

# Mathematics Education and Learning

---

Jember, Indonesia • 30–31 October 2021

**Editors** • Dian Kurniati, Rafiantika Megahnia Prihandini and Ridho Alfarisi



— COMMITTEE —  
**ICOMELA**  
— 2021 —

AIP Conference Proceedings

# AIP Conference Proceedings

---

Volume 2633

ISBN: 978-0-7354-4376-1

ISSN: 0094-243X

[scitation.org/journal/apc](https://scitation.org/journal/apc)



AIP Conference Proceedings

Mathematics Education and Learning

Volume 2633





# Mathematics Education and Learning

**Jember, Indonesia**

30-31 October 2021

## Editors

**Dian Kurniati**

**Rafiantika Megahnia Prihandini**

University of Jember, Jember, Indonesia

**Ridho Alfarisi**

Universitas Airlangga, Surabaya, Indonesia

All papers have been peer reviewed.



Melville, New York, 2022  
AIP Conference Proceedings

Volume 2633

To learn more about AIP Conference Proceedings visit <http://proceedings.aip.org>

## Editors

### Dian Kurniati

#### Rafiantika Megahnia Prihandini

University of Jember  
Mathematics Education  
Jl. Kalimantan No. 37 Sumbersari  
Jember, 68121  
Indonesia

Email: dian.kurniati@unej.ac.id  
rafiantikap.fkip@unej.ac.id

### Ridho Alfarisi

Universitas Airlangga  
Mathematics  
Jl. Mulyorejo  
Surabaya, 60114  
Indonesia

University of Jember  
Primary School  
Jl. Kalimantan No 37  
Jember, 68121  
Indonesia

Email: alfarisi.fkip@unej.ac.id

Authorization to photocopy items for internal or personal use, beyond the free copying permitted under the 1978 U.S. Copyright Law (see statement below), is granted by the AIP Publishing LLC for users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that the base fee of \$30.00 per copy is paid directly to CCC, 222 Rosewood Drive, Danvers, MA 01923, USA: <http://www.copyright.com>. For those organizations that have been granted a photocopy license by CCC, a separate system of payment has been arranged. The fee code for users of the Transactional Reporting Services is: 978-0-7354-4376-1/22/\$30.00



© 2022 AIP Publishing LLC

No claim is made to original U.S. Government works.

Permission is granted to quote from the AIP Conference Proceedings with the customary acknowledgment of the source. Republication of an article or portions thereof (e.g., extensive excerpts, figures, tables, etc.) in original form or in translation, as well as other types of reuse (e.g., in course packs) require formal permission from AIP Publishing and may be subject to fees. As a courtesy, the author of the original proceedings article should be informed of any request for republication/reuse. Permission may be obtained online using RightsLink. Locate the article online at <http://proceedings.aip.org>, then simply click on the RightsLink icon/"Permissions/Reprints" link found in the article abstract. You may also address requests to: AIP Publishing Office of Rights and Permissions, 1305 Walt Whitman Road, Suite 300, Melville, NY 11747-4300, USA; Fax: 516-576-2450; Tel.: 516-576-2268; E-mail: [rights@aip.org](mailto:rights@aip.org).

ISBN 978-0-7354-4376-1

ISSN 0094-243X

Printed in the United States of America

*AIP Conference Proceedings, Volume 2633*  
**Mathematics Education and Learning**

**Table of Contents**

**Preface: The 1st International Conference of Mathematics Education, Learning and Application 2021** 010001

**MATHEMATICS**

**Modeling the number of early detection of cervical cancer in Lampung province using the generalized linear model**  
Septian Wulandari 020001

**Goal programming model in the optimization of fertilizer mixtures for oil palm plant as monograph**  
Yoan Maria Magdalena, Susi Setiawani, and Lioni Anka Monalisa 020002

**Transformation geometry mathematic connection analysis based on Etnomatics**  
Arwanto 020003

**Comparison of spatial weight for consumer price index modeling in East Java using generalized space-time autoregressive**  
Affiati Oktaviarina, Henny Pramodyo, Suci Astutik, and Rahma Fitriani 020004

