Ethnomathematic Exploration on Cassava Leaf Painting Batik

Ni Ketut Wedastuti(✉)

State Junior High School 6 Singosari, Malang, Indonesia
ketutweda81@gmail.com

Abstract. Ethnomathematics is the relationship between culture and mathematics that is found in the habits of society where people have unconsciously applied mathematical concepts in their culture or habits. The habits referred to in this study are what the batik makers do in making one sheet of finished batik each time. The purpose of this study was to describe the ethnomathematics of cassava leaf batik in the production house of the new Kartini pujer batik. This research is qualitative research with an ethnographic approach. The subjects of this research are craftsmen in the production house of Karini Pujer Baru Batik. Data collection methods used are observation, interviews, and documentation. Observations were carried out by the researchers themselves and assisted by 2 observers who had been provided with observation guidelines, and interviews were conducted with the craftsmen at the batik production house of the new Kartini Pujer Bondowoso, while the documentation was carried out by the researcher himself using a camera recorder. The results of this study indicate the existence of ethnomathematics in cassava leaf painting batik. The geometric concepts or elements found include points, lines, angles, shapes (rectangles, squares), congruence, congruence, equations, and geometric transformations (dilation).

Keywords: batik painting · cassava leaf batik · cassava leaf ethnomathematics

1 Introduction

Mathematics is a science that has always been and continues to develop in human life until now. D'Ambrosio (2001) [1] explains that the purpose of ethnomathematics is to recognize that there are different ways of doing mathematics taking into account the academic mathematical knowledge developed by different sectors of society as well as taking into account the different modes by which different cultures negotiate their mathematical practices (how to group, count, measure, design buildings or tools, play and others). Ethnomathematics is a variety of mathematical activities owned or developed in the community, including mathematical concepts such as cultural relics in the form of temples and inscriptions, pottery and traditional equipment, local units, batik cloth motifs, and embroidery, traditional games, and community settlement patterns. Often people do not realize that they have involved mathematics in their lives. Son (2017) [2] stated that not only students, but people also think that mathematics is not related to

D. Pristine Adi et al. (Eds.): ACIE 2022, ASSEHR 714, pp. 42–52, 2023.
https://doi.org/10.2991/978-2-38476-044-2_6

their lives, when in fact there is a connection with culture in people's lives. Culture is a lifestyle that is passed down from generation to generation, where culture describes the characteristics of an area. Wahyuni (2016) [3]. The natural wealth in Indonesia is very abundant and should be proud of, where the combination of the two is known as ethnomathematics. Several researchers reported the results of their research related to ethnomathematics, including Stathopoulou, Kotarinou, and Appelbaum (2015) [4] reporting the results of their research that in learning mathematics students are taught with an artistic approach. Irawan, Lestari, and Rahayu (2017) [5] revealed that ethnomathematics identification in typical Balinese batik in addition to learning is also useful in making applications to detect new designs or motifs that may arise from the results of integration between the two. Yulianto, Prabawanto, and Sabandar (2019) [6] revealed that the Sukapura Sunda batik pattern is a reinforcement to students who are hooked on moral strengthening so that students are sure that mathematics and culture are not separated from each other. Sudirman, Son, and Rosyadi (2018) [7] said that the use and introduction of geometry material through Paoman batik is very effectively applied to elementary school students because it is easy to identify. Abi (2016) [8] said ethnomathematics is a mathematical science that is associated with certain cultures such as occupational groups (farmers, laborers, traders, ranchers, fishermen, and other occupations) both in the high and low classes. The five researchers revealed how to use batik as a result of collaboration between mathematics and culture for classroom learning. In particular, batik is defined as an art of writing or painting on fabrics, wherein the work batik craftsmen use candles ("night") in the process of obtaining patterns or designs on cloth using canting [9]. There are many types of batik and one of them is painting batik, where in making it, it is used how to paint directly on the fabric he has chosen, usually white cloth [10]. According to Seodjono [11] painting batik is a batik that has a free pattern and is not a traditional batik that has certain ties. The creation of coloring will produce a variety of colors with complex patterns. The pictures contained in the written batik are made using a brush or a combination of brushes and canting. If the researchers before raising the topic related to the use of ethnically only but have not explored in detail the elements that can be taken from the observed batik, then this article it is revealed related to the geometric elements of batik objects that make students more critical and creative again in developing batik in Bondowoso district, especially in batik painting. Bondowoso is a regency between Jember Regency in the south and Situbondo Regency in the north, known as tape city and there is one of the batik craftsmen's areas including batik Tulis, batik cap, and batik painting. This painting batik is one of the things in Bondowoso, namely Cassava Leaf Batik. Bondowoso itself is known as the City of Tape, where cassava-based tape. Therefore, cassava leaves are used as batik motifs typical of the Bondowoso area. One of the places that produce cassava leaf batik is the new Kartini Mujer batik production house Bondowoso. The purpose of this study is to reveal the concept or element of geometry in cassava leaf painting batik.

