Etnomathematics: Exploration of *Geblek Renteng Batik* in Transformation Geometry

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Article Info	Abstract
	This study aims to explore the ethnomathematics of *Batik Geblek* jointly in Kulonprogo. As we know that Batik has been a Humanitarian Heritage for Oral and Intangible Heritage since October 2, 2009, by UNESCO, so that the existence of Batik as an intangible cultural heritage, it is possible to use it as an alternative medium for learning mathematics, so that mathematical concepts are closer to the context in everyday life. This type of research is qualitative descriptive with an ethnography approach. The collected data is qualitative, as the resource is gained from the observation, interview, and documentation related to batik *Geblek Renteng*. The research instrument is private research. The technic of data collection is gained from in-depth interviews and documentation. The aid that is used in this research is interview guidance and documentation. The validation data is done by doing qualitative descriptive analysis. The result of the research shows that the motifs on Batik *Geblek Renteng* contain a mathematics concept. The identification results from *Geblek Renteng Batik* as the triangle elements, parallelogram, translation, reflection, rotation, and dilatation. The math concept on Batik *Geblek Renteng and the introduction of culture are* also expected for one of the math learning applications based on the culture process.

INTRODUCTION

Batik is historically derived from the era of our ancestors, known since the XVII century, written and painted on palm leaves. At that time, batik motifs or patterns were still dominated by animal and plant forms. However, Batik has developed in its development, namely from the patterns of painting animals and plants, gradually turning to abstract motifs that resemble clouds, temple reliefs, *wayang beber*, etc. Furthermore, by combining painting styles with decorating clothes, the art of written Batik emerged as we know it today. The types and patterns of traditional Batik are classified widely, but the styles and variations according to the philosophy and culture of each region are very diverse. Batik is a traditional *wastra*, comes in so many varieties. Each region arguably has its distinctive motifs and meanings.

Indonesian Batik as a whole, from the techniques, technology, and the development of motifs and culture related to UNESCO, has been designated as a Humanitarian legacy for Oral and intangible heritage since October 2, 2009 [1]–[4]. Batik is a craft that has high artistic value and has been a part of Indonesian culture, especially Java [5]–[8]. Some of the batik motifs are adapted to the philosophy of an area including the *Geblek Renteng Batik* from Kulonprogo, *Megamendung* from Cirebon, *Garutan* batik from Garut, and *Pekalongan* batik from Pekalongan.

Today only a handful of people still care about culture [9]. Even though cultural values become the foundation of the nation's character and are essential things to be instilled in each

individual, then cultural values must be instilled early so that each individual can better understand, interpret, and appreciate and realize the importance of cultural values in carrying out every life activity [10]. As appropriate, cultural values can be cultivated through the family environment, education, and community environment [11]. Culture is the fruit of the human mind as a result of human struggle against two powerful influences, namely age and nature, which is evidence of the triumph of human life to overcome various obstacles and difficulties in life and life to achieve salvation and happiness that are born in an orderly and peaceful manner because the culture is the product of creativity, taste, and intention within [12]–[16].

Today only a handful of people still care about culture. On the other hand, the next generation's awareness of the importance of regional culture began to diminish. One of the cultures of the region that is starting to be abandoned is batik activity. Many people began to leave the profession of Batik because it is considered less profitable and requires capital and a long time, so that most people switched professions. This, of course, can lead to the distinctive Kulonprogo Batik disappearing more and more because there are no generations to continue.

Mathematics, in general, can be practiced by cultural groups such as urban and rural groups, labor groups, children of specific age groups, or indigenous peoples as ethnomathematics [17], [18]. The learning process that follows the conditions and culture of the local area can be more accepted by the general public, including students [19]–[21]. It can connect culture and education, especially in mathematics, namely ethnomathematics [22]. Ethnomathematics is an idea to utilize social and cultural elements in mathematics learning [23], [24].

The idea of making ethnomathematics a concept that bridges mathematics and culture, ethnomathematics is a science used to understand how mathematics is adapted from culture and expresses the relationship between culture and mathematics [25]–[28]. So it can be said that ethnomathematics is the science of studying the culture of society, historical relics related to mathematics and mathematics learning. Whereas [29] states that the integration of ethnomathematics into the formal mathematics curriculum is one way to overcome the difficulties of students learning mathematics [28], [29]. From the experts' definitions, it can be said that there is a relationship between mathematics and culture that can be used for school mathematics learning. However, the facts show that mathematics learning in schools tends not to use culture as a learning context [30]–[33]. Based on the application of the 2013 curriculum, which advocates that the learning process in the classroom must provide special meaning for students. It is intended that students are not only oriented towards results but can interpret every material they learn. One of the things that can be done is through contextual learning related to the surrounding environment. In this regard, this study aims to explore ethnomathematics on *Geblek Renteng Batik*, which can be used as a medium for learning transformation geometry.