**A meta-analysis of the implementation of ANN back propagation methods in time series data forecasting: Case studies in Indonesia**  
Syaharuddin, Fatmawati, and Herry Suprajitno 020005

**EDUCATION**

**Teachers' communication in mathematics learning based on zone of promote action**  
Siti Faizah, Toto Nusantara, Sudirman, Rustanto Rahardi, Susiswo, Subanji, and Ria Kamilah Agustina 030001

**Perceptions of pre-service and in-service mathematics teachers on the mathematical link between matrices and vectors**  
Marfuah Marfuah, Didi Suryadi, Turmudi Turmudi, Arif Muchyidin, and Gusni Satriawati 030002

**Analysis of student representation ability in solving HOTS questions review from self efficacy**  
Wasilatul Murtafi'ah, Revy Crismona Delia, and Edy Suprpto 030003

**How are students' higher order thinking skills (HOTS) in mathematical problem solving viewed from the ability to understand mathematical concepts?**  
Ika Putri Lenawati, Wasilatul Murtafiah, and Sanusi 030004

**Analysis of students' understanding of mathematical concepts in the Faraid calculation using modulo arithmetic theory**  
Mohammad Tohir, Muzayyanatun Munawwarah, Saiful, Abd. Muqit, Khoirul Anwar, Kandiri, and Asmuki 030005

- Mathematics teacher's ability in inclusion school made learning media with Canva application**  
Ika Kurniasari, Tatag Yuli Eko Siswono, Rini Setianingsih, and JanetTrineke Manoy 030020
- The effect of the infusion learning approach on the students' truth-seeking behavior on Cartesian coordinates**  
Muhammad Syarif Hidayat, Dian Kurniati, Sharifah Osman, and Dinawati Trapsilasiwi 030021
- Cognitive experience of junior high school students in numerical prolem solving on minimum competency assesment based on cognitive style**  
Sutama, Sabar Narimo, Harsono, Diana Purwita Sari, and Mazlini Adnan 030022
- Development of Batik Daun Singkong Bondowoso motifs based on fractals as student worksheets**  
Imyilia Kirana Candra Dewi, Erfan Yudianto, and Susanto 030023
- 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, Erfan Yudianto, Reza Ambarwati, and Lela Nur Safrida 030024
- Development of student's worksheet based on realistic mathematics education (RME) approach to know students' mathematical problem solving abilities**  
Sinta Priciliya, Sunardi, Erfan Yudianto, and Susanto 030025
- Mathematics teachers' problems in online learning during the Covid-19 pandemic**  
Imam Sujadi, Budiyo, Ira Kurniawati, Arum Nur Wulandari, Riki Andriatna, and Hanifa Alifia Puteri 030026
- Profile of metacognition experience of mathematics education students in understanding the concept of differential calculus review gender differences**  
La Misu, La Masi, and Arviaty 030027
- The development of a mobile phone application based on RME model for probability of union of two events**  
Ervin Azhar, Khoerul Umam, and Edy Wihardjo 030028
- Ethnomathematics: Geometry exploration in Pura's architecture of Taman Nasional Alas Purwo**  
Lela Nur Safrida, Susanto, Toto Bara Setiawan, Erfan Yudianto, Reza Ambarwati, and Brigita Wanda Pangestika 030029
- The implementation of edmodo-based interactive learning media in mathematics subject**  
Dhanar Dwi Hary Jatmiko and Hobri 030030
- Students' mathematical literacy ability in solving story problems**  
Muftihatul Azizah, Sunardi, and Erfan Yudianto 030031
- Geometric reasoning of analysis level students in classifying quadrilateral**  
Arum Hikmahtul Afifah, Susanto, and Nurcholif Diah Sri Lestari 030032
- A qualitative content analysis: To what extent do mathematical literacy test involve mathematical process activities?**  
Nurcholif Diah Sri Lestari, Suwarno, and Wasilatul Murtafi'ah 030033

## Development of Batik Daun Singkong Bondowoso Motifs Based on Fractals as Student Worksheets

Imyilia Kirana Candra Dewi<sup>1, a)</sup>, Erfan Yudianto<sup>1, b)</sup>, and Susanto<sup>1, c)</sup>

