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Design Development of Batik Tulis Daun Singkong Bondowoso Motifs with Combination of Fractal Objects as Material for Student Worksheets with Ethnomathematical-Based

Pandhu Dinar Ratu Becik[1, a)] and Erfan Yudianto[1], Reza Ambarwati[1], Lela Nur Safrida[1]

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Abstract: Ethnomathematics is the integration of mathematics with culture that is applied by certain cultural groups. Ethnomathematics can be used as a teaching reference in order to make it easier for students to understand because the material they learn is in accordance with the context of their daily life. The research method used in this study is a development research type in which a batik motif design is developed combined with fractal objects to become an ethnomathematics-based LKPD (Student Worksheet) with data collection methods in the form of observation and documentation. Based on initial observations, it was found that the ethnomathematics of batik tulis Daun Singkong Bondowoso. The development of motifs design shows geometry transformation concept that can be used for the materials to make a student worksheets.
Keywords: ethnomathematics, fractals, batik, bondowoso cassava leaf batik, LKPD

INTRODUCTION

Culture that develops in society sometimes goes hand in hand with mathematical concepts that we learn formally at school. Uniquely, people do not realize that the culture around us often departs from mathematical concepts that have not been studied. The integration between mathematics and culture can be used as a teaching reference in order to facilitate students' understanding because the material they learn is in accordance with the contextual context of students' daily lives. Facts in the field show that mathematics is one of the subjects that are difficult for students to understand, so it tends to cause students to stay away from mathematics. This is certainly a big task for educators to explore more creativity to teach mathematics that can make students not bored and give up in learning it.

The innovation of teaching mathematics which at the same time introduces the culture of everyday life is actually a common thing. The mingling of cultural activities associated with mathematics is known as ethnomathematics. Marsigit (in Zayyadi, 2017) says that ethnomathematics is a science that is used to understand how mathematics is adapted from a culture and serves to express the relationship between culture and mathematics so that it can be said that ethnomathematics is a science in studying the culture of society, historical heritage related to mathematics. and learning mathematics[1].

Koentjaraningrat (in Nahak, 2019) states that culture is defined as the whole of human ideas and works that must be familiarized with learning, and the overall results of that mind and work. One of the Indonesian cultures that is well known to the world is batik[2]. In particular, Supriono (in Yudianto et al., 2020) states that batik is defined as an art of writing or painting on cloth, in which batik craftsmen use wax or "night" in the process of obtaining patterns or designs on cloth using canting[3].

The development of batik motifs in each region raises diversity according to environmental influences. Each motif depicted on the cloth usually has certain philosophies or meanings that are influenced by the conditions around the batik maker (Anggraini, 2019)[4]. Including in the Bondowoso area, East Java. Bondowoso is a district directly adjacent to Jember Regency in the south and Situbondo Regency in the north (Yudianto et al., 2020)[5]. This district is famous for its cassava tape so that it has an influence on the surrounding culture by forming one of the batik motifs

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that is closely related to the basic material for making cassava tape, namely the Batik Tulis Daun Singkong Bondowoso motifs.

Batik has quite a variety of patterns and often these patterns are geometric shapes that are interesting to study in mathematical research. The development of science and technology also has implications for batik in the form of developments in motifs, meanings, manufacturing processes, and their role in everyday life. The development of batik designs has also evolved in various ways, one of which is by using fractals. Fractal is a geometric concept that shows the irregularity of shapes in nature that cannot be visualized with general geometric dimensions (Euclidean geometry). The geometry describes the various irregular and fragmentable shapes that surround us by identifying a set of shapes called fractals. The combination of batik and fractals which have different concepts and the application of mathematical formulas gives rise to fractal batik motifs (Anggraini, 2019)[6]. The combination of fractals in the design development of the Batik Tulis Daun Singkong Bondowoso motifs aims to introduce students to irregular geometric shapes that are close to the nature that surrounds us.

This study wanted to show how the ethnomathematics of Bondowoso cassava leaf batik was developed with a combination of fractal objects and the output that would be used as an ethnomathematics-based Student Worksheet (LKPD). It is hoped that in the future the LKPD as a result of developing the Batik Tulis Daun Singkong Bondowoso motifs will help students to more easily understand mathematics learning, especially on the topic of geometric transformation.

