and the distance of the figure or object from the flat mirror is equal to the distance of the shadow from the mirror. If depicted in Cartesian coordinates, the vertical and horizontal axes are the axis of its reflection. Consider the following Figure 6.
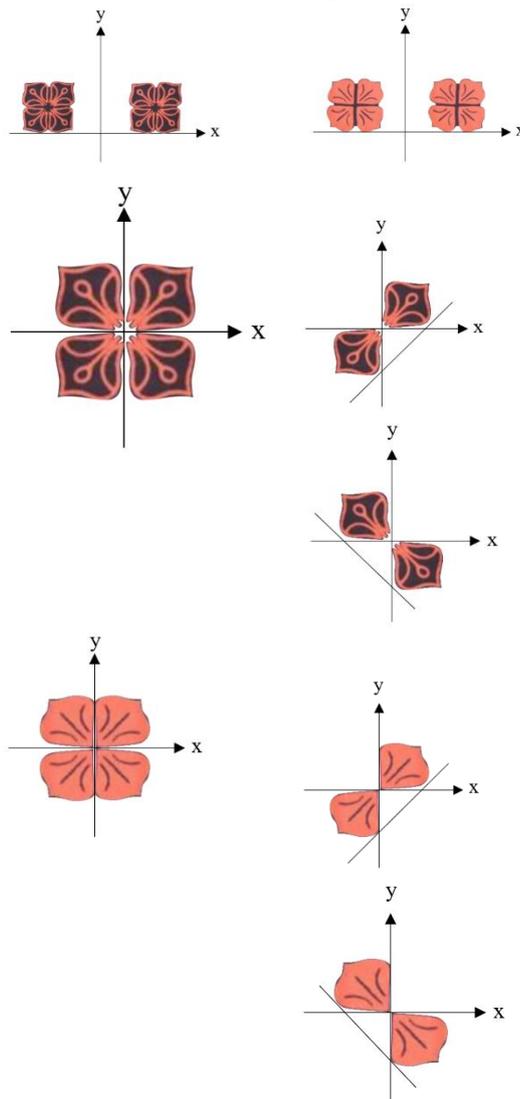

Figure 6. The Concept of Reflection on Cupat Manggu Motif

Another mathematical concept contained in this motif is the concept of rotation. It is said that rotation is because the rotated figure does not change shape and size, and the rotated figure changes position. Where this concept is by rotating the motif in accordance with its axis as far as 360° clockwise as shown in Figure 7.
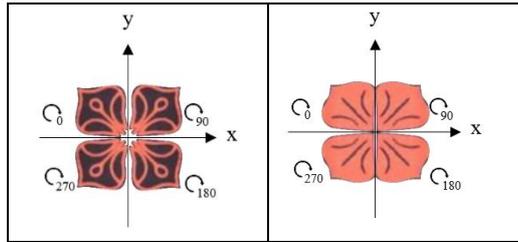
Figure 7. Concept of Rotation on Cupat Manggu Motif

Another concept in the cutat manggu batik motif is translation. It is said to be translation because all points on the translated image element move in the same direction and distance, the area of the original object is equal to the area of the object of its shift, the shadow is the same and is the same as the original object, and can be expressed in pairs of numbers, where the number shows the distance of the displacement or shift. Suppose we place the elements of the motif image at the cartesius coordinates, then the group of elements is translated into units to the right or left and up or down or translations with vectors $\binom{a}{b}$ $a, b > 0$ as shown in Figure 8.
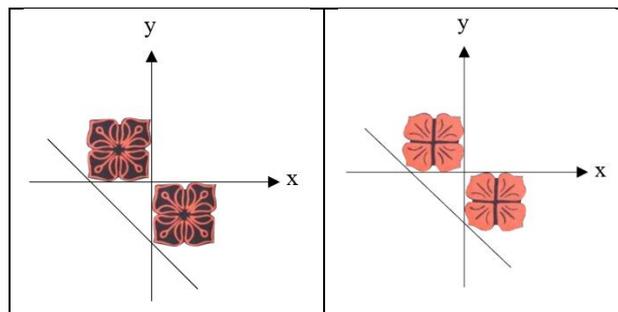

Figure 8. The Concept of Translation on Cupat Manggu Motif

Based on the description above, it can be seen that in the manufacture of Cupat Manggu motif There are mathematical concepts, namely the concepts of translation, rotation, and reflection.