<sup>1</sup>Mathematics Education Department, Universitas Jember, Jl. Kalimantan 37, Jember, Indonesia

<sup>a)</sup> Corresponding author : [imyilia7416@gmail.com](mailto:imyilia7416@gmail.com)

<sup>b)</sup> [erfanyudi@unej.ac.id](mailto:erfanyudi@unej.ac.id)

<sup>c)</sup> [susantouj@gmail.com](mailto:susantouj@gmail.com)

**Abstract.** Fractal is a geometric object that can be broken down into several parts and has a shape similar to the original. The development of the motif uses Koch Snowflake, the Mandelbrot Association, the Hilbert Curve, and the Julia Association to add a combination of Batik Daun Singkong Bondowoso. This study uses the Research and Development (RnD) research method with the final product in the form of Student Worksheets (LKS) containing fractal-based batik motifs. Data collection methods used are observation, interviews, student response questionnaires, and documentation. Based on the results of initial observations, it was found that several Batik Daun Singkong Bondowoso motifs had mathematical elements. Some of these batik motifs were developed using fractals assisted by GeoGebra application technology and resulted in the final product of the Student Worksheet (LKS)

### INTRODUCTION

Indonesia is a country with a variety of cultures. Culture is a complex matter which includes knowledge, law, morals, beliefs, arts, customs, and habits of the people. One of Indonesian culture is batik. The word "Batik" comes from the word "amba" which means to write and the word "dot". In English, batik is also called wax – resist dyeing, which is taken from the word wax which means night that is scratched on the cloth as dye (dye).[1]. Batik has several processing techniques, including stamping, screen printing, painting, writing, and so on.

Each region in Indonesia has batik motifs with different philosophies. One of them, Bondowoso, has Batik Daun Singkong Bondowoso. Batik with the main motif of cassava leaves. The motif symbolizes the livelihoods of the Bondowoso people, most of whom work as tobacco farmers and tape makers with cassava as the main ingredient[2]. Over time, the cassava leaf batik motif has developed, adding other ornaments to batik is increasingly adding to the aesthetic value of batik itself.



FIGURE 1. Batik Daun Singkong Bondowoso

One of the branches of mathematics, fractals also teach to form imitations of objects around us. Fractal is a repetition of geometric shapes with different lengths and widths as well as different positions(Purnomo, Hadi, and Putri, 2020).



By using fractals, it is easier to produce imitations of rock objects, clouds, planets and so on. This will produce a new batik pattern. according to Anggraini (2019), the application of fractals in batik lies in the decorative technique in filling motifs on "isen", large and small motifs. The combination of the resulting fractals applies mathematical formulas and produces various pattern designs. The combination of lines, points, angles, magnifications, repetitions, and shifts is recorded in fractal batik. There are several kinds of fractal motifs, including Koch Snowflake, Sierpinski arrowhead curve, Julia set, Mandelbrot set, and so on.

Mathematics that is associated with culture and daily life activities is called etomathematics. It aims, there is another point of view in looking at mathematics, not only in terms of education but also in terms of social and cultural. In Bondowoso cassava leaf batik, there are many ethnomathematical concepts that are poured. There are the concepts of flat shapes, similarity, points and lines. This is also related to students' learning of geometric transformations. The application of contextual problem-based learning will lead to more logical student reasoning. With the example of this cassava leaf batik motif, it will attract students to understand the material of geometric transformation. This study shows how batik motifs are produced by combining fractal patterns and are used as ethnomathematics-based Student Worksheets (LKS).

## METHOD

This study uses a research and development approach (research and development). Research and Development (RnD) is an effort to develop products or devices and have uses in learning. This research leads to the application of the GeoGebra program in drawing fractal patterns to develop Bondowoso cassava leaf batik motifs.

The generation of a combined fractal design from Sierpinski and Koch Snowflake arrowheads consisting of several stages. Sierpinski's arrowhead curve was generated into a fractal batik using the 3rd and 5th iterations, while the Koch Snowflake pattern was generated into a 5th iteration fractal batik.

