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Research article

Developing a Mathematics Learning Application Using an Android-based Ethnomathematics Concept of Traditional Javanese Batik Pattern

Mei Lestari, Ari Irawan*, Wanti Rahayu, and Nurfidah Dwitiyanti

Universitas Indraprasta PGRI, Indonesia

Abstract.
Ethnomathematics is a part of the integration of mathematics and culture. This study aims to create an Android-based mathematics learning application using Javanese batik ethnomathematics material on flat shapes and their transformation properties. The method used in this research is Research and Development (R&D) with the ADDIE model (analysis, design, development, implementation, and evaluation). The authors examine traditional batik motifs of West Java, Central Java, and East Java to develop ethnomathematical learning media for an Android-based learning media application. Needs analysis and ethnomathematical analysis of batik motifs from each region were done. Next, the screen display for each page of the material was designed. The research is currently ongoing and is in the development stage.

Keywords: ethnomathematics, Javanese batik, batik pattern, learning media, mathematics

Corresponding Author: Ari Irawan; email: ari_irawan@unindra.ac.id

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1. Introduction

Ethnomathematics is a learning approach that uses a combination of mathematics learning with the culture in it. Ethnomathematics emerged as a new category in the conceptual discourse of mathematics education and the interaction between mathematics and culture.**[1]** Furthermore,**[2]** asserts that ethnomathematics is a field of study that examines how other cultures understand, articulate, and use concepts and practices that originate in their culture and are described as mathematics**[3]**.

It is well known that Indonesia is a nation that is famous for its cultural diversity, from Sabang to Merauke. One of Indonesia's cultural heritage is batik. Batik is a cultural product that has existed for centuries and developed through modernization.**[4]** The island of Java is known as one of the centers of batik development, and several cities in this area are batik producers. Batik, which has a distinctive image for the Javanese

people in the culture that is carried out, cannot be separated from the elements of art that are very thick and cannot be separated from the existence of mathematics, especially in the field of flat geometry. For example, the machete, mega cloudy, and several other batik motifs have mathematical elements. Elements of mathematics that exist in this culture are called ethnomathematics.

In today's digital era, students are already familiar with technology, giving rise to equipment and applications that are very easy to learn and use as teaching media.**[5]** Learning media is used to support the learning process so that it can achieve learning objectives. Learning media is defined as a tool in the form of physical and non-physical used by teachers in delivering material to students to be