

# Ethnomathematics: Mathematical Exploration on Batik Gedog Tuban

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## ABSTRAK

Batik Gedog Tuban merupakan salah satu pola batik yang terkenal di Tuban, Indonesia. Batik ini mempunyai motif yang bervariasi dan kaya warna. Penelitian ini bertujuan untuk menganalisa nilai matematis yang terdapat pada Batik Gedog Tuban. Pengumpulan data dilakukan melalui studi pustaka, observasi, wawancara, catatan lapangan dan dokumentasi. Hasil menunjukkan bahwa terdapat beberapa konsep matematika pada Batik Gedog Tuban seperti geometri, transformasi, dan kongruensi.

**Keywords:** *Ethnomathematics, Batik Gedog Tuban, Konsep Matematika.*

## ABSTRACT

Batik Gedog Tuban is a famous Batik in Tuban. This batik has a variety of motifs/patterns with a variety of colors. This research is a qualitative descriptive with an ethnographic approach, and this research aims to analyze the mathematical value within Batik Gedog Tuban. Data collections were conducted by the study of literature, observation, interview, note, and documentation. The results show that there are several mathematical concepts contained in Batik Gedog Tuban, such as geometry concepts, geometry transformation, and congruence.

**Keywords:** *Ethnomathematics, Batik Gedog Tuban, Mathematical Concept.*

## 1. Introduction

Mathematics is one of the main subjects in school. Mathematics also is one branch of science that is closely related to human life [1]. Several studies indicated that students' interest in mathematics was shallow. Because many students feel that mathematics is difficult, tedious, abstract lessons and many theorems and formulas are difficult to understand. This is because mathematics at school is sometimes different from the mathematical problems found in everyday life. So most of them feel that learning mathematics is a waste of time.

Developing and applying mathematical concepts based on daily-life problem situations is a part of the student learning process [2]. Learning is an active process of constructing understanding and knowledge, primarily through social interaction [3]. Students' interest is one of the internal factors that can improve student learning achievement [4]. Students' interest in mathematics is strongly influenced by the teacher and the approach used in teaching [5]. Students' interest is needed in the learning process

because interest can create a condition where students feel the need and want to learn. The higher learning interest will make students' positive attitudes toward mathematics. Interest does not turn spontaneous, but it does turn up because of participation, experience, and habit when studying.

To increase the students' interest, mathematics learning should be based on the surrounding culture because of the difficulty of students in understanding mathematics obtained in school and the difficulty of students connecting mathematics with real life. For this reason, a connection between mathematics outside of school and mathematics in school is needed. D'Ambrosio (1985: 44) said that "Making a bridge between anthropologists and historians of culture and mathematicians is an important step towards recognizing that different modes of thoughts may lead to different forms of mathematics; this is the field which we may call ethnomathematics [6]."

Making a bridge between culture and mathematics is an important step to recognize various ways of thinking that can lead to various forms of mathematics. This issue is a field called ethnomathematics. The term ethnomathematics is used to express the relationship between culture and mathematics [7]. This ethnomathematics can be interpreted that in the culture, there can be found various mathematical concepts, so it shows that mathematics and culture are two things that are related to each other. Therefore, learning mathematics in schools needs to be updated by applying cultural elements in the learning of ethnomathematics [8]. So, ethnomathematics can make students understand mathematics more efficiently.

Batik Gedog is a famous Batik in Tuban. There are several types of batik gedog, like Kijing Miring, Likasan Kothong, Owal Awil, Panji Konang, Panji Serong, Panji Ori, Srigunting, Kembang Kluwih, Ganggeng, Kembang Waluh, etc. In this article, the author discusses mathematical concepts contained in Batik Gedog Tuban motifs, especially on the motifs of Kijing Miring, Owal Awil, and Panji Ori motifs.

## **2. Research Methods**

This type of research is qualitative descriptive with an ethnographic approach. The instruments in this research are the main instrument, observation guidelines, interview guidelines, and documentation. The data collections in this research are study of literature, observation, interview, note, and documentation [9]. The data validity technique in this research is triangulation.