METHOD

This research uses a descriptive qualitative research method with an ethnographic approach [34]. Descriptive data is collected in words, images, and not numbers, while the ethnographic method is used to describe, explain, and analyze a society or ethnic group [35]–[37]. The instrument in this study is the researcher itself as a human instrument. In this case, the researcher acts as a

data collector and cannot replace his role, so the researcher is the main instrument [34]. Data collection techniques in this study were obtained by in-depth documentation and study of literature. The literature search is carried out by collecting primary reference sources such as journals, research reports, theses, theses, dissertations, proceedings, and secondary reference sources such as books and internet sources.

Data analysis techniques used in this study include four main points, namely: (1) Data collection used to obtain accurate data using literature and documentation studies, (2) data reduction, which means to summarize and select the main points, (3) presentation of data conducted in the form of narrative text, and (4) concluding data that has been analyzed [34]. The validity of the data in this study was checked using triangulation techniques, namely source triangulation [38]. This technique is a way to check data through several informants relevant to the research context [39].

RESULT AND DISCUSSION

Kulonprogo Regency is one of the Batik producing regions that is uniquely patterned with shapes resembling mathematical objects. *Geblek* is a portion of exceptional food from the Kulonprogo area, made from cassava flour [40], [41]. The motif was taken from one of the local specialties called *Geblek*. Also, other motives symbolize the natural wealth of the Kulonprogo Regency. Batik typical of the Kulonprogo area is known by the name of *Geblek Renteng Batik* [42]. The motifs of the Kulonprogo Batik have their meanings, including the *Geblek* shape, which resembles the number eight, symbolizing that the Kulonprogo Regency has 88 villages [43]. At the same time, *Renteng* means a bond or bond with each other when fried symbolizes the community standing together to build Kulonprogo [44]. In addition to the *Geblek* symbol in the *Geblek Renteng Batik* motif, there is the *Binangun* symbol in the shape of a flower bud that will bloom and meaning that Kulonprogo is an area that will soon develop [45]. Besides the built symbol, there is a mangosteen fruit motif that means that the fruit is a typical flora of Kulonprogo [46].

Mathematical objects in *Geblek Renteng Batik* can be clearly defined, such as triangles, parallelograms, circles, reflection, concept lines, etc. Finding mathematical objects on *Geblek Renteng Batik*, a clear idea of knowledge is needed. One idea that can bridge between culture and mathematics is ethnomathematics [47]. Ethnomathematics itself was first introduced by a Brazilian mathematician named D'Ambrosio. D'Ambrosio defines ethnomathematics as mathematical practices in a cultural group that can be identified as mathematical study ideas [17], [18], [24], [26], [48]. The search for mathematical relationships in *Geblek Renteng Batik* motifs can be identified mathematically through the branch of mathematical knowledge in the field of geometry. As for the results of the identification of ethnomathematics obtained from *Geblek Renteng Batik*, it can then be used as a learning material for mathematics, such as questions based on ethnomathematics. The following is a discussion of ethnomathematics exploration of the *Geblek Renteng Batik* in Kulon Progo.

Translation

In Euclidean geometry, a translation is a geometric transformation that moves every point of a figure or a space by the same distance in a given direction. A translation can also be interpreted as adding a constant vector to every point or shifting the origin of the coordinate system. The translation is a shift or displacement of all points on the geometric plane to the same extent and direction. Suppose that points A, B, and C, respectively, are translated to points A', B', and C' with the same distance and direction (see figure 1).
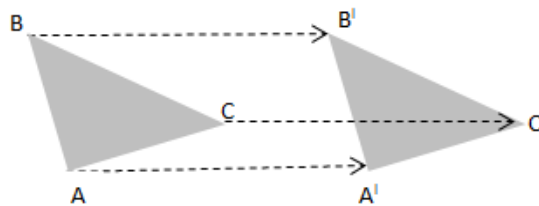

Figure 1. Concept of Translation

A translation can be viewed concerning the axis and the ordinate. Shift as far as a parallel to the *x-axis* (shift right $a > 0$, left $a < 0$), and the shift as far as b is parallel to the *y*-ordinate (shift up $b > 0$, down $b < 0$) is denoted as

$$A(x, y) \binom{a}{b} \rightarrow A' (x + a, y + b)$$

The *Geblek Renteng Batik* motif found translational concepts as in figure 2. If the triangle motif on the *Geblek Renteng Batik* is shifted vertically up as far as h units, then k units are shifted again in the same direction, we can find the basic concept of translation. On the motif, the triangle ABC is translated twice as far as a unit and k units up parallel to the *y-axis* and results in an A'B'C' building and an A"B"C".
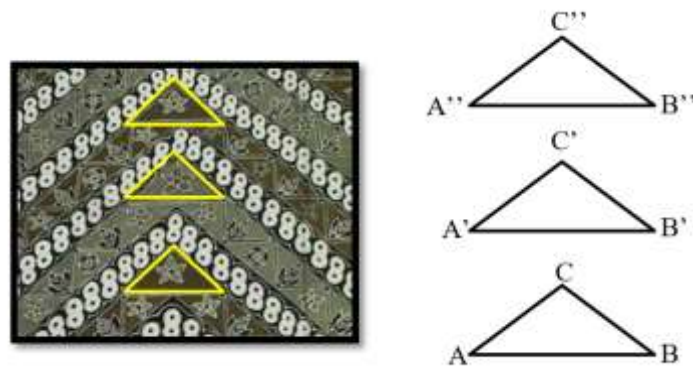