2 Method

Qualitative research with an ethnographic approach allows researchers to obtain information related to the habits of batik makers in producing batik every day. The focus of the object studied is cassava leaf batik made by painting. To make it easier for researchers to achieve research goals, the first step taken is preliminary, where this step what is done is to choose the area and subject of the study. The subjects of the study or respondents are the parties who are used as samples in a study. The subject of the batik study was the Kartini batik production house in the new poker village of Bondowoso. The second step is the creation of a draft instrument consisting of observation guidelines and interview guidelines which are compiled based on the results of observations in the field and realized into a draft of observation and interview guidelines. The third step is instrument validation, which is to validate the draft instrument of the observation guidelines and interviews (the previous step) to validators. Data were obtained by conducting site observations, interviewing the three subjects, and documenting everything needed in data collection. The observation was carried out by directly observing the Cassava Leaf batik found in the new Kartini Mujer batik production house. Interviews were conducted with batik makers at the Kartini batik production house to obtain as much clear as possible data or information. The next step is data analysis, this step is carried out by compiling data on the focus of the problem study and research objectives. The last step is a conclusion, where the researcher gets the final result of his research and answers according to the purpose of the study.

3 *Results and Discussion*

A) *Concept of Mathematical Concepts*

Mathematical Concepts Concepts are abstract ideas that can be used to classify or classify a set of objects [12]. Concepts are formed from several experiences that have similarities in general. When the first concept is formed, it can be said to be an example of the concept. So that the more experience gained the more concepts you have. Concepts are abstract ideas that can be assimilated and accommodated with knowledge so that they can group and name a set of objects. Thus, to form a concept requires several experiences that have something in common. Wahyuni dkk (2019) [13]. The use of names in linking an object is related to the classification process, that is, to recognize an object belonging to an existing class. Naming plays a role in the formation of new concepts. If the same name arises from different experiences, it will affect the grouping of those experiences in the mind and abstract their intrinsic similarities to separate their groups. Thus, the relationship between the concept and its name can be formed after the concept is formed or in the process of its formation. Some cassava leaf painting batik motifs can be used as a tool to introduce mathematical concepts as well as geometric concepts to make it easier to understand abstract mathematical concepts, including straight lines, curved lines, parallel lines, symmetry, points, angles, rectangles, triangles, circles, jajargenjang and the concept of revival. In the process of making patterns/designs on cassava leaf painting batik, there are elements or geometric concepts that are unconsciously applied by the batik makers. The geometric elements or concepts used include points, lines, angles, flat builds, revivals, and geometric transformations.