## **3. Result and Discussion**

The original name of Batik Tuban is Batik Tenun Tradisional. There is a sound like "dog dog dog" in the weaving process, so people used to call it "Tenun Gedog". "Tenun Gedog" in Indonesia only exists in Tuban and the center is located in Kerek village. Batik Gedog is believed to have existed since the Majapahit kingdom. A long time ago batik was used for royal traditional ceremonies and other important events.

Because of the infertile natural conditions, there is a large amount of cotton planted by the local community [10]. Then this cotton is made into a lawn, then the weaving process is done traditionally. Since long time ago in Tuban, especially in Kerek District, it has been producing woven fabrics. Even now in this area there are still some residents making lawns and weaving.

Maybe in East Java, only Tuban makes batik on woven fabrics. Many people refer to Tuban's Batik with "Batik Gedog", whereas the truth is "Batik Tulis Kain Tenun Gedog".

This batik is very distinctive in its appearance. In addition to the patterns mentioned above, Batik Gedog displays a color scheme that contains a specific meaning and it's used by certain groups. Some terms that can be called are: *bangrod*, *pipitan*, *putihan*, and *irengan* [10].

Most Tuban batik Gedog motif is the symbolic expression of plants, animals, and cultural-social life which grow and develop in coastal Tuban area [11]. Every motif contained in Batik Gedog has a meaning that describes the character of the batik. The meaning of the batik can be seen from the symbols or patterns and colors of batik. The motif found in Batik Gedog have their own meaning according to the functions and values that develop in society.

### 3.1 Kijing Miring Motif

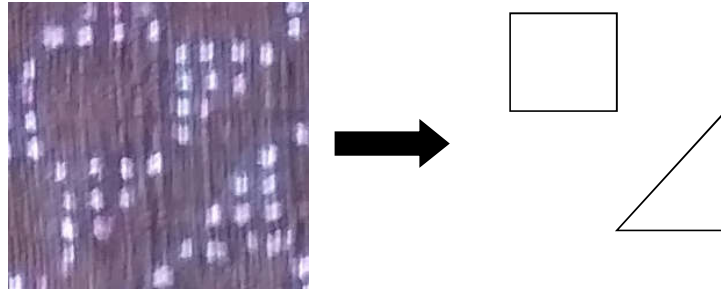


**Picture 1** Kijing Miring Motif

Kijing Miring Motif is one of the motifs of Gedog Tuban batik that has existed since the time of the Majapahit kingdom. The name Kijing Miring comes from a triangle-shaped image or symbol that resembles the shape of a gravestone in a cemetery [12]. So the purpose of this batik is about death or reminding someone of death. The use of the Kijing Miring motif in the past until now is for the death ceremony. The Kijing Miring motif is a motif that can be used by all people, nobles and ordinary people. There are a number of mathematical concepts found in the Batik Gedog Kijing Miring.

#### 3.1.1 Geometry

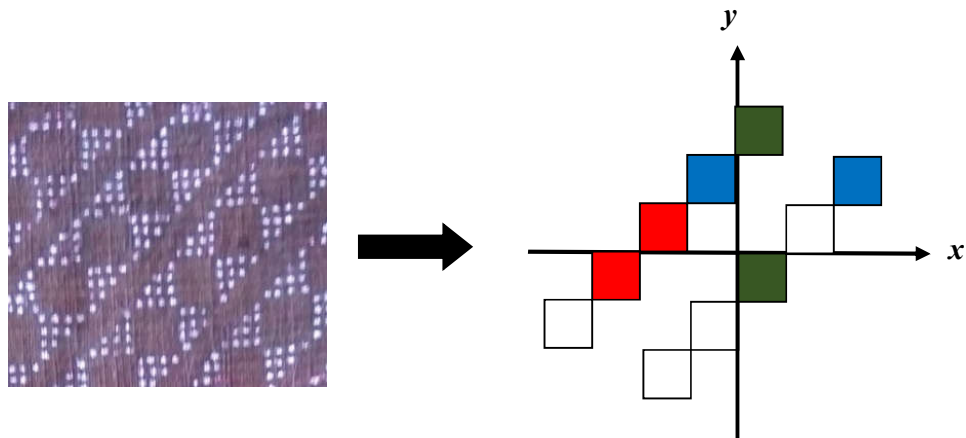
In the Kijing Miring motif there are geometric concepts such as points, lines, triangles, and squares. The triangle pattern created is an equilateral triangle arranged by 10 points, with each side of a triangle consisting of 4 points. While the sides of the square pattern made are arranged by 4 points.