RESEARCH METHODS

Research This research uses the type of research R&D (Research and Development) or commonly called the type of development research. The purpose of the research and development method is to produce certain products that are expected to be able to demonstrate the development and renewable innovations of a developed product. The development model according to Branch used is the ADDIE model which consists of five main stages, namely Analysis, Design, Development, Implementation, and Evaluation. The research and development procedures are:

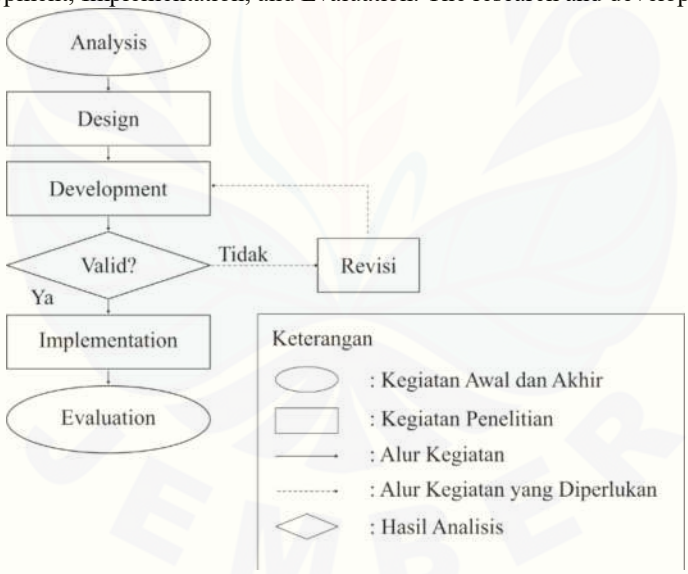

FIGURE 1. Research Procedure

1. Analysis

   Activity at this stage is to analyze potential problems that occur during initial observations of batik craftsmen at the Daweea Batik Bondowoso Production House. Observations on the finished batik products in the batik production house show that the Batik Tulis Daun Singkong Bondowoso motifs has various geometric shapes that can be developed with a combination of fractal objects to be used as Student Worksheets (LKPD). The results of the batik were documented and unstructured interviews were conducted as a form of data collection to determine the ethnomathematics of Bondowoso cassava leaf batik.

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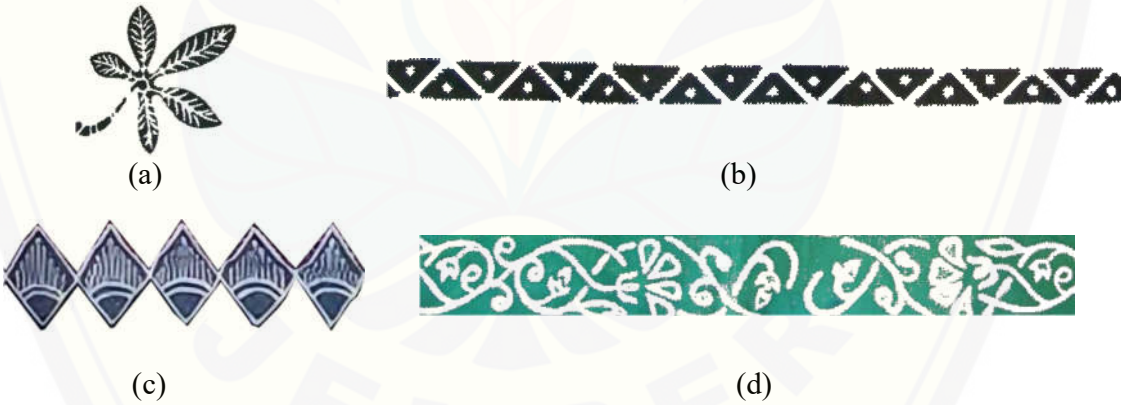
2. Design

At this stage, after the data has been obtained, the design of the development motif of the Bondowoso cassava leaf batik is made combined with fractal objects. The design of the development motif is carried out by selecting the source of ideas where the researchers obtained two motif designs as a source of development ideas, namely:

(a) (b)

FIGURE 2. Batik Tulis Daun Singkong Bondowoso motifs

Objects from batik motifs above that chosen for the development design motifs include:



(a) (b)

(c) (d)

FIGURE 3. (a) Cassava Leaf Pattern (b) Triangle Pattern (c) Rhombus Pattern (d) Flower Patter

Fractal objects used as a combination of development motif designs include:

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FIGURE 4. Fractal Object: (a) Koch Snowflake (b) Fractal Trees

From the source of these ideas, two new designs were made with a combination of Bondowoso Cassava Leaf batik and fractal objects that were used as ethnomathematics-based Student Worksheets, namely:

FIGURE 5. Design Development of Batik Tulis Daun Singkong Bondowoso motifs

3. Development

   This development stage includes design validation which is carried out by selecting the development motif design directly by two expert mathematics lecturers media and material experts, then evaluated to be revised according to suggestions if needed. The selected design from the two development motif designs that have been made is the first development motif design.