Figure 2. *Geblek Renteng Batik* Found Translational Concepts

As for the translational properties that can be found in the *Geblek Renteng Batik* designs together (a) field size ABC = field size A'B'C' = field size A"B"C", (b) The distance of each point to each other, (c) The direction of the ABC plane is in the direction of the plane A'B'C' and A"B"C".

Reflection

A reflection is an example of a transformation that takes shape (called the preimage) and flips it across a line (called the line of reflection) to create a new shape (called the image). It is the same as the image of an object that is formed in a mirror. An object that experiences reflection will have an image of the object produced by a mirror. The result of reflections on the Cartesian plane depends on the axis being the mirror. So that reflection is the removal of all points using the mirror property of a flat mirror. For example, the reflection concept can be seen in the triangle, reflected in the ordinate (see figure 3).
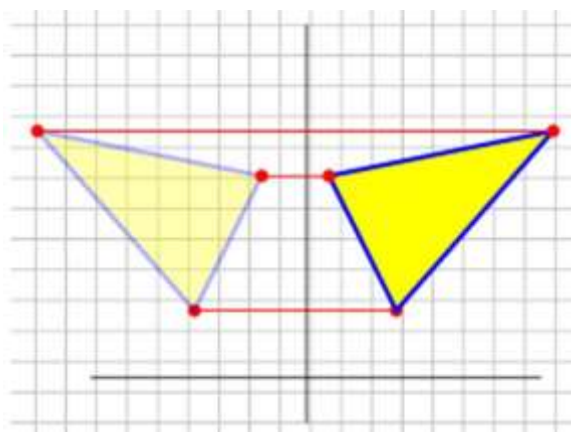

Figure 3. Concept of Reflection

In the *Geblek Renteng Batik* motif found reflection concepts as in figure 4. Reflection is a transformation that moves every point on the plane by using mirror image properties.
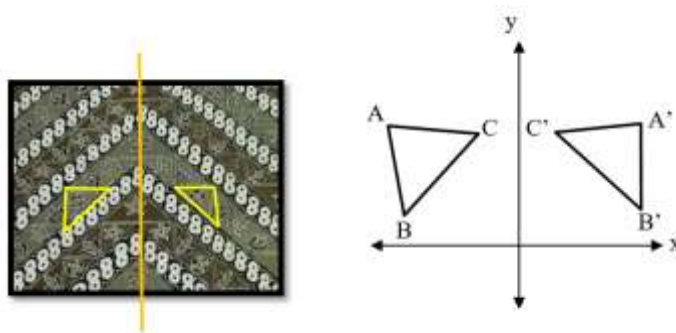

Figure 4. *Geblek Renteng Batik* Found Reflection Concepts

If a vertical line is drawn in the middle of the *Geblek Renteng Batik* motif, we can find the basic concept of reflection. In figure 2, the ABC figure is reflected against the y-axis and produces the A'B'C'. Mathematically, the reflection matrix concerning the *y-ordinate* is $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$. Consequently, if point A with coordinates (x, y) is reflected against the *y-axis*, then

$$R(A) = A' = \begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} -x+0 \\ 0+y \end{pmatrix} = \begin{pmatrix} -x \\ y \end{pmatrix}$$

As for the properties of reflection that can be found in the common *Geblek* batik cloth motif is (a) ABC field size = A'B'C' field size, (b) the distance of each point with the same image to the mirror, and (c) The direction of the ABC plane is opposite to the direction of the A'B'C' plane.

Rotation

Rotation is a change in the position or position of an object by rotating it through a specific center and angle. The principle used in the rotation is to rotate at a certain angle and center point with the same distance as each rotated point.

