Ethnomathematics as Indonesia Batik Artwork in Mathematics Learning Two-dimensional Figure Materials

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Abstract- This study aims to describe Indonesia ethnomathematics in Malang batik art in mathematics learning of two-dimensional figure material. This research is a qualitative-explorative study which explores batik motifs in the form of the two-dimensional figure. The data in this research are in the form of data from the study of literature both from documents and electronic media. Also, in the form of recorded interviews related to Malang batik art and observations. The results of this study indicate that: 1) in Malang motifs there is the concept of a two-dimensional figure; and 2) the batik motifs contained in the concept of the two-dimensional figure can be applied in learning with innovative learning models

Index Terms- Ethnomathematics, Malang Batik Artwork, Mathematics Learning, Two-dimensional Figure Material.

I. INTRODUCTION

Cultural values that are the basis of the character of the nation is an important thing to be instilled in every individual, for that the value of this culture should be instilled early on so that each individual can better understand, interpret, and appreciate and realize the importance of cultural values in carrying out every activity of life. Cultivation of cultural values can be done through the family environment, education, and within the community of course. Preservation of local culture and the development of national culture through education both formal and non-formal education, using all containers and educational activities. Education and culture is something that can not be separated in everyday life because the culture is a unified whole, prevails in society and education are fundamentally needed for every individual in society [1].

Etnomathematicsis mathematics both grown and developed in a particular culture. Etnomathematicsis perceived as a lens to see and understand that mathematics is a product of culture [2]. Ethnomathematics perspectives strengthen mathematical modeling [3]. The characteristics and culture in the environment will attract development by the local content of learning. It is indeed that learning requires an innovation of learning that encourages students to build new knowledge [4]. A classroom using ethnomathematics assessment would be full of examples that draw on the students' own experiences or on experiences that are common in the cultural environment of the students [5]. One culture that is a reference for learning mathematics is the motif of batik art.

Mathematics is introduced early on. The mathematics learning process in elementary school is a crucial phase for children in understanding the concept of mathematics. In this elementary education level, children will build the foundations of mathematical concepts [6]. Mathematics learning must be more active and fun, so students understand the material. This initiative provided teachers, students and parents with an opportunity to engage with mathematics, increasing the mathematical understanding and competence of teachers, providing opportunities for deep engagement with mathematics and providing teachers with the opportunity to work with and learn from mathematicians and math educators within the context of their classrooms [7].

Batik viewed from the morphology of the language. The word "batik" consists of two words, "ba" and "tik". About batik as an art, "batik" is one of the elements of art to initiate the art of writing. The word has an equivalent consisting of the word "ba" with the prefix "am" and the word "tik", so that when combined into "ambatik" which means making a point. In the approach of fine arts, batik formed begins with a point, connected into a line that subsequently evolved into a form [8]. Batik is a cloth that is painted with the night (the process of deepening) with a certain pattern and given a certain coloring that contains meaning and art that is processed through a specific process. Batik has characteristics of motifs/patterns and patterns [9].

Indonesia is a country consisting of land and sea. There are several large and small islands separated by the sea which lead Indonesia to be called Nusantara [10]. Batik is a work of art that developed in Indonesia. Batik is one of the popular arts of Indonesia [11]. This work of art has different motives in each region. Generally, this motif is related to the cultural customs that developed in the area. Batik, as a cultural heritage from Indonesia, has two kinds of true batik, handwritten batik, and batik cap or stamped batik [12].

Malang batik motifs have many types. One of them is batik which has a flat motif. The motifs and forms of flat shapes can be applied in mathematics learning. Learning mathematics is closely related to problem-solving. For example, solving problems in a flat wake. Problems in solving mathematic problems result in various ideas from different experts to solve problems which are expressed in models of problem-solving, and one of the experts is George Polya. In 1957, he succeeded in applying the mathematic model for solving problems. This model is called the Polya method. According to Polya, in solving mathematic problems, four stages may be made: understanding the problem, planning strategies for problem-solving, carrying out the problem and looking back the obtained result [13].