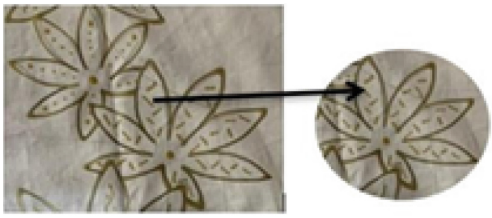

Fig. 1. Dot Pattern on Cassava Leaf Writing Batik

B) *Elements of Lines and Lines in Batik*

Ethnomathematics arises when the batik maker draws a line. Given two points on the line, there is always one point located between the lines. Based on observations and interviews that have been carried out in this study, it was found that in making batik there are elements of lines and line segments. The method used by the line and line segments varies, some directly use canting and some use a ruler when creating a pattern. The line segments are included in the isen, and the line elements are included in certain parts of the pattern. The line segments that include isen are made to fill the space and make the batik look more beautiful. The line elements included in certain parts of the pattern are made using a ruler to get a straight result and some lines are made using a ruler but after being edited they are not straight because the insertion process does not use a ruler. Elements of this line and line segment are found in the cassava leaf batik pattern. The elements of the line segments included in the isen section are the line segments on the cassava leaf writing batik pattern. The line segments are scattered on the cassava leaf ornament. The line segments contained in the cassava leaf ornament are small.

Researcher: In this cassava leaf, there is a bone point of the leaf using a canting or brush.

Speaker: Use canting, if the scratches are using a brush.

Researcher: So these points include isen?

Speaker: Yes, it's not including isen.

C) *Corner Elements in Cassava Leaf Painting Batik*

An angle is defined as the confluence of two rays that have the same base point. An angle that measures less than 90o is called a tapered angle. Angles that have a size of exactly 90o are called right angles. If the size of the angle is between 90o and 180o, then the angle is called an obtuse angle. The angle that measures exactly 180 o is a bulleted corner. An angle that has a size between 180o and 360o is called a reflex angle.

In this study, ethnomathematics appeared when batik makers made corner patterns in batik designs. Based on the results of research, pembatik subconsciously carries out mathematical activities, namely making angular patterns. In cassava leaf painting batik, there is an angular concept, namely two lines that meet at the same base point.

Researchers: then this is how it is made, how? this is what it's called? And What shape does it look like?

Speaker: The shape is rectangular.

Researcher: If it's this one, use a ruler.

Resource Person: No, some lines need to be drawn using a ruler to be straight, namely on blue fire batik and coffee.

Fig. 2. Illustration of Corner Patterns on Cassava Leaf Painting Batik

D) *Translation*

Translation (shift) is a form of transformation that aims to move all points of a building within a certain distance. Based on the results of observations and interviews that have been carried out, ethnomathematics appears when batik makers make batik patterns/designs in which there is a translational or shifting concept. The translational concept is found in the pattern of batik writing Cassava leaves, blue fire, singo ulung, and coffee. These batik patterns have shapes, sizes, and distances in certain units. Subjects C, T, and S say that several ways were used to move the motif, including by way of approximation and blat. According to C and T for the method of estimation, usually, the batik maker only estimates the distance between one ornament and another. Subject S says that for novice batik makers, it is customary to use the help of a lidi or folded paper to determine the approximate distance between ornaments. For the blat way, say that the batik maker makes one pattern on a piece of paper first and then plagiarizes it on the fabric, so that the resulting image has the same shape and size. The translational concept is found in the pattern of cassava leaf writing batik.

Speaker A: several ways used to move motives, including using estimation and blat.

Source B: for the method of estimation, usually the batik maker only estimates the distance between one ornament and another (Fig. 3).

Fig. 3. Pattern of Distance of One Ornament to Another

E) Elements of Flat Build on Cassava Leaf Painting Batik

Ethnomathematics appears when batik makers make flat wake patterns on batik designs. Based on the results of research on cassava leaf painting batik, there is a flat building drawn, namely a quadrangle. To make the building flat, the batik maker just draws directly on the fabric. The flat buildings contained in this study are triangles, quadrilaterals, and circles. A triangle is a flat construct bounded by three closed sides [14]. The triangle found in cassava leaf writing batik is a pointed triangle. The triangular build is found in the cassava leaf writing batik, where the triangle wake is used as isen. S says that the manufacture of the triangular wake does not take measurements. The rectangles in question are rhombuses and squares. The rhombus is a jajargenjang with two adjacent sides contemporaneously [15]. Jajargenjang is a quadrangle with two pairs of sides facing parallel and equal in length. A square is a rhombus that has a right angle (Fig. 4).