4. Implementation

   The implementation stage is the application of the selected development motif design to make ethnomathematical-based Student Worksheets (LKPD). This development motif design contains various geometric elements that can be used as teaching aids with the topic of geometric transformation.

5. Evaluation

   The evaluation stage is an activity to assess and look for advantages and disadvantages related to the results of the implementation as a form of revision needs so that the product can be further refined in order to find out whether the design of this development motif is worthy of circulation.

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Time and Place of The Research

The research was conducted at the Daweea Batik Bondowoso Production House. The research was conducted in October 2021.

Operational Description of Research Objects

1. Development of batik motifs is an activity to redesign existing batik motifs with the aim of making them more varied according to the research objectives.
2. Bondowoso cassava leaf batik is a typical batik of Bondowoso district with cassava leaf patterns and various other geometric elements.
3. Fractal objects are geometrical concept ornaments that show the irregularities of shapes in nature that cannot be visualized with general geometric dimensions (Euclidean geometry) and have infinite details so that they are widely used as the basis for developing batik patterns in Indonesia.
4. Student Worksheets (LKPD) are part of the learning tools developed by educators for students.
5. Ethnomathematics is an amalgamation of mathematics and culture that developed accidentally in the midst of certain societies, in this case the concept or element of geometry contained in Bondowoso Bondowoso cassava leaf batik.

Data Collection Method

The data collection method used in this research is observation and documentation. Observation is the search for data by focusing research on objects using the senses of hearing, touch, and sight. This observation was carried out to explore in detail about the finished batik motifs of Bondowoso Cassava Leaves which will be used as the basis for the development of motif designs combined with fractal objects and retrieve the documentation. Initial observations show that there is ethnomathematics in Bondowoso cassava leaf batik.

Research Instruments

Research instruments are tools used to collect data. In development research, there are several data to be collected, including product validation sheets and observation sheets validated by the validator.

Data Analysis

Observation and documentation results are a systematic arrangement obtained through data analysis (Sugiyono, 2017)[7]. Data analysis was carried out in order to obtain answers to the problems in accordance with the research guidelines. The data analysis method used in this research is descriptive qualitative where data processing is in the form of suggestions and responses from the validator in the form of descriptive data. If the analysis results show a valid category, then it can be continued to the field trial stage. However, if the results of the analysis show that the category is not valid, a total revision is needed and a validation process is carried out again by experts and practitioners.

RESULTS AND DISCUSSION

Aldina said (in Maskar & Anderha, 2019) geometric transformation is one of the discussions in geometry regarding changes in shape, location, and presentation based on an image and matrix[8]. Based on the design of the development motif of Bondowoso cassava leaf batik, there are elements of geometry along with a combination of fractal objects that can be used as materials for making LKPD by mathematics teachers on the topic of geometric transformation. The results of the development are as follows:

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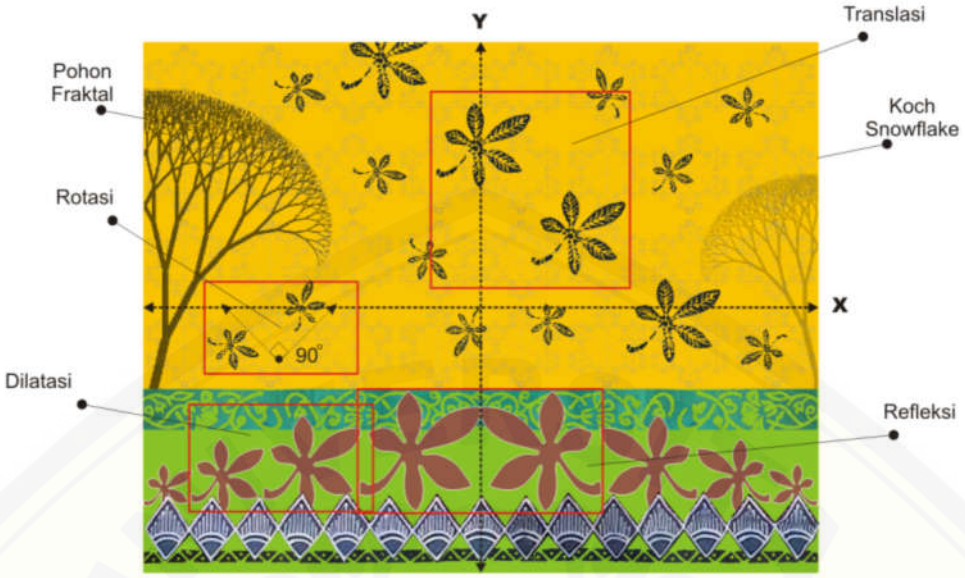

FIGURE 6. Development of Batik Tulis Daun Singkong Bondowoso motifs Design and its Geometric Elements

a) Reflection

FIGURE 7. Reflection of Cassava Leaf Pattern (a) Reflection of the Rhombus Pattern (b)

The image above shows the reflection or reflection of the cassava leaf pattern and the geometric shape of the rhombus reflected on the Y axis.