5. The Value of Philosophy and Mathematical Concepts on Batik Lereng Motif

Figure 9. Batik Lereng Motif

Lereng Motif is Garutan batik that uses the names of objects around Garut such as rocks, furniture, parts of houses, places, and work equipment. No wonder the use of the name Lereng Motif inspired by the condition of Garut as well. The technique of making this batik motif uses the stamp and write method (mixed).

The mathematical concept contained in this motif is the concept of rotation. Rotation is the shift from one point to another in the geometric plane by rotating at the center of the point (Yanti & Haji, 2019). It is said that rotation is because the rotated figure does not change shape and size, and the rotated figure changes position. Where this concept is by rotating the motif that corresponds to its axis as far as 180° clockwise as shown in Figure 10.
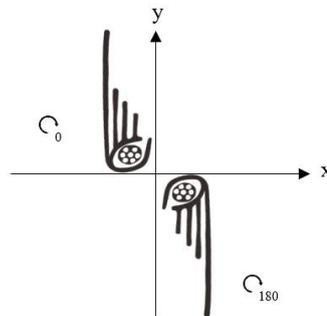

Figure 10. Concept of Rotation on Batik Lereng Motif

Another concept in the image element is translation. It is said to be translation because all points on the translated image element move in the same direction and distance, the area of the original object is equal to the area of the object of its shift, the shadow is the same and is the same as the original object, and can be expressed in pairs of numbers, where the number shows the distance of the displacement or shift. Suppose we place the image element at the cartesius coordinates and then the group of elements is translated into units or translated with vectors $\begin{pmatrix} a \\ b \end{pmatrix}$ $a, b > 0$ as shown in Figure 11. Based on the description above, it can be seen that in the manufacture of Cupat Manggu Motif There are mathematical concepts, namely the concepts of translation, rotation, and dilatation.
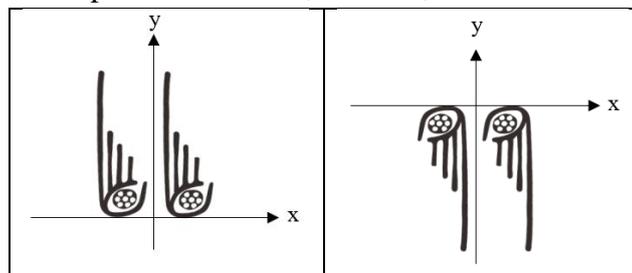

Figure 11. The Concept of Translation on Batik Lereng Motif

Mathematics is considered a product of human culture (Diki & Bantas, 2021). Through culture, students can learn mathematical concepts. A concept is structured based on previous concepts, and will be the basis for future concepts, so that a wrong understanding of a concept, will result in a wrong understanding of the next concept. In this case, the role of educators is to create a learning atmosphere that can develop students' understanding of mathematical concepts, one of which is by associating learning with culture (Syahdan, 2021).

One of the cultures that can be associated with mathematical materials is batik. Ethnomathematics with batik objects usually contains the concepts of geometry, pattern

arrangement, and transformation (Toha, et al., 2023). Ethnomathematics in garutan batik contains the concept of transformation such as reflection, translation, rotation, and dilation. In this case, teachers can use garutan batik as an ethnomathematical medium in learning transformation materials.

Mathematical media has a role in facilitating students in constructing mathematical concepts (geometry) based on contextual prior knowledge, as well as forming a learning environment that can foster positive and qualitative motivation (Richardo, 2017). One of the scientific approaches can facilitate students in understanding abstract mathematics (geometry) by using concrete ethnomathematical objects (Hardiarti, 2017)

The use of Ethnomathematics-based media helps students construct mathematical knowledge inductively (Wirawan and Novaliyosi, 2023). Students will be more creative in solving problems by observing ethnomathematical media. In addition, the use of ethnomathematical media in learning can increase student activity (Ajmain, et al., 2020),

Batik is one of the concrete learning media that can increase the effectiveness and efficiency of mathematics learning (Sintya, et al., 2021). The use of ethnomathematics-based geometry learning media has a positive effect on improving students' critical thinking skills (Sumiyati et al., 2018). Batik can be used as a learning medium that will trigger students' understanding of mateamtika and culture. Students who have a better understanding of cultural values and mathematics will be more motivated to learn more creatively (Sufia et al., 2023).

This research contributes to mathematics education by integrating local culture into mathematics teaching. By using Garutan batik motifs as a learning medium, students can understand mathematical concepts such as symmetry, fractals, and tessellation within the cultural context they are familiar with. This makes the learning process more relevant and engaging, while also deepening their understanding of mathematics.