Problem-solving is one part of the mathematics curriculum which is very important because, in the process of learning and completion, students may gain experience using the knowledge and skills that have been previously owned [14]. Also, solving problems requires critical thinking processes. The ability to select and analyze the relevant information is known as critical thinking [15]. Critical thinking is sometimes referred to as 'critic-creative thinking [16]. One of the steps to solve problems with the process of critical thinking is raised by White. As stated by White, there are 4 phases in solving problems, namely introduction, evaluation analysis, and alternative solutions [17]. This means that critical thinking requires the use of various strategies to be able to produce a decision as a basis for taking action or belief [18].

The ability to think critically must be trained from an early age. As students progress into junior and senior high school, critical thinking skills, decision-making skills, and information gathering skills need to be taught [19]. Critical thinking is also an important goal of education within the schooling sector [20]. Batik artworks by sharing beautiful motifs. Its application in learning mathematics provides new innovations. The Malang batik motif in this flat figure is an example of its application. The two-dimensional figure is a flat area that is bounded by straight lines or curved lines. a plane that is bounded by a straight line or curved line.

II. METHODS

This research is qualitative-explorative research that is exploring batik motifs in the form of the two-dimensional figure. He purpose of qualitative research is to describe and interpret issues or phenomena systematically from the point of view of the individual or population being studied, and to generate new concepts and theories [21]. This research was conducted at Savana Batik Malang. The expansion in the form of shapes that can be used in learning. The approach used is the ethnographic approach, which is an empirical and theoretical approach. The object in this study is the type of Malang batik art motifs related to flat arising.

The data in this research are in the form of data from the study of literature both from documents and electronic media. In addition, in the form of recorded interviews related to Malang batik artworks and observations. As for the question has to be clearly explained. "Clearly explained" means that it is necessary to make every part of the question as explicit as possible [22]. This research is a qualitative study so that researchers act as the main instruments for collecting data and information needed by researchers. In addition to the main instrument, it is then integrated with the auxiliary instrument, namely the field notes, interview guidelines, observation guidelines, and documentation.

III. RESULT AND DISCUSSION

The city of Malang is a city located in East Java Province. The second-largest city after Surabaya City in East Java Province. The city was founded during the Kanjuruan Kingdom and is located on a plateau of 145.28 km2. which is located in the middle of Malang Regency. Together with Batu City and Malang Regency, Malang City is part of a regional unit known as Malang Raya.

Malang City has a variety of people from various ethnic groups and cultures. The population of Malang city reaches 895. Three hundred eighty-seven people with Javanese majority, followed by Madura. When viewed from culture, Malang is included in the area culture. The culture that developed also varied. For example, batik that developed in Malang has many motifs beautifully. Generally, the motive is influenced by the cultural development that develops around. There are Malang batik motifs related to mathematics. Usually called by the name ethnomathematics. Poor batik motifs that are sought application is the material to get up flat. However, in this article, the shapes presented are only circles, triangles and rhombus.

A. Malang Batik Artwork

Malang Batik is commonly called Malangan Batik, Malang Batik is not as famous as another batik in East Java, but the beauty of Malang Batik is not inferior to other regions, both from its own unique and unique batik style or from its coloring. For example, the batik motif of the Malangan mask is a mask dance of the Malang area, which is painted attractively on the batik cloth.

Also, there is poncokusumo batik that develops in Malang. Poncokusumo batik is a lung-patterned batik created by a part of the Poncokusumo Village community who put forward the chrysanthemum or chrysanthemum motif as the central motif element combined with other ornaments in the form of masks and lyrical. Poncokusumo batik motif is one of the biodiversity in the Poncokusumo village in the form of the existence of Seruni flowers as one of the plants cultivated by the community.