**Picture 2** Triangle and Square on Kijing Miring Motif

### 3.1.2 Translation

There are concepts of transformation in the Kijing Miring motif, namely translation, which is found in triangular and square patterns. By moving or sliding the pattern to a particular position. Translated to vectors  $\begin{pmatrix} a \\ b \end{pmatrix}$ ,  $\begin{pmatrix} a \\ 0 \end{pmatrix}$ , and  $\begin{pmatrix} 0 \\ b \end{pmatrix}$ . The translation result is a pattern with the same size and shape at the certain position.



**Picture 3** Translation on Kijing Miring Motif

Note:

Translation to vector  $\begin{pmatrix} a \\ b \end{pmatrix}$

- Translated to the  $x$ -axis and followed by the  $y$ -axis

Translation to vector  $\begin{pmatrix} a \\ 0 \end{pmatrix}$

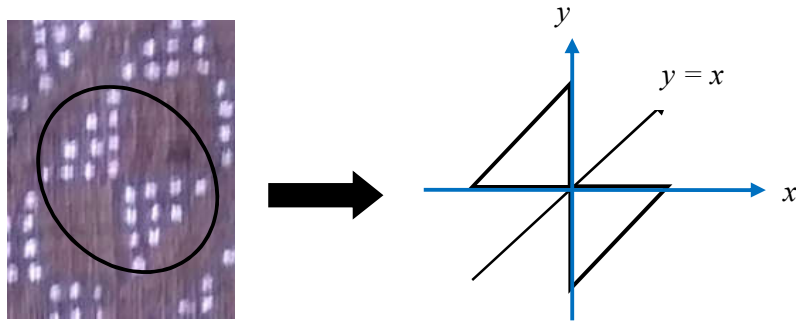
- Translated to the  $x$ -axis

Translation to vector  $\begin{pmatrix} 0 \\ b \end{pmatrix}$

- Translated to the  $y$ -axis

### 3.1.3 Reflection

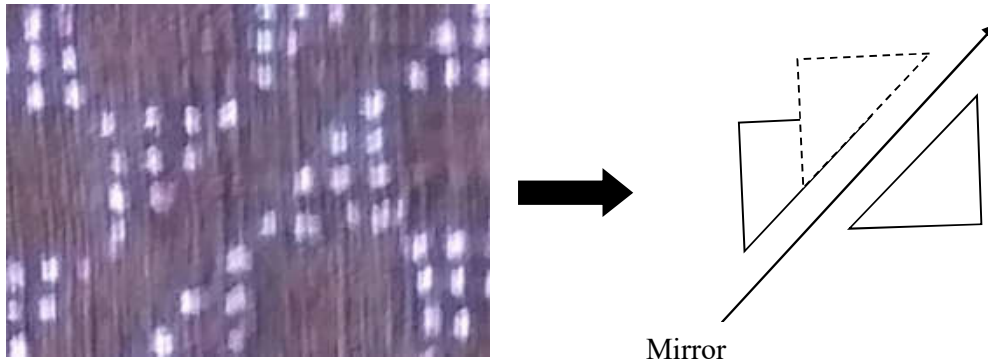
In the Kijing Miring motif there is a concept of transformation, namely reflection that is contained in the triangle pattern. Reflection on the  $y$  axis then reflection on the  $x$  axis. Reflection produces the same object as the original object while maintaining a fixed distance to the symmetry axis.