CONCLUSION

The mathematical concept in the garutan batik motif is in the form of the concept of geometric transformation, namely translation, rotation, and reflection. The peacock ngibing batik motif is related to the concept of translation and reflection. The chicken feather motif is related to the concept of translation. In the kale slope batik motif, it is related to the concept of rotation and translation. The cutat manggu batik motif is related to the concept of reflection, rotation, and translation. The slope batik motif is related to the concept of rotation and translation.

Merak Ngibing Motif has the meaning of a peacock dancing together which describes beauty, harmony, so that it is always harmonious, peaceful, and full of joy. Merak Ngibing It is usually worn at formal, customary, and wedding events. Due to the dynamic nature of batik from West Java, it is not fixated on certain rules.

Bulu Ayam Motif, inspired by the natural conditions, flora and fauna of Garut and is a pattern inspired by the state of the environment around the artisans. Some craftsmen of course add diagonal geometric motifs for sweeteners and not only about the feather motif.

Lereng Kangkung Motif has a uniform basic color in each motif such as blue and brown. The kale slope batik motif in the form of kale plants that we usually find, is poured

in the motif in the batik. This motif is inspired by kale plants that grow on the slopes of plantations in Garut.

Cupat Manggu Motif inspired by fruits. Batik motifs do not only consist of flowers, vegetables, leaves, grains, trees, grass, and parts of plants, but also consist of fruit motifs such as the cutat manggu batik motif or mangosteen fruit.

Lereng Motif is Garutan batik that uses the names of objects around Garut such as rocks, furniture, parts of houses, places, and work equipment. No wonder the use of the name Garutan Lereng Batik Motif is inspired by the condition of Garut as well.

REFERENCES

Rinaldi, A., Novalia, S. ., & Syazali, M. (2021). *Statistika Inferensial untuk Ilmu Sosial da* Ajmain, A., Herna, H., & Masrura, S. I. (2020). Implementasi Pendekatan Etnomatematika dalam Pembelajaran Matematika. *SIGMA (Suara Intelektual Gaya Matematika), 12(1), 45–54*. https://doi.org/10.26618/sigma.v12i1.3910

Bishop, A. (1994). Cultural Conflicts in Mathematics Education: Developing a Research Agenda. *For the Learning of Mathematics, 14(2), 15–18.* http://resolver.scholarsportal.info/resolve/02280671/v14i0002/15_ccimedara.x ml

Christanti, A. D. I., Sari, F. Y., & Pramita, E. (2020). Etnomatematika Pada Batik Kawung Yogyakarta Dalam Transformasi Geometri. *ProSANDIKA UNIKAL (Prosiding Seminar Nasional Pendidikan Matematika Universitas Pekalongan), 1, 435– 444.* https://proceeding.unikal.ac.id/index.php/sandika/article/view/438

D'Ambrosio, U. (1985). Ethnomathematics and its place in the history and pedagogy of mathematics. *For the Learning of Mathematics, 5(1), 44-48.*

Dhiki, Y. Y., & Bantas, M. G. D. (2021). Eksplorasi Etnomatematika Sebagai Sumber Belajar Matematika Di Kabupaten Ende. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika, 10(4), 2698.* https://doi.org/10.24127/ajpm.v10i4.4254

Faiziyah, N., Khoirunnisa, M., Azizah, N. N., Nurrois, M., Prayitno, H. J., Desvian, Rustamaji, & Warsito. (2021). Ethnomathematics: Mathematics in Batik Solo. *Journal of Physics: Conference Series, 1720(1).* https://doi.org/10.1088/1742-6596/1720/1/012013

Hardiarti, S. (2017). Etnomatematika: Aplikasi Bangun Datar Segiempat Pada Candi Muaro Jambi. *Aksioma, 8(2), 99.* https://doi.org/10.26877/aks.v8i2.1707

Hutajulu, M., Agustiana, W., Yulianti, V., Sucahya, P., Aritonang, B., Putri, N., Ningrum, A., & Rahayu, D. S. (2023). Analisis Pembelajaran Menggunakan Pendekatan Saintifik Dan Discovery Learning Berbantuan Canva Terhadap Kemampuan Pemecahan Masalah Pada Materi Transformasi Geometri Kelas IX. *Jurnal Edukasi dan Sains Matematika.* 9(1), 69–78.