Fig. 1 Batik Mask Handmade Motif

Fig. 2 Typical Batik Chrysanthemum Poncokusumo

The existence of a mask ornament that is integrated into the Poncokusumo batik creation is the preservation of one of the works of art that have become one of the icons of Malang district. The lyrical motif in Poncokusumo batik as the meaning is resilience and endurance in living life. The batik motif in Malang is divided from its geographical location. In the Bromo Mountain motif, classic batik with triangles motifs, and the Malang mask batik motif there is the concept of building a triangle.

Fig. 3 Batik Motif of Mount Bromo

Fig. 4 Classic Batik with Isen-Isen Triangles

Malang City has many batik motifs that develop with the times. Kawung Batik is one of the batik patterns/motifs that has a long history of development in society. Batik Kawung is an old motif originating from the land of Java which is shaped like a pile arranged in four square corners. The Kawung batik motif is beautiful with charming geometric patterns. The motive turns out to have a deep story and contains elements of Javanese wisdom. In the Kawung motif below, there are concepts of square and rhombic shapes.

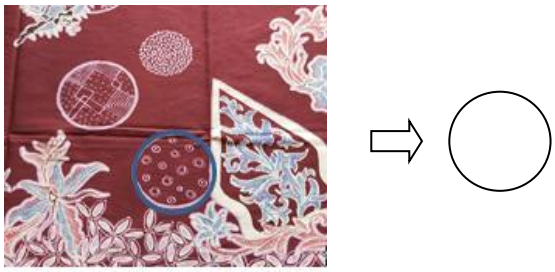
Fig. 5 Kawung Motif Batik

Fig. 6 Kawung Motif Batik

B. Ethnomathematics in Malang Batik Artwork

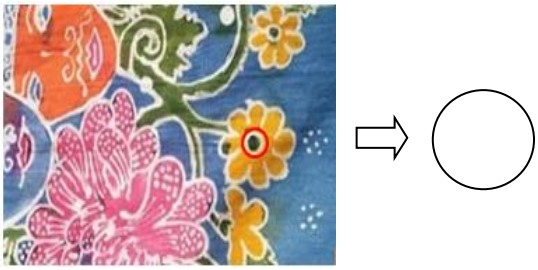
In the batik artwork, there are mathematical concepts related to flat arising. The flat shape contained in the batik motif as follows.

1. Circles on Malang Batik Artwork (Batik motif mask and Batik Chrysanthemum motif)



(a) (b)

Fig. 7 (a) Batik Motif Mask Handmade, and (b) circle

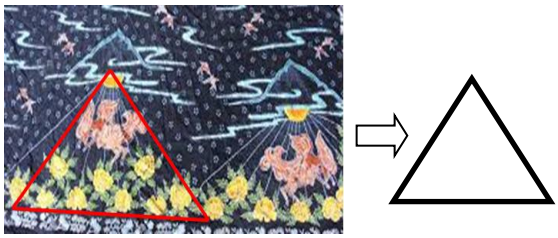


(a) (b)

Fig. 8 (a) Batik Typical Chrysanthemum Poncokusumo Malang, and (b) circle

Based on the Malang mask stamp motif and Krisan Poncokusumo written batik motif, the concept of circle building is obtained. A circle is a flat shape that has a diameter and radius.

2. Triangle in Malang Batik Artwork
Batik Motifs of Mount Bromo, Classic Batik Motifs of Isen-Isen Triangles, and Batik Motif Mask



(a) (b)

Fig. 9 (a) Motif Batik Gunung Bromo; dan (b) Triangle

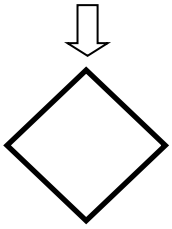
(a) (b) (c)

Fig. 10 (a) Classic Batik Motifs with Isen-Isen Triangles (b) Motifs for Written Batik in Malang; and (c) Triangle

Based on the Malangan masked batik motifs, the Brom Brom Mountain motif, and the classic batik motifs with the triangle triangles above, the concept of triangles is obtained. A triangle is a flat figure bounded by three sides and has three angles.