Rotation is a change in the position or position of an object by rotating it through a specific center and angle. The principle used in the rotation is to rotate at a certain angle and center point with the same distance as each rotated point. The rotation magnitude in the geometric transformation of α has been agreed for the direction opposite the clockwise direction. If the direction of rotation of an object is clockwise, the angle formed is –α. The result of the rotation of an object depends on the center and the angle of rotation. Note the change in the position of the rotated triangle by 135^0 with the center O(0, 0) in figure 5.
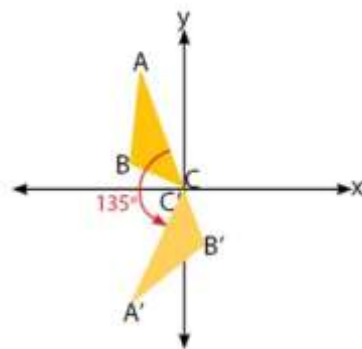

Figure 5. Concept of Rotation

In the *Geblek Renteng Batik* motif found rotation concepts as in Figure 6. Rotation is a change in the position of an object that is rotated at one particular point. Where the magnitude of rotation in the geometry transformation of α with the direction of rotation counterclockwise.
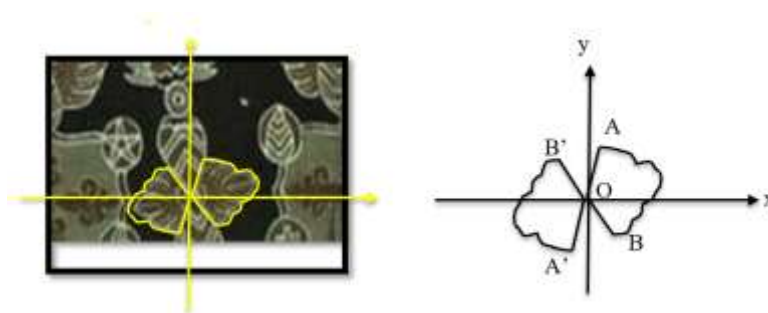

Figure 6. *Geblek Renteng Batik* Found Rotation Concepts

If a vertical line is drawn in the middle of the motif, we can get the basic rotation concept. In this motif, the AOB shape is rotated 180 ° counterclockwise at the center of O, and the A'OB' shape is obtained. Mathematically, a rotation matrix concerning a point of α is $\begin{pmatrix} \cos \alpha & -\sin \alpha \\ \sin \alpha & \cos \alpha \end{pmatrix}$. Consequently, if a point A with coordinates (x, y) is rotated 180° counterclockwise at the center of O, then

$$R(A) = \begin{pmatrix} \cos 180° & -\sin 180° \\ \sin 180° & \cos 180° \end{pmatrix} \cdot \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix} \cdot \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} -x \\ -y \end{pmatrix}$$

As the rotational properties that can be found on the *Geblek Renteng Batik* fabric motif are (a) AOB field size = A'OB' field size, (b) The determinant value in the rotation matrix is 1, (c) a. Two successive rotations with the same center and angle are the same as the rotation with the sum of the two rotational angles, and (d) the wake's shape is permanently fixed.

Dilatation

Dilation is also known as enlarging or reducing an object. If translation, reflection, and rotation only change the object's position, it differs from dilation, which performs geometric transformations by changing the object's size. The size of the object can be changed by dilating it to be bigger or smaller. This change depends on the scale being a factor of the multiplier.

The *Geblek Renteng Batik* motif found dilatation concepts as in Figure 7. Dilation itself is known as the magnification or reduction of an object. So the result of dilation will affect the dimensions/size of an object that depending on the scale used.
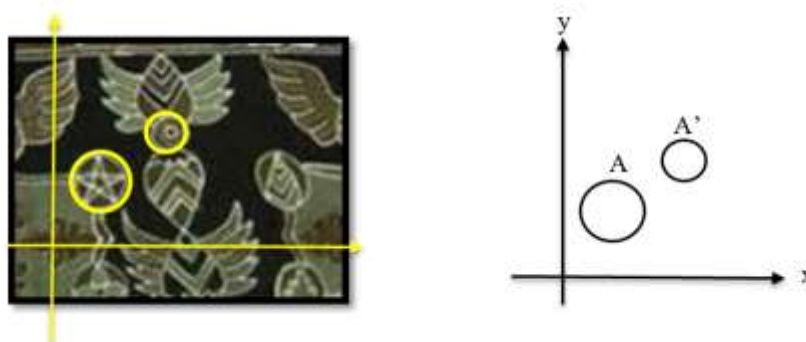

Figure 7. *Geblek Renteng Batik* Found Dilatation Concepts

There are several circles on the motif of the *Geblek Renteng Batik* with different sizes and locations so that the concept of dilation can be obtained. On one of the circles with center A (x, y) dilated with center A'(x', y') with a scale factor m, the result is obtained

$$R(A) = \begin{pmatrix} m & 0 \\ 0 & m \end{pmatrix} \cdot \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} mx \\ my \end{pmatrix}$$

The properties of dilatation that can be found in the common *Geblek* batik cloth motif are (a) Resize but not change shape, (b) The size can be bigger or smaller depending on the scale factor used, (c) A dilatation requires a point as the center point (center point) and a number as a factor.