Richardo, R. (2017). Peran Ethnomatematika Dalam Penerapan Pembelajaran Matematika Pada Kurikulum 2013. *Literasi (Jurnal Ilmu Pendidikan), 7(2), 118.* https://doi.org/10.21927/literasi.2016.7(2).118-125

Setiawan, I. (2010). Batik garut: Studi tentang sistem produksi dan pemasaran. Patanjala: *Journal of Historical and Cultural Research, 2(3), 429-448.*

Siregar, P. S., Wardani, L., & Hatika, R. G. (2017). Penerapan Pendekatan Pembelajaran Aktif Inovatif Kreatif Efektif Dan Menyenangkan (Paikem) Pada Pembelajaran Matematika Kelas Iv Sd Negeri 010 Rambah. *Jurnal Pemikiran Dan Pengembangan Sekolah Dasar (JP2SD), 5(2), 743. https://doi.org/10.22219/jp2sd.vol5.no2.743-749*

Sufia, N. V., Mahmudah, U., Munawaroh, Z., & Fitrotunnida, T. (2023). Kegiatan Pendampingan Untuk Menggali Nilai Tradisional Dalam Matematika Di Kota

Pekalongan: Peningkatan Wawasan Motif Batik Melalui Etnomatematika. *Tarbi: Jurnal Ilmiah Mahasiswa, 2(2), 595–610*

Sumiyati, W., Netriwati, N., & Rakhmawati, R. (2018). Penggunaan Media Pembelajaran Geometri Berbasis Etnomatematika. Desimal: *Jurnal Matematika, 1(1), 15.* *https://doi.org/10.24042/djm.v1i1.1907*

Syahdan, M. S. S. (2021). Etnomatematika pada Budaya Lokal Batik Kawung. *Jurnal Inovasi Pendidikan Matematika (JIPM), 3(2), 83–91.* https://doi.org/10.37729/jipm.v3i2.1580

Sintiya, M. W., Astuti, E. P., & Purwoko, R. Y. (2021). Pengembangan E -modul Berbasis Etnomatematika Motif Batik Adi Purwo untuk Siswa SMP. *Jurnal Pendidikan Matematika Raflesia, 06(01), 1–15. https://ejournal.unib.ac.id/index.php/jpmr*

Toha, A.M., dkk. (2023). Etnomatematika Batik Kawung Solo sebagai Media Pembelajaran Transformasi Geometri Berbasis STEM. *SEMANTIK: Prosiding Seminar Nasional Pendidikan Matematika*

Ubayanti, C. S., Lumbantobing, H., & Manurung, M. M. (2016). Eksplorasi etnomatematika pada sero (set net) budaya masyarakat kokas Fakfak Papua Barat. *Jurnal ilmiah matematika dan pembelajarannya, 1(1).*

Wirawan, N., & Novaliyosi, N. (2023). Media Pembelajaran Berbasis Etnomatematika : Systematic Literature Review. *Jurnal Lebesgue : Jurnal Ilmiah Pendidikan Matematika, Matematika dan Statistika, 4(1), 477-490* https://doi.org/10.46306/lb.v4i1.286

Yanti, D., & Haji, S. (2019). Studi Tentang Konsep-Konsep Transformasi Geometri Pada Kain Besurek Bengkulu. *JNPM (Jurnal Nasional Pendidikan Matematika), 3(2), 265.* https://doi.org/10.33603/jnpm.v3i2.1744

Zahroh, H. R., Purnama, K. A., Asalauqi, M. F., Faridayanti, I., & Kusuma, J. W. (2021). Eksplorasi etnomatematika ditinjau dari nilai Matematika pada motif batik Banten. Himpunan: *Jurnal Ilmiah Mahasiswa Pendidikan Matematika, 1(2), 154-161.n Pendidikan*. PT Penerbit IPB Press.

Septian, A., & Komala, E. (2019). Kemampuan Koneksi Matematik dan Motivasi Belajar Siswa dengan Menggunakan Model Problem-Based Learning (PBL) Berbantuan Geogebra di SMP. *PRISMA*, *8*(1), 1–13. https://doi.org/10.35194/jp.v8i1.438

Septian, A., Suwarman, R. F., Monariska, E., & Sugiarni, R. (2020). Somatic , Auditory , Visualization, Intellectually Learning Assisted by GeoGebra to Improve Student's Mathematical Representation Skills. *Journal of Physics : Conference Series*, *1657*(1), 012023. https://doi.org/10.1088/1742-6596/1657/1/012023