3. Rhombus in Malang Artworks
Kawung Motif Batik

(a)



(b)

Fig. 11 (a) Kawung Motif Batik; and (b) Rhombus

Based on the poor Kawung batik motif above, the concept of a rhombus is obtained. Rhombus is waking up with sides of the same size. The diagonals intersect perpendicularly and form a right angle, but the angle of the rhombus is not right elbows. Rhombus has two symmetry axes. The symmetry axis is the diagonals. Also, there are two folding symmetries and two rotary symmetries.

4. Application of Circles in Malang Batik Motifs in Learning

Based on the concept of the circle described in the Malangan batik motifs, batik motifs can be used as an alternative in learning. The alternative batik motifs can be developed by teachers both for primary school learning, junior high school, and senior high school or equivalent. The following alternative steps for learning the concept of a circle.

a. Let's Observe

Choose batik motifs that have a circle concept in the image below. Can you describe the concept of the circle on the batik motif with your own sentence?

(a) (b) (c)

Fig. 12 (a) Batik Mask Handmade Malang Motif; (b) Batik Mask Handmade Malang Motif; and (c) Kawung Batik Motif

b. Let's Try

Based on the concept of the circle on the batik motif you chose above, if known the radius of the circle is 7 cm. Determine the area and circumference of a circle?

c. Let's Analyze

Based on the concept of the circle on the batik motif you chose above, then explain according to your language.

a. Does it have a symmetry axis?
b. Does it have rotational symmetry?
c. How to determine the diameter of a circle?

d. Let's Conclude

Based on what was observed, the questions that were tried, and the questions that were analyzed, then what can you conclude?

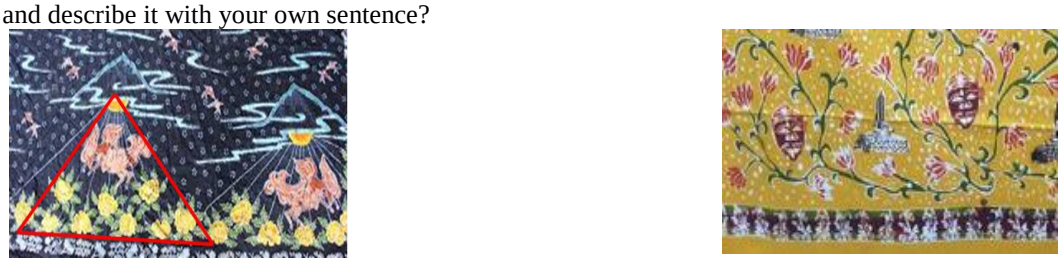
The above problem is an example of a variety of questions from the concept of a circle in Malang batik artwork. To be more varied in the learning process, teachers can apply various innovative learning models.

5. Application of Triangles in Malang Batik Motifs in Learning

Based on the triangle concept that is explained in the Malangan batik motifs, batik motifs can be used as an alternative in the learning process. Alternative learning steps in the concept of a triangle, which will be discussed the steps in solving Polya's problem. Polya's steps consist of understanding the problem, planning a solution, implementing the plan, and reviewing the results as an example of the following problem.

a. Let's Understand the Problem

Choose batik motifs that have a Triangle concept in the image below. Can you understand the concept of a square on the batik motif and describe it with your own sentence?



(a) (b)

Fig. 13 (a) Motifs of Mount Bromo Batik; and (b) Malang Lotus Sulur Batik Motif

b. Let's Plan Solution to Problem

Based on the triangle concept on the batik motif you chose above if you know the circumference of the triangle is 30 cm.

- Determine the base and sloping sides of the triangle with the same length and sides?
- Determine the area of the triangle with a height of 7 cm?

In the steps to plan for solving this problem, describe the formula needed from what is known to solve the problem above. The formula needed is the circumference and area of the triangle.

c. Let's Implement the Problem Solving Plan

Based on the triangle concept on the batik motive you chose above, then explain according to carrying out the problem-solving plan?