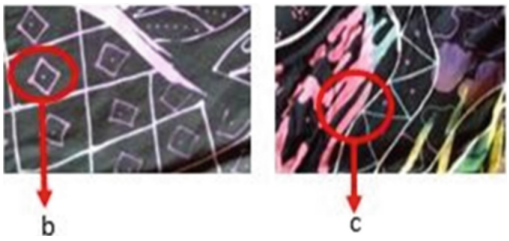

Fig. 4. Illustration of Flat Wake Pattern on Cassava Leaf Painting Batik

Researcher: For batik, this one is in the form of a rhombus or a quadrangle?
Speaker: Quadrangle.
Researcher: For batik, what is the quadrangle too?
Source: No, because the line that is smitten is not straight

F) *Elements of Revival in Cassava Leaf Painting Batik*

Ethnomathematics appears when batik makers make patterns/designs and results of cassava leaf painting batik. Based on the results of the study, batik makers unconsciously carry out mathematical activities, namely making ornament patterns. Batik ornaments that have the same shape but are comparable in size are building ornaments. The concept of revival can be seen in the coffee bean ornamentation. In the ornament, it appears that one ornament has the same shape as the other ornaments. But the sizes are different, some are enlarged, some are reduced, and some are comparable or similar.

If two geometric constructs have the same shape then the two constructs are said to be a building. However, if two geometric constructs have the same shape, all sides and corresponding angles have the same size, then the two constructs are said to be congruent [15] (Fig. 5).

Fig. 5. Revival Pattern in Cassava Leaf Painting Batik

In this study, ethnomathematics that appears or is visible is geometric elements, including points, lines, angles, flat wakes (quadrangles), revivals, and geometric transformations (dilatation) [4, 16]. In Fig. 1, you can see the dot pattern on the cassava leaf writing batik and confirmed through interview footage. The way it is made is carried out according to what the subject is used to working on. In line with Stathopoulou, Kotarinou, and Appelbaum (2015) [4] which also resulted in the concept of a point. In Fig. 2, the line pattern on cassava leaf painting batik also appears in the research results of Wahyu et al. (2018) [16]. Astuti, Purwoko, & Sintiya (2019) [17] produces number patterns, especially Arithmetic and if linked will produce the following patterns.

1. Dot pattern

In this study, ethnomathematics appeared when batik makers made a point on batik design. Points cannot be defined but can be determined to be located and have zero dimensions. Batik itself is an activity to make a point using canting and night. According to C the dot is part of the isen and is made to embellish the existing motifs. Points are drawn using canting number 1 or canting isen. The way the caning makes a point is to heat the night first on the pan then the canting is filled with night and etch the canting on the cloth. The night should not be too hot or too cold, because if it is too hot when you put it on the cloth, it will “mblobor”.

2. Line pattern

In this study, ethnomathematics appeared when batik makers made lines on batik designs. A line is a set of infinite points. If there are two points on the line, there is always a point located between the two points. There are various ways in which the batik maker makes lines, namely by using a ruler and directly using canting. According to D, there is a line that includes isen, the line is made to embellish the design of the existing motif. In addition, according to M, some lines need to be drawn using a ruler to make them straight and neat. There is also a line that when patterned is straight then after being set the line becomes not straight. Because the insertion process does not use a ruler. For the line that is the isen of the batik, there is no need to make a pattern, it’s just that it directly etches the night on the fabric. And the number of lines is erratic and not the same in each ornament.