Learning Media with Batik

Learning devices are tools or equipment to carry out processes that support educators and students in carrying out learning activities [49], [50]. The learning process, an integral part of learning planning, is designed in a syllabus, lesson plans, separated from lesson plans, learning tools, and learning scenarios [51]. This is what causes learning media is one of the components needed in learning.

Learning media is a tool that serves to convey learning messages [52]–[54] so that the learning process using media becomes more efficacious [55]–[57]. The teacher conveys this inner message received by students to stimulate the students' thoughts, feelings, attention, or willingness to encourage the learning process. Messages or information brought by learning media can be in the form of messages prepared to actively meet students' learning needs and abilities to participate in the learning process.

In addition, learning media is a component that is interconnected with other components in order to create the expected learning situation, concretize the abstract so that it can reduce the occurrence of verbalism, increase student stimulation in learning activities, reduce student misunderstanding of the explanations given by educators, overcome limitations of experience. Possessed by students, it allows direct interaction between students and their environment, produces uniformity of observations, generates motivation, and stimulates children to learn [58].

The use of media in the teaching and learning process is significant. Several criteria in the selection of materials to achieve effective results include (1). Interesting, meaning that the media used must be attractive to students, (2). Motivating, meaning that the media used can motivate students to read, (3). Relevant/appropriate, meaning that the media used must be relevant or by the topics discussed and according to the age of the students [53]. In addition, so that the media used is appropriate and effective in learning, it can consider visible, attractive, simple, practical, accurate, legitimate, and structured [53], [59].

The use of media in the learning process needs to consider that (1) there is no single media that is best for all learning objectives, (2) the media is an integral part of the learning process, (3) the selection of media should be objective, meaning that it is based on the learning objectives, use of several media at once will be able to confuse students, and (4) the merits and demerits of media do not depend on concreteness and abstraction alone [60].

Because learning media is a communication tool to convey a message to students to stimulate students to learn in order to achieve learning objectives, choosing media needs to consider the learning objectives to be delivered, adjusted to the level of student development, the media must be adjusted to the ability of the teacher. The media must be adjusted with the situation and conditions or at the right time, place, and situation. Besides that, the media selection must also pay attention to the material characteristics to be given to students, student characteristics or individual student differences, and learning support facilities [61].

In using the learning model, at least the teacher can choose learning media that uses the environment around students. This is because the use of media that comes from the environment around students can bring very abstract mathematical concepts to be more contextual in students' eyes so that the meaning of mathematics which is still considered far from everyday life, becomes closer to everyday life (more contextual).

One cultural heritage comes from the surrounding environment and has been recognized as intangible, including Batik. The concept of Batik in the form of writing or abstract images on cloth, in general, can be used as an alternative medium for learning transformation geometry. Like the new paradigm curriculum (curriculum of 2023), geometry transformation material in mathematics in the F+ phase (advanced mathematics). It shows that transformation geometry is a high-level and very abstract material, so learning media is needed to effortlessly understand geometric transformation concepts such as translation, rotational, dilation, and reflection.

CONCLUSION AND SUGGESTION

The data analysis and discussion show that the *Geblek Renteng Batik* motif has a mathematical concept in culture (ethnomathematics). Mathematical concepts in the form of geometric objects that are identified in the joint *Geblek* batik motif. Geometry shapes identified from the *Geblek Renteng Batik* motif building are translation, reflection, rotation, and dilation elements. It shows that mathematics exists in all aspects of life and culture, the batik *Geblek* joint.

REFERENCES

[1]   J. O. Haryanto and S. H. Priyanto, "Recent Future Research in Consumer Behavior: a Better Understanding of Batik As Indonesian Heritage," *Journal of Arts International Refereed Research Journal*, vol. 4, no. 4, p. 32, 2013.

[2]   P. D. Kusuma, "Fibrous root model in Batik pattern generation," *Journal of Theoretical and Applied Information Technology*, vol. 95, no. 14, 2017.

[3]   I. Widiaty, L. S. Riza, A. A. Danuwijaya, R. Hurriyati, and S. R. Mubaroq, "Mobile-based augmented reality for learning 3-dimensional spatial Batik-based objects," *Journal of Engineering Science and Technology*, vol. 12, pp. 12–22, 2017.

[4]   R. Azhar, D. Tuwohingide, D. Kamudi, Sarimuddin, and N. Suciati, "Batik Image Classification Using SIFT Feature Extraction, Bag of Features and Support Vector Machine," in *Procedia Computer Science*, 2015, pp. 24–30. doi: http://dx.doi.org/10.1016/j.procs.2015.12.101.

[5]   E. Steelyana, "Batik, A Beautiful Cultural Heritage that Preserve Culture and Supporteconomic Development in Indonesia," *Binus Business Review*, vol. 3, no. 1, p. 116, 2012, doi: http://dx.doi.org/10.21512/bbr.v3i1.1288.

[6]   S. Poon, "Symbolic Resistance: Tradition in Batik Transitions Sustain Beauty, Cultural Heritage and Status in the Era of Modernity," *World Journal of Social Science*, 2020, doi: 10.5430/wjss.v7n2p1.