## RESULTS AND DISCUSSION

The result of this article is a worksheet with the material object in the form of the Bondowoso Cassava Leaf batik motif which was developed with a fractal pattern. The fractal pattern taken in this development is the Koch Snowflake pattern and the Sierpinski arrowhead curve which was carried out with the help of the GeoGebra application. The Sierpinski arrowhead curve pattern is carried out until the 5th iteration while Snow Kochflake is carried out until the 5th iteration. The results of the development are as follows:

### a. Rotation

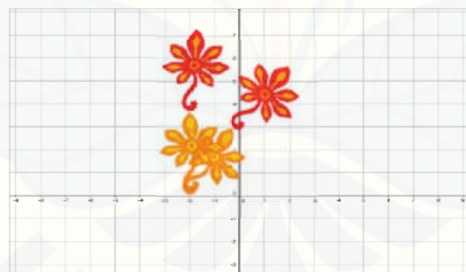


FIGURE 2. Bondowoso Cassava Leaf Rotation

The picture above is, the cassava leaf object is rotated by  $30^\circ$  clockwise.

### b. Reflection

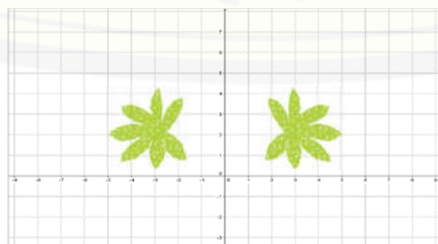


FIGURE 3. Bondowoso Cassava Leaf Reflection

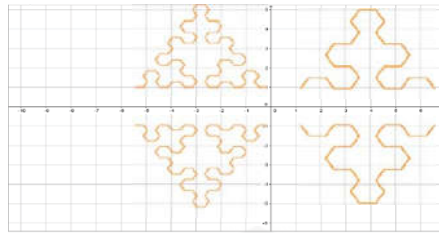


FIGURE 4. Reflection of Sierpinski's Arrow Curve

The picture above shows the reflection or reflection of the Bondowoso cassava leaf and the fractal pattern of the Sierpinski arrow curve. On fractal objects, arrow curves are obtained with the 5th and 3rd iterations.

**c. Translation**

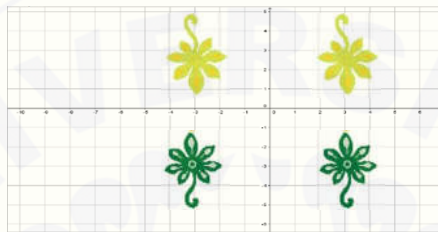


FIGURE 5 Cassava Leaf Translation

The figure above shows the translation (shift) as far as 3 units to the right.

**d. Dilated**

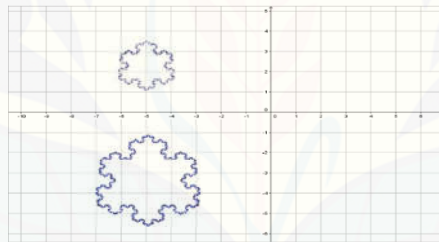
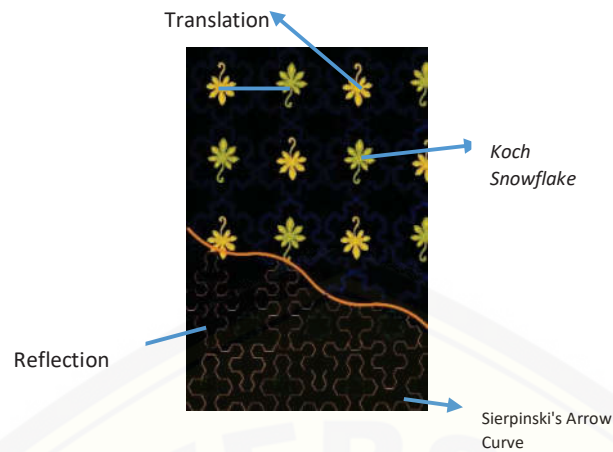