**Picture 4** Reflection on the  $y$  axis then reflection on the  $x$  axis  
(Reflection on line  $y = x$ )

### 3.1.4 Sliding Reflection

In the motif of Kijing Miring, there is also the concept of transformation, namely sliding reflection found in a triangle pattern. Triangles are reflected on the  $x$  and  $y$  axes first, then translated to vectors  $\begin{pmatrix} a \\ b \end{pmatrix}$ .

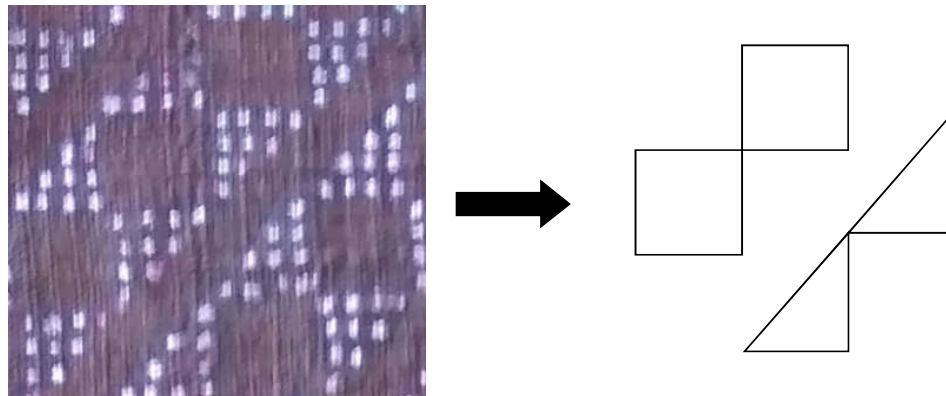


**Picture 5** Sliding Reflection in Triangle Pattern

### 3.1.5 Congruence

In the motif of Kijing Miring also contains congruence concepts which is in a triangle and square pattern. The congruence concept can be demonstrated by giving the action of reflection, translation or rotation of the basic pattern in order to obtain another motif at a particular position with the same shape and size as the original pattern.

Students can show that two objects are congruent by moving one object on top of the other and more than that students can show that an object if it is reflected or rotated or translated will get the same result as the original object.



**Picture 6** Congruence in Triangle and Square

### 3.2 Owl Awil Motif

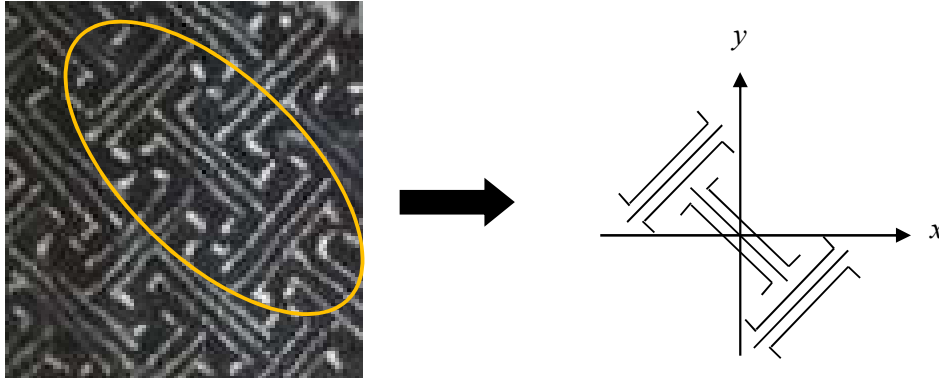


**Picture 7** Owl Awil Motif

Owal awil shows the main style of swastika or banji, this pattern is also called wal-wil which means "continuously repeating". Main background with white pattern. This motif is believed by the community as a form of harmony between husband and wife, men are symbolized by the form of birds, which means courage that is willing to fly to make a living for their family, while women are symbolized by the cananga flower which illustrates that a woman has a gentle, beautiful and fragrant nature. Usually this motif is worn by the bride and groom, the basic motif is composed of two swastika, swastika is a symbol that resembles the letter T with a bent cross, the swastika is also a religious symbol of Hindus [13]. There are a number of mathematical concepts found in the Batik Gedog Owl Awil.