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b) Dilatation

FIGURE 8. Dilation of Cassava Leaf Pattern

The image above shows the dilatation of the cassava leaf pattern where there is a change in the size of the object as a result of multiplying a certain scale factor but does not change the shape of the object.

c) Rotation

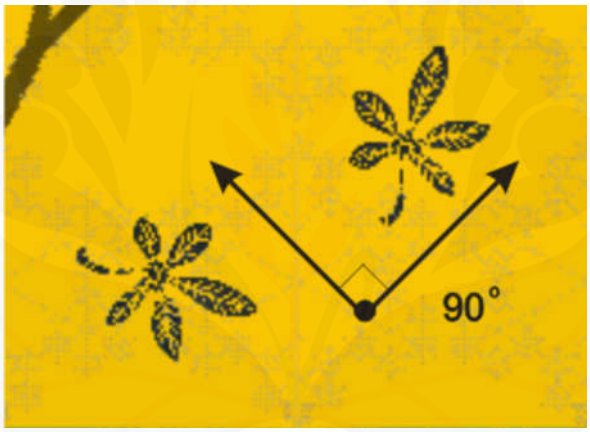

FIGURE 9. Rotation of Cassava Leaf Pattern

The image above shows the rotation or rotation of the cassava leaf pattern with the process of rotating any point from an object to another point.

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d) Translation

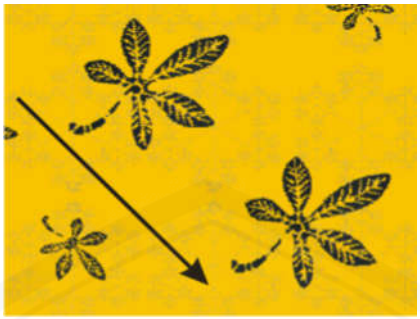

FIGURE 10. Translation of Cassava Leaf Pattern

The image above shows the translation or shift of the cassava leaf pattern with the process of moving a point along a straight line with a certain direction and distance.

A similar study on the development of batik designs with fractal patterns was conducted by Linda Dwi Fenti Anggraini (in Anggraini, 2019) who reviewed fractal geometry and geometric transformations that can be applied in the development of new batik motifs in Indonesia[9]. This study uses anapproach *applied research* which aims to develop a sekar Jagad batik motif with fractal geometric patterns assisted by geometric transformations as well asapplications *Maple 13* and *Corel Draw*.

Further relevant research was also carried out by Ngilawajan (2015) who carried out research to examine fractals in the motifs formed on Tanimbar woven fabrics[10]. The results of this study indicate the repetition of an object in the same or different sizes so as to form a pattern. The repetition of an object in the same or different sizes shows similarities to the concept of fractal geometry.

The results of this development are expected to be further utilized in learning mathematics in everyday life which we know as ethnomathematics. Ethnomathematics provides the right adjustment to a sustainable culture in a society that turns out to have unconsciously used mathematics in the process. Ethnomathematics leads to the understanding that mathematics is not just a meaningless material that is learned in school. Based on a similar study, this time the researchers wanted to develop a batik motif design with a combination of fractal objects from Bondowoso cassava leaf batik as a student worksheet material. Bondowoso cassava leaf batik is a batik motif that is quite famous compared to other batik motifs in Bondowoso. It is hoped that in the future, LKPD as a result of developing the design of batik motifs and this combination of fractals will help students learn the topic of transforming mathematical geometry to be easier to understand.

CLOSING

Conclusions

Batik tulis Daun Singkong Bondowoso contains various elements of geometry eligible to be used as Worksheet Students (LKPD) based etnomatematika. The results of developing the design of Batik Tulis Daun Singkong Bondowoso motifss with cassava leaf patterns and various geometric elements combined with fractal objects are a relevant way so that the objectives of learning mathematics with the topic of geometric transformation can be easily understood by students. This development motif design provides opportunities for students to think more creatively in understanding changes in an object studied in the topic of geometric transformation.

Suggestion

It is recommended for mathematics teachers or advanced researchers to make Student Worksheets that are able to increase students' enthusiasm in learning mathematics, especially with the help of an ethnomathematical approach that is close to students' daily lives as well as efforts to preserve national culture. Students should also be freed in analyzing

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what forms of change in the design of development motives have been made so that students will be easier to open up and appreciate the difference that the solution to solving something is not single and there are various ways to achieve a goal.

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