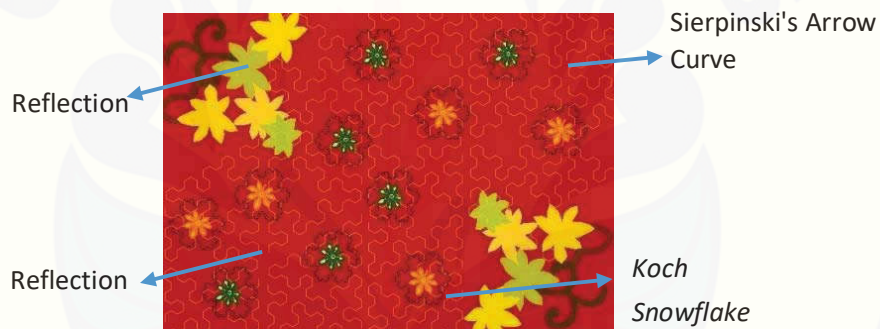
FIGURE 6. Dilated Koch Snowflake

The last image shows the Koch Snowflake fractal pattern with the 5th iteration which is magnified at 2x. Merging the above batik objects using Corel Draw. Get 3 models of batik motifs as below



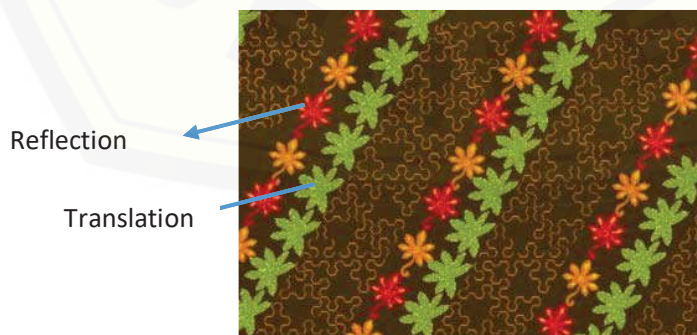
**FIGURE 7.** Development of the First Bondowoso Cassava Leaf Batik Motif

The first batik pattern produced is a combination of Bondowoso cassava leaves which are reflected on the x-axis. The fractal pattern blends using the 5th iteration Koch Snowflake and the 3rd iteration Sierpinski arrow curve. The Koch snowflake fractal pattern is reflected on the y-axis while the Sierpinski arrow curve is reflected on the x-axis. With the addition of a curve in the batik design as a barrier.



**FIGURE 8.** The Development of the Second Bondowoso Cassava Leaf Batik Motif

The second batik pattern produced is a combination of the object of Bondowoso cassava leaves which are reflected. The combination of fractal patterns uses the 5th iteration of Koch Snowflake and the 4th iteration of Sierpinski arrows curves. The Koch snowflake fractal pattern is translated about the x-axis while the Sierpinski arrow curve is rotated by  $60^\circ$ .



**FIGURE 9.** The Development of the Second Bondowoso Cassava Leaf Batik Motif

The third batik pattern produced is a combination of the first and second models of Bondowoso cassava leaves which are rotated by  $30^\circ$ . The fractal pattern blends using the 5th iteration Sierpinski arrow curve. The fractal pattern of the Sierpinski arrows was translate.

### CONCLUSIONS AND SUGGESTIONS

Fractal geometry and the application of the principle of geometric transformation, can be applied to the pattern of making new motifs of Bondowoso Cassava Leaf Batik. The application used can be adapted to the form you want to make. The results of this development can be stated in Student Worksheets in learning geometric transformations, so that students are able to understand the material through the implementation of life around them.

This study only uses two fractal patterns, and one batik motif. The resulting fractal pattern is also simple. In further research, it can be used to develop mathematical formulas for each resulting pattern, both fractal patterns and Bondowoso Cassava Leaf batik patterns.

### REFERENCE

1. M. Utami, "Characteristics of Batik Painting Saint Noveni," *Essay*, 1–146 (2019)
2. Ayu, "Batik and Socio-Cultural Legitimacy Study of Motif Analysis and Recognition of Batik Jember, Lumajang, and Bondowoso," *jantara*, **2**, 191–207 (2016)
3. K. D Purnomo, D. Hadi, and P. Putri, "Fractal batik design innovation using fractal geometry," *Prism*. **3**, 131–140 (2020)
4. L. D. F Anggraini, "Fractal Geometry and Geometry Transformation as the Basis for Development of Sekar Jagad Batik Motifs," *Transformation*, **3**(1), 1–14 (2019)