3. Angular pattern

According to Alexander and Koeberlein (2011) [18] an angle is formed from the confluence of two rays that have the same base point. An angle that measures less than 90° is called a tapered angle. Angles that have a size exactly 90° are called right angles. If the size of the angle is between 90° and 180°, then the angle is called an obtuse angle. Angles that have a size of exactly 180° are called bulleted angles. Angles that have a size between 180° and 360° are called reflex angles. In this study, ethnomathematics appeared when batik makers made corner patterns in batik designs. Based on the results of research on Cassava Leaf batik, D and M as batik makers unconsciously carry out mathematical activities, namely in making corner patterns.

4. Flat Wake Pattern

Flat buildings that are often found in learning in schools include triangles, quadrangles and circles. In this study, ethnomathematics appeared when batik makers made a flat wake pattern in batik designs. Based on the results of research on the results of cassava leaf painting batik, there are rectangles and circles. The rectangle in question is a rectangle and a rhombus. According to Alexander and Koeberlein (2011) [18] a rectangle is a parallelogram with one right angle and a rhombus is a parallelogram with two adjacent sides contemporaneous. The definition of parallelogram itself is a quadrangle with two pairs of sides facing parallel and equal in length. D refers to the rhombus as "wajik", the circle as round and rectangular as square. Mentions the division of Erfan Yudianto, Susanto, Sinta Priciliya eISSN: 2442–4226 208 rhombic as a quadrangle. To make the build flat, the batik maker does not measure the length of each side, only directly draws on the fabric. But to create a rectangle, the batik maker uses a ruler to make it straight and neat. This can also be seen from the results of Putri's research (2017) [19] which says that the results of well-observed objects can be used as the source of these objects such as producing the concept of flat building geometry. Furthermore, Khofifah, Sugiarti, and Setiawan (2018) [20] also reported the results of research related to Banyuwangi batik producing flat building objects that were developed again into student worksheets.

5. Revival Pattern

If two geometric constructs have the same shape then the two constructs are said to be a building. If two constructs have the same shape and all corresponding sides and angles have the same size, then the two wakes are said to be congruent [15]. In this study, ethnomathematics appeared when batik makers made ornament patterns that had the same shape and size in batik designs. Based on the results of research on D and M as batik makers, they unconsciously carry out mathematical activities, namely in making ornament patterns that have the same shape and size. Batik ornaments that have the same shape but are comparable in size are building ornaments. Batik ornaments that have the same shape and size are congruent ornaments. In line with Nurjamil and Nurhayati (2019) [21] who reported that Tasikmalaya's typical batik writing also produces mathematical patterns that form a flat building that is in harmony, including those related to the concept of mirroring or reflection. Furthermore, the results of research by

Sudirman, Rosyadi, and Lestari (2017) [22] reported that elements of geometric transformation were also obtained in research related to Indramayu batik, namely translation and reflection. Strengthened by the results of Yanti & Haji's (2019) [23] research on Besurek Bengkulu fabric which produces complete transformation elements, namely translation, reflection, rotation and dilatation.

4 Conclusion

There is ethnomathematics in cassava leaf painting batik in the production house of Batik Kartini pujer Baru Bondowoso. Cassava Leaf Batik typical of the new pujer Bondowoso has the characteristic of the shape of one cassava leaf blade consisting of seven leaf fingers. Ethnomathematics arises when batik makers make patterns/designs and in cassava leaf painting batik there are elements or concepts of geometry. Elements or geometric concepts contained in cassava leaf painting batik are points, lines, angles, flat builds (quadrangles), revivals, and geometric transformations (dilatation). To make these elements or concepts of geometry, we use measurement methods or approximate methods.