[7]   W. Steelyana, "Cultural Tourism in Cirebon: A Story of Preserving Cultural Heritage and Support Small-Medium Enterprises, Especially Cultural Entrepreneurs," in *Bigstar International Conference at Politeknik Negeri Bandung*, 2015, pp. 28–29. doi: http://dx.doi.org/10.2139/ssrn.2396445.

[8]   R. Syamwil, E. Sugiarto, T. R. Rohidi, and S. Nurrohmah, "Weeds as a source of development idea on batik motive," *Vlakna a Textil*, vol. 26, no. 2, pp. 69–73, 2019.

[9]   D. Nur Alvian, D. Agustito, T. Astuti Arigiyati, E. Harini, and S. Adi Widodo, "Identifying geometrical objects in Sumur Gumuling Tamansari: An ethnomathematics analysis," *Journal of Physics: Conference Series*, vol. 1778, no. 1, p. 012021, 2021, doi: http://dx.doi.org/10.1088/1742-6596/1778/1/012021.

[10]   R. Y. Putra, Z. Wijayanto, and S. A. Widodo, "Etnomatematika: Masjid Soko Tunggal Dalam Pembelajaran Geometri 2D," *Jurnal Riset Pendidikan dan Inovasi Pembelajaran Matematika (JRPIPM)*, vol. 4, no. 1, p. 10, 2020, doi: 10.26740/jrpipm.v4n1.p10-22.

[11]   B. E. Susilo and S. A. Widodo, "Kajian Etnomatematika Dan Jati Diri Bangsa," *Indomath: Indonesia Mathematics Edcuation*, vol. 1, no. 2, pp. 121–128, 2018, doi: http://dx.doi.org/10.30738/indomath.v1i2.2886.

[12] A. Musanna, "Indigenisasi Pendidikan: Rasionalitas Revitalisasi Praksis Pendidikan Ki Hadjar Dewantara," *Jurnal Pendidikan dan Kebudayaan*, vol. 2, no. 1, pp. 117–133, 2017, doi: http://dx.doi.org/10.24832/jpnk.v2i1.529.

[13] Muthoifin and M. Jinan, "Pendidikan Karakter Ki Hajar Dewantara : Studi Kritis Pemikiran Karakter dan Budi Pekerti dalam Tinjauan Islam," *Studi Islam*, vol. 16, no. 2, pp. 167–180, 2015.

[14] W. Nugroho, "Implementasi Trilogi Ki Hadjar Dewantara di SD Taman Muda Jetis Yogyakarta," *Edukasi Journal*, vol. 10, no. 1, pp. 41–54, 2018, doi: http://dx.doi.org/10.31603/edukasi.v10i1.2031.

[15] K. H. Dewantara, "Pendidikan sesuatu yang pendidikan membebaskan yang," *Pendidikan Usia Dini*, 2013.

[16] S. V. Susilo, "Refleksi Nilai-Nilai Pendidikan Ki Hadjar Dewantara Dalam Upaya Upaya Mengembalikan Jati Diri Pendidikan Indonesia," *Jurnal Cakrawala Pendas*, vol. 4, no. 1, 2018, doi: http://dx.doi.org/10.31949/jcp.v4i1.710.

[17] U. D'Ambrosio, *What is Ethnomathematics, and How Can it Help Children in School?* Rotterdam: Sense Publisher, 2001.

[18] U. D'Ambrosio, "The Program Ethnomathematics: A theoretical basis of the dynamics of intra-cultural encounters," *The Journal of Mathematics and Culture*, vol. 1, no. 2, pp. 1–7, 2006.

[19] Sudirman, A. L. Son, and Rosyadi, "Penggunaan Etnomatematika Pada Batik Paoman Dalam Pembelajaran Geometri Bidang di Sekolah Dasar," *Indomath: Indonesia Mathematics Edcuation*, vol. 1, no. 1, pp. 27–34, 2018.

[20] M. Irfan, D. Slamet Setiana, E. Fitria Ningsih, W. Kusumaningtyas, and S. Adi Widodo, "Traditional Ceremony Ki Ageng Wonolelo As Mathematics Learning Media," *Journal of Physics: Conference Series*, vol. 1175, no. 1, 2019, doi: http://dx.doi.org/10.1088/1742-6596/1175/1/012140.

[21] A. Martyanti and Suhartini, "Etnomatematika: Menumbuhkan Kemampuan Berpikir Kritis Melalui Budaya," *Indomath: Indonesia Mathematics Edcuation*, vol. 1, no. 1, pp. 35–41, 2018.

[22] I. Risdiyanti and R. C. I. Prahmana, "Etnomatematika : Eksplorasi Dalam Permainan Tradisional Jawa," *Journal of Medives Volume*, vol. 2, no. 1, pp. 1–11, 2018.