#### 3.2.1 Translation

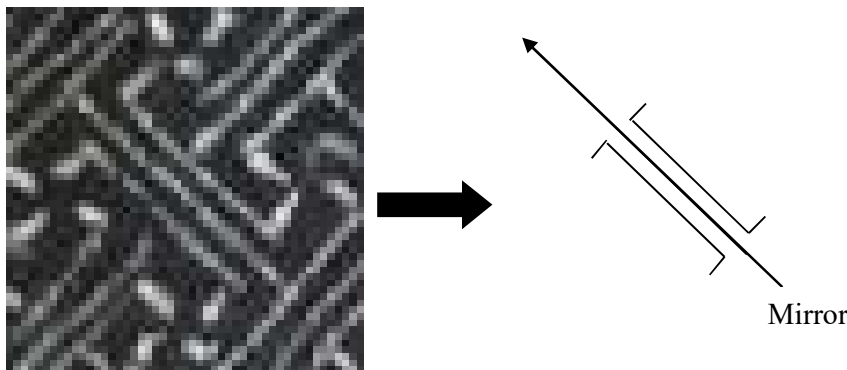
On the Oval Awil motif there is the concept of transformation, namely translation. Translation to vector  $\begin{pmatrix} a \\ b \end{pmatrix}$ . Translated to the  $x$ -axis followed by the  $y$ -axis or on the  $y$ -axis first and followed by the translation of the  $x$ -axis. The translation result is a pattern with the same size and shape at the certain position.



**Picture 8** Translation to vector  $\begin{pmatrix} a \\ b \end{pmatrix}$ . Translated to the  $x$ -axis and followed by the  $y$ -axis

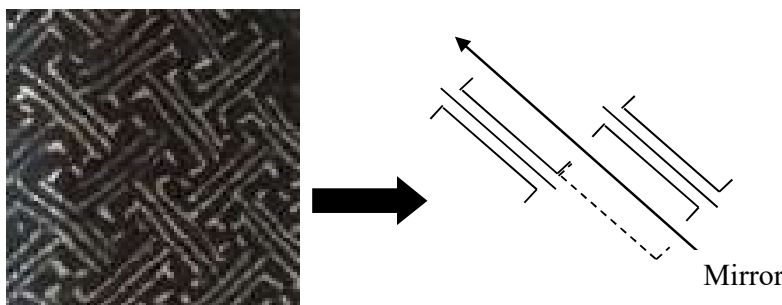
### 3.2.2 Reflection

There is the concept of transformation, namely reflection in Oval Awil Motif. Reflection produces the same object as the original object while maintaining a fixed distance to the symmetry axis.



**Picture 9** Reflection in Oval Awil Motif

### 3.2.3 Sliding Reflection





**Picture 10** Sliding Reflection in Owl Awil Motif

In the Owl Awil motif there is also the concept of transformation, namely sliding reflection. The patterns are reflected on the  $x$  and  $y$  axes first, then translated to vectors  $\begin{pmatrix} a \\ b \end{pmatrix}$

### 3.2.4 Congruence

In the Owl Awil motif there is the congruence concept. The congruence concept can be demonstrated by giving the action of reflection, translation or rotation of the basic pattern in order to obtain another motif at a particular position with the same shape and size as the original pattern.