References

1. U. D'Ambrosio, *Ethnomathematics : link between traditions and modernity* . Rotterdam: Sense Publishers, 2001.
2. A. L. Son, "STUDY ETHNOMATEMATICS: PENGUNGKAPAN KONSEP MATEMATIKA DAN KARAKTER SISWA PADA PERMAINAN KELERENG MASYARAKAT SUKU DAWAN," *J. Medives J. Math. Educ. IKIP Veteran Semarang*, vol. 1, no. 2, 2017.
3. I. Wahyuni, "Eksplorasi Etnomatematika Masyarakat Pesisir Selatan Kecamatan Puger Kabupaten Jember," *Fenomena*, vol. 15, no. 2, pp. 225–238, 2016.
4. C. Stathopoulou, P. Kotarinou, and P. Appelbaum, "Ethnomathematical research and drama in education techniques: developing a dialogue in a geometry class of 10th grade students," *Rev. Latinoam. Etnomatemática* , vol. 8, no. 2, pp. 105–135, 2015.
5. A. Irawan, M. Lestari, and W. Rahayu, "PENDEKATAN UNSUR ETNOMATIKA DALAM PENGENALAN MOTIF BATIK KHAS BALI," *Semin. Nas. Mat. DAN Pendidik. Mat. (2nd Senat. Progr. Stud. Pendidik. Mat. FPMIPATI*, pp. 34–39, 2017.
6. E. Yulianto, S. Prabawanto, J. Sabandar, and Wahyudin, "Pola matematis dan sejarah batik sukapura : Sebuah kajian semiotika," *JP3M J. Penelit. Pendidik. dan Pengajaran Mat.*, vol. 4, no. 1, pp. 15–30, 2019.
7. Sudirman, A. L. Son, and Rosyadi, "Penggunaan Etnomatematika Pada Batik Paoman Dalam Pembelajaran Geomteri Bidang di Sekolah Dasar," *Indomath Indomanesian Math. Educ.*, vol. 1, no. 1, pp. 27–34, 2018.
8. A. M. Abi, "Integrasi Etnomatematika dalam Kurikulum Matematika Sekolah," *J. Pendidik. Mat. Indones.*, vol. 1, no. 1, pp. 1–6, 2016.
9. P. Supriono, *Ensiklopedia the heritage of batik : identitas pemersatu kebanggaan bangsa.* Yogyakarta: Penerbit ANDI, 2016.
10. A. Prasetyo and Singgih, "Karakteristik Motif Batik Kendal Interpretasi dari Wilayah dan Letak Geografis," *J. Imajin.*, vol. 10, no. 1, pp. 51–60, 2016.
11. R. N. F. Amrulloh and F. Ratyaningrum, "BATIK LUKIS KARYA GUNTUR SASONO DI DESA CARAT KECAMATAN KAUMAN KABUPATEN PONOROGO PERIODE 2008-2016," *J. Seni Rupa*, vol. 6, no. 1, pp. 653–662, 2018.