[23] M. Rosa and D. C. Orey, "State of the art in Ethnomathematics," in *Current and future perspectives of ethnomathematics as a program*, Springer, 2016, pp. 11–37.

[24] M. Rosa and M. E. Gavarrete, "An ethnomathematics overview: an introduction," in *Ethnomathematics and its Diverse Approaches for Mathematics Education*, Springer, 2017, pp. 3–19.

[25] Marsigit, R. Condromukti, D. S. Setiana, and S. Hardiarti, "Pengembangan Pembelajaran Matematika Berbasis Etnomatematika," 2019. doi: http://dx.doi.org/10.1017/CBO9781107415324.004.

[26] M. Rosa and D. C. Orey, "Ethnomodeling as a Research Theoretical Framework on Ethnomathematics and Mathematical Modeling," *Journal of Urban Mathematics Education*, vol. 6, no. 2, pp. 62–80, 2013.

[27] M. Rosa and D. C. Orey, "A Theoretical Discussion to Reveal the Principles of Culturally Relevant Education in An Etnomathematical Perspective," *RIPEM*, vol. 1, no. 1, pp. 42–67, 2013, doi: http://dx.doi.org/10.1017/CBO9781107415324.004.

[28] M. Rosa, D. Clark, and D. C. Orey, "Ethnomathematics: the cultural aspects of mathematics," *Revista Latinoamericana de Etnomatemática*, vol. 4, no. 2, pp. 32–54, 2011.

[29] R. A. S. Matang and K. Owens, "The role of indigenous traditional counting systems in children's development of numerical cognition: Results from a study in Papua New Guinea," *Mathematics Education Research Journal*, vol. 26, no. 3, pp. 531–553, 2014, doi: http://dx.doi.org/10.1007/s13394-013-0115-2.

[30] W. S. Dominikus, T. Nusantara, Subanji, and M. Muksar, "Ethnomathematics in Marriage Tradition in Adonara Island-East Flores," in *Proceeding of 3rd International Conference On Research, Implementation And Education of Mathematics And Scienceinternational Conference On Research, Implementation And Education of Mathematics And Science*, 2016, no. May, pp. 16–17.

[31] Y. S. Eko, "The Existence of Ethno mathematics in Buna Woven Fabric and Its Relation to School Mathematics," in *International Conference on Mathematics and Science Education*, 2017, pp. 128–136.

[32] W. S. Dominikus, M. Muksar, T. Nusantara, Subanji, and M. Muksar, "Ethnomathematical Ideas in The Weaving Practice of Adonara Society," *Journal of Mathematics and Culture*, vol. 11, no. 4, pp. 83–95, 2017.

[33] Choirudin, Eka Fitria Ningsih, Muhammad Saidun Anwar, Intan Ratna Sari, and Suci Amalia, *Etnomatematika Situs Purbakala Pugung Raharjo*. Malang: Lentera Ilmu, 2019.

[34] J. W. Creswell, *Educational Research: Planning, Conducting and Evaluating Quantitative and Qualitative Research*. London: Pearson, 2012.

[35] N. T. Arianto and A. Nurcahyo Tri, "Kajian etnografi," *Disampaikan dalam Pelatih. Metod. Penelit. Sos. bagi Guru-guru SMA, Selasa 21 Juni 2011, di Dep. Antropol. FISIP Unair*, 2011.

[36] M. Zayyadi, "Eksplorasi Etnomatematika Pada Batik Madura," *Sigma*, vol. 2, no. 2, pp. 36–40, 2017.

[37] I. Rachmawati, "Eksplorasi Etnomatematika Masyarakat Sidoarjo," *Ejournal Unnes*, 2012.

[38] Sugiyono, *Metode Penelitian Pendidikan: Pendekatan Kuantitatif, Kualitatif, dan RND*. Bandung: Alfabeta, 2015.

[39] S. Hadi, "Pemeriksaan Keabsahan Data Penelitian Kualitatif Pada Skripsi," *Jurnal Ilmu Pendidikan Universitas Negeri Malang*, 2016.

[40] E. G. B. Susilo and Rijanta, "Kajian Implementasi 'Bela-Beli Kulon Progo' (Kasus: Air-KU, Batik *Geblek Renteng*, dan ToMiRa," *Jurnal Bumi Indonesia*, vol. 6, no. 3, 2017.

[41] K. T. Meiyana, D. P. Dewi, and S. Kadaryati, "Kajian sifat fsik dan serat pangan pada gèblek substitusi daun kelor (Moringa oleifera L.)," *Ilmu Gizi Indonesia*, vol. 1, no. 2, pp. 127–133, 2018, doi: http://dx.doi.org/10.35842/ilgi.v1i2.38.

[42] G. Wibisono and W. E. Susanto, "Perancangan Website Sebagai Media Informasi dan Promosi Batik Khas Kabupaten Kulonprogo," *Jurnal Evolusi*, vol. 3, no. 2, 2015.