**Picture 11** Congruence Concept in Owl Awil Motif

### 3.3 Panji Ori Motif



**Picture 12** Panji Ori Motif

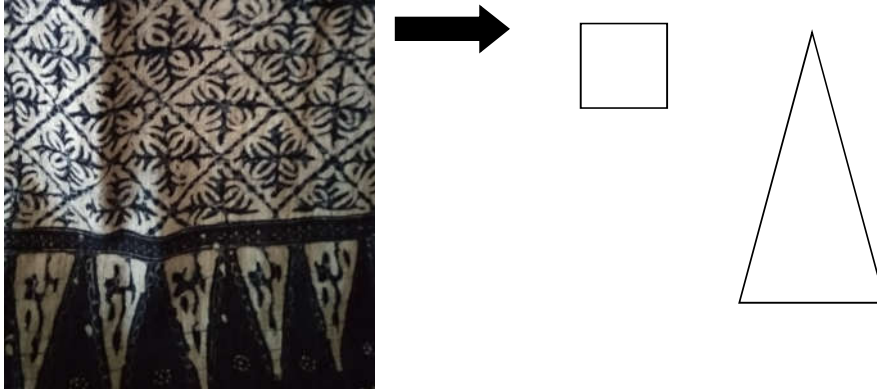
The *Panji Ori* motif is also believed to have existed since the days of the kingdom, it was used by knights. The form of the main motif is *ren-renan* which is placed in a cage or rectangular area. *Panji Ori* are also commonly referred to as *Panji Lor* which can have the meaning of *southern Panji*, or may also be interpreted with the word *banji* which is a mistake of the pronunciation and the word *wan ji* in Chinese which usually refers to the



swastika ornamental style with all its variations. The decorative style means the wheel of Buddhist life. This *Panji Ori* motif used to be only owned by the nobility and those who used it were men or knights. But with the development of the era, this motif can be worn by ordinary people [13]. There are a number of mathematical concepts found in the Batik Gedog Panji Ori.

### 3.3.1 Geometry

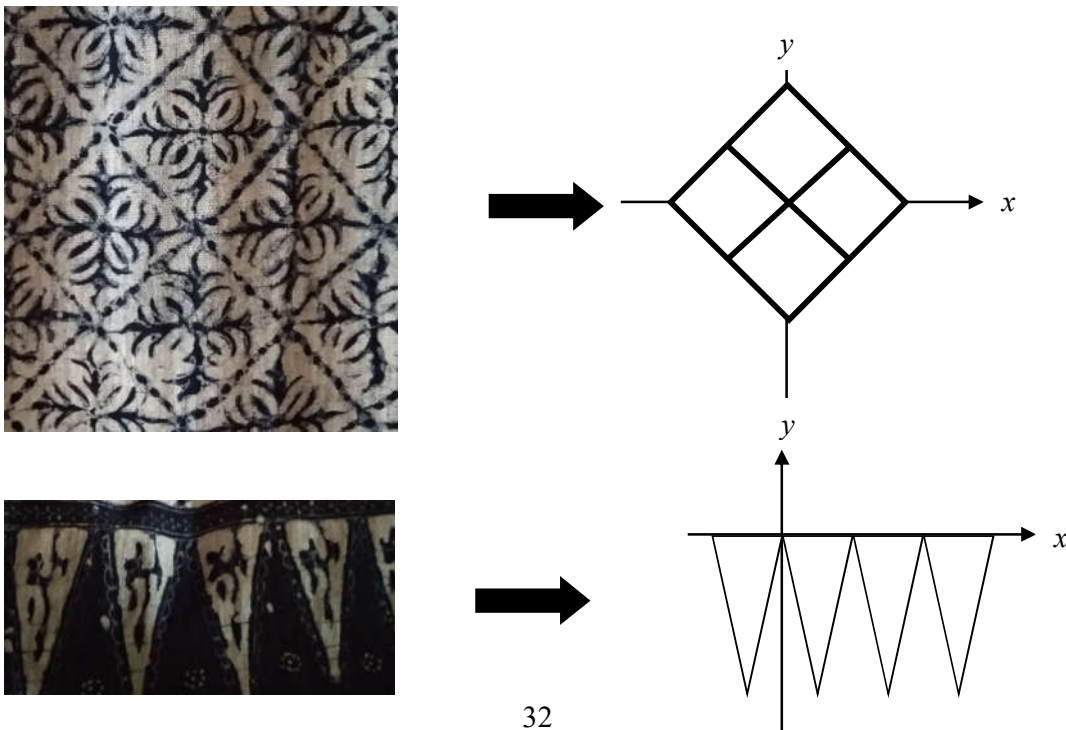
On the Panji Ori motif there are geometric concepts such as points, lines, squares, and triangles.