In the steps of implementing this problem-solving plan look for the value for which the formula has been planned. The values sought in carrying out the problem-solving plan are the base side, the hypotenuse, and the area of the triangle.

d. Let's check the results again

Based on what is understood, plan problem solving, and carry out problem-solving plans, then double-check the results then you conclude with your own sentences?

The problem above is an example of a variety of questions with Polya's steps from the concept of building a triangle on Malang batik art. The learning process is more active and innovative with teachers able to develop various learning models.

6. Rhombus Applications in Malang Batik Motifs in Learning

The concept of diamonds contained in batik motifs in Malang can be applied in learning. Critical thinking steps can be an alternative problem. The stages of critical thinking have 4 phases, namely introduction, analysis, evaluation, and alternative solutions. Every phase there are indicators that must be achieved.

a. Introduction Phase

Table 1 Introduction Phase

Phase	Indicator
Introduction	1) Find information about the problem 2) Mention the question correctly

b. Analyze Phase

Table 2 Analyze Phase

Phase	Indicator
Analisis	1) Analyze information needed or not needed 2) Find the information needed to solve the problem 3) Solve Using relevant information or prior knowledge to solve problems 4) Explain the relationship of each information available 5) Finding steps in solving problems 6) Draw conclusions

c. Evaluation Phase

Table 3 Evaluation Phase

Phase	Indicator
Evaluation	1) Re-examine the results of the problem solving

d. Thinking About Alternatives Phase

Table 4 Thinking About Alternatives Phase

Phase	Indicator
Thinking About Alternatives	1) Find another step and solve another problem or answer 2) Explain well the completion steps that have been found

Based on the 4 phases of critical thinking above by having indicators in each phase. Here is an example of a problem.

A kawung motif batik cut in the form of a diamond. The area of rhombus-shaped fabric is 162 cm2. The ratio of the diagonal lengths is 9: 4. Determine the shortest diagonal length?

Sub Questions

1. Find information about the problem
   What information is known from the problem?
2. Mention the question correctly
   What was asked about the problem?
3. Analyze information needed or not needed
   In your opinion, what is the relationship between what is known from the problem and what is being asked?
4. Find the information needed to solve the problem
   Do you use everything you know to solve problems? Why?
5. Solve Using relevant information or prior knowledge to solve problems
   Is there a concept/theorem/ formula that you will use to solve the problem? If so, what concept /theorem/formula will you use?
6. Explain the relationship of each information available
   Have you ever worked on a problem similar to this problem?
   A note :
   a. If yes, describe the completion steps you have taken?
   b. If not, write down the planning sequence that you will use to solve the problem?

7. Finding steps in solving problems and Draw conclusions
   Solve the problem based on the steps in number 6? And Conclude?
8. Re-examine the results of the problem solving, find another step and solve another problem or answer, and explain well the completion steps that have been found
   Are there other ways to work on the problem?
   A note:
   a.If yes, describe the completion steps?
   b. If not, why?

The questions above are an example of variations of questions with critical thinking phases of the concept of rhombus building in Malang batik art. So that the learning process is more fun the teacher can develop with various learning models.

IV. CONCLUSION

Ethnomathematics in Malang batik art is an application of a two-dimensional figure. The two-dimensional figure is a flat area that is bounded by straight lines or curved lines Flat build is found in the exploration of Malang batik art. For example, the Kawung and Malang batik motifs have the concept of a two-dimensional figure. In addition, for example, in the poor mask motifs and the poncokusumo batik chrysanthemum motif, there is the concept of a circle. The concept of circles, triangles, and rhombus in poor batik motifs can be applied in mathematics learning. Especially with flat material. Thus, learning mathematics is more fun and more innovative. For example, these innovations solve problems with Polya's steps and critical thinking steps. Malang batik motifs can be used as an alternative source of learning for students. Students' knowledge becomes wider. In addition, teachers can design learning that is more innovative and creative.

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