[43] N. Noordyanto, "Studi Tipografi Kawasan Di Yogyakarta," *DeKaVe*, vol. 9, no. 1, pp. 65–84, 2017, doi: http://dx.doi.org/10.24821/dkv.v9i1.1659.

[44] R. Aditya, "Batik *Geblek* Renting Kulon Progo," *KOMUNITAS*, vol. 10, no. 2, 2019, doi: http://dx.doi.org/10.20414/komunitas.v10i2.1201.

[45] D. Phawestrina, " 'Bela Beli Kulon Progo' (Study on Implementation of Regional Regulation of Kulon Progo Regency Number 5 year 2016 about Local Products Protection)," 2018.

[46] Sukadari, B. M. Sukemi, and Sunarti, "Local socio-cultural wisdom as a basis of character education in primary schools," *International Journal of Innovation, Creativity and Change*, vol. 7, no. 6, pp. 298–311, 2019.

[47] B. A. B. Firdaus, S. A. Widodo, I. Taufiq, and M. Irfan, "Studi Etnomatematika: Aktivitas Petani Padi Dusun Panggang," *Jurnal Derivat*, vol. 7, no. 2, pp. 85–92, 2020.

[48] D. Orey and M. Rosa, "Cultural assertions and challenges towards pedagogical action of an ethnomathematics program," *For the Learning of Mathematics*, vol. 27, no. 1, pp. 10–16, 2007.

[49] D. Setyawarno and Z. K. Prasetyo, "Development Of Indonesian Qualification Framework (IQF) Level 6 Of Physics Education," no. May, pp. 16–17, 2016.

[50] Z. K. Prasetyo, "Pengembangan Perangkat Pembelajaran Sains Terpadu Untuk Meningkatkan Kognitif, Keterampilan Proses, Kreativitas serta Menerapkan Konsep Ilmiah Peserta Didik SMP," Yogyakarta, 2011.

[51] Mentri Pendidikan dan Kebudayaan, *Peraturan Mentri Pendidikan dan Kebudayaan Republik Indonesia No 65, Tahun 2013 Tentang Standar Proses Pendidikan Dasar dan Menengah*. 2013.

[52] E. Mediawati, "Pembelajaran Akuntansi Keuangan Melalui Media Komik Untuk Meningkatkan Prestasi Mahasiswa," *Jurnal Penelitian Pendidikan*, vol. 12, no. 1, pp. 61–68, 2011.

[53] S. A. Widodo, "Selection of Learning Media Mathematics for Junior School Students," *Turkish Online Journal of Educational Technology - TOJET*, vol. 17, no. 1, pp. 154–160, 2018.

[54] S. A. Widodo, J. A. Dahlan, and Turmudi, "Can Sociomathematical Norms Be Developed With Learning Media?," *Journal of Physics: Conference Series*, vol. 1315, no. 1, 2019, doi: http://dx.doi.org/10.1088/1742-6596/1315/1/012005.

[55] M. Bulut, H. Ü. Akçakın, and G. Kaya, "The Effects of GeoGebra on Third Grade Primary Students' Academic Achievement in Fractions," *International Society of Educational Research*, vol. 11, no. 2, pp. 347–355, 2016.

[56] E. J. Wibowo, "Media Pembelajaran Interaktif Matematika Untuk Siswa Sekolah Dasar Kelas IV," in *Seminar Riset Unggulan Nasional Informatika dan Komputer FTI UNSA 2013 MEDIA*, 2013, pp. 75–78.

[57] A. K. Ismail, Sugiman, and P. Hendikawati, "Efektivitas Model Pembelajaran Teams Group Tournament (TGT) Dengan Menggunakan Media '3 In 1' Dalam Pembelajaran Matematika," *UNNES Journal of Mathematics Education*, vol. 2, no. 2, 2013.

[58] S. A. Widodo, Pardimin, and E. Purwaningsih, "Pengaruh Media Komik Terhadap Kemampuan Pemecahan Masalah dan Prestasi Belajar Matematika Ditinjau Dari Kemampuan Awal Siswa Kelas VIII," in *Seminar Nasional Matematika Dan Pendidikan Matematika UNY 2016*, 2016, pp. 481–486.

[59] T. Nurseto, "Membuat Media Pembelajaran yang Menarik," *Ekonomi & Pendidikan*, vol. 8, no. 1, pp. 19–35, 2011.

[60] Sungkono, "Pemilihan Dan Penggunaan Media Dalam Proses Pembelajaran," *Majalah Ilmiah Pembelajaran*, vol. 4, no. 1, pp. 71–80, 2008.

[61] R. Susilana and C. Riyana, *Media Pembelajaran Hakikat, Pemanfaatan dan Penilaian*. Bandung: Wacana Prima, 2009.