Picture 13 Square and Triangle in the Panji Ori Motif

### 3.3.2 Translation

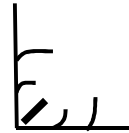
On the Panji Ori motif there is the concept of transformation, namely translation. Translation to vector  $\begin{pmatrix} a \\ 0 \end{pmatrix}$  (Translated to the  $x$ -axis) and  $\begin{pmatrix} 0 \\ b \end{pmatrix}$  (Translated to the  $y$ -axis). The translation result is a pattern with the same size and shape at the certain position.



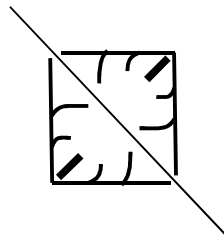
**Picture 14** Translation on Panji Ori Motif

### 3.3.3 Reflection

On the Panji Ori motif there is the concept of transformation, namely reflection on the  $x$ -axis and  $y$ -axis. Reflection produces the same object as the original object while maintaining a fixed distance to the symmetry axis.



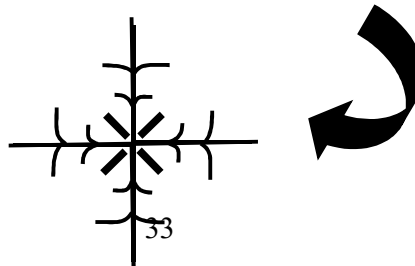
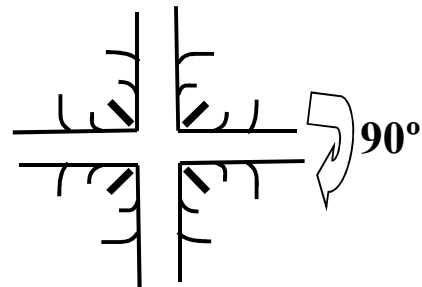
**Picture 15** Basic Shape



**Picture 16** Reflection on the  $y$ -axis and  $x$ -axis

### 3.3.4 Rotation

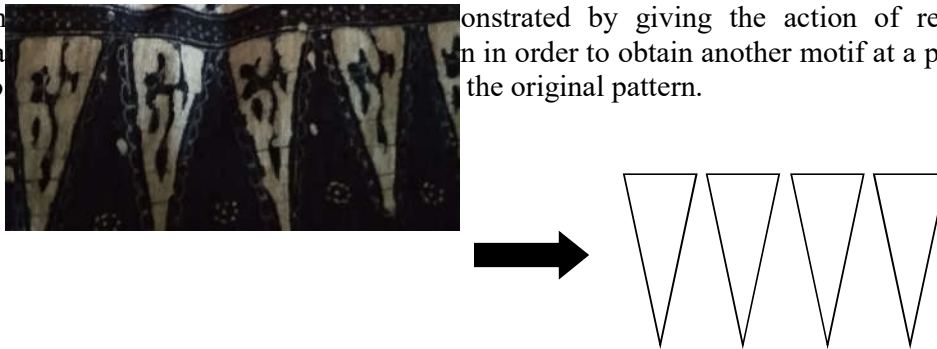
On the Panji Ori motif there is also the concept of transformation, namely rotation at  $90^\circ$



**Picture 16** Rotation at  $90^\circ$

### 3.3.5 Congruence

On the Panji Ori motif there is the congruence concept which is in a Triangle pattern. The transformation is demonstrated by giving the action of reflection, translation, and rotation in order to obtain another motif at a particular position from the original pattern.



**Picture 17** Congruence concept in Triangle

## 4. Conclusion

Batik Gedog Tuban is one of the ancestral heritage in Tuban which is still preserved until now with diverse and unique motifs and colors. Not only the unique motif of Batik Gedog, but the motif also contains several mathematical concepts, such as geometric concepts (square, triangle, and circle), geometric transformation (translation, reflection, rotation, sliding reflection), and congruence. Without realizing it, the people in Tuban have applied mathematical concepts in the pattern of Batik Gedog Tuban. This research can be a reference for teachers to design teaching materials based on cultural context.

## 5. References

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