12. R. R. Skemp, *The Psychology of learning mathematics: Expanded American edition*. Routledge, 1987. https://doi.org/10.4324/9780203396391/PSYCHOLOGY-LEARNING-MATHEMATICS-RICHARD-SKEMP.
13. I. Wahyuni, P. Prof, S. Dr., and R. Rahardi, "The students' mathematical thinking ability in solving the program for international student assessment(Pisa) standard questions," *J. Adv. Res. Dyn. Control Syst.*, vol. 11, no. 7, pp. 777–787, 2019.
14. R. D. Gustafson, *Elementary geometry* , 3rd ed. New York: John Wiley & Sons, 1991.
15. D. C. Alexander and G. M. Koeberlein, *Elementary Geometry for College Students, Sixth Edition*. Canada: Nelson Education, Ltd., 2015.
16. S. Wahyu, T. B. Setiawan, and Sunardi, "ETNOMATEMATIKA PADA PURA MANDARA GIRI SEMERU AGUNG SEBAGAI BAHAN PEMBELAJARAN MATEMATIKA," *Kadikma*, vol. 9, no. 1, pp. 156–164, 2018.
17. E. P. Astuti, R. Y. Purwoko, and M. W. Sintiya, "Bentuk Etnomatematika Pada Batik Adipurwo Dalam Pembelajaran Pola Bilangan," *J. Math. Sci. Educ.*, vol. 1, no. 2, pp. 1–16, 2019, https://doi.org/10.31540/jmse.v1i2.273.
18. D. C. Alexander and G. M. Koeberlein, *Elementary geometry for college students*. USA: Nelson Education, Ltd., 2011.
19. L. I. Putri, "EKSPLORASI ETNOMATEMATIKA KESENIAN REBANA SEBAGAI SUMBER BELAJAR MATEMATIKA PADA JENJANG MI," *J. Ilm. "PENDIDIKAN DASAR,"* vol. 4, no. 1, pp. 21–31, 2017.
20. L. Khofifah, T. Sugiarti, and T. B. Setiawan, "ETNOMATEMATIKA KARYA SENI BATIK KHAS SUKU OSING BANYUWANGI SEBAGAI BAHAN LEMBAR KERJA SISWA MATERI GEOMETRI TRANSFORMASI," *Kadikma*, vol. 9, no. 3, pp. 148–159, 2018.
21. D. Nurjamil and E. Nurhayati, "Eksplorasi unsur matematika dalam pembuatan batik khas Tasikmalaya," *J. Mat. Ilm. STKIP Muhammadiyah Kuningan* , vol. 5, no. 2, pp. 111–119, 2019.
22. Sudirman, Rosyadi, and W. D. Lestari, "Penggunaan Etnomatematika Pada Karya Seni Batik Indramayu Dalam Pembelajaran Geometri Transformasi," *Pedagogy*, vol. 2, no. 1, pp. 74–85, 2017.
23. D. Yanti and S. Haji, "Studi Tentang Konsep-Konsep Transformasi Geometri Pada Kain Besurek Bengkulu," *JNPM (Jurnal Nas. Pendidik. Mat.*, vol. 3, no. 2, pp. 265–280, 2019, https://doi.org/10.33603/jnpm.v3i2.1744.
24. Albab, I. U., Hartono, Y., & Darmawijoyo, D. (2017). Kemajuan Belajar Siswa Pada Geometri Transformasi Menggunakan Aktivitas Refleksi Geometri. Jurnal Cakrawala Pendidikan, 3(3), 338–348. https://doi.org/10.21831/cp.v3i3.23 78
25. Arwanto. 2017. Eksplorasi Etnomatematika Batik Trusmi Cirebon untuk Mengungkap Nilai Filosofi dan Konsep Matematis. Prosiding Seminar Nasional Matematika. Cirebon: Universitas Muhammadiyah Cirebon
26. Amirullah, A., Wardoyo, T., & Rapitasari, D. (2019). Peningkatan Kualitas Batik Tulis Motif Tajung di Kelurahan Polagan Sampang Menggunakan Bahan Pewarna Alam Mangrove. JPP IPTEK (Jurnal Pengabdian Dan Penerapan IPTEK), 3(2), 113–126. https://doi.org/10.31284/j.jppiptek.2019.v3i2.683
27. Astuti, E. P., Purwoko, R. Y., & Sintiya, M. W. (2019). Bentuk Etnomatematika Pada Batik Adipurwo Dalam Pembelajaran Pola Bilangan. Journal of Mathematics Science and Education, 1(2), 1–16. https://doi.org/10.31540/jmse.v1i2. 273
28. Ayuningtyas, A. D., & Setiana, D. S. (2019). Pengembangan Bahan Ajar Matematika Berbasis Etnomatematika Kraton Yogyakarta. AKSIOMA: Jurnal Program Studi Pendidikan Matematika, 8(1). https://doi.org/10.24127/ajpm.v8i1. 1630
29. Gerdes, Paulus. (1999) Ethnomathematics As New Research Field, Illustrated By Studies Of Mathematical Ideas In Africa History.

30. Kamarudin, Muhammad. (2015). Eksplorasi Etnomatematika Masyarakat Madura pada Pola Pemukiman Taneyan Lanjang, Thesis, Universitas Negeri Surabaya.
31. Rosa, Milton dan Daniel Clark Orey. 2011. Ethnomathematics: the cultural aspects of mathematics. Revista Latinoamericana de Etnomatemática, 4(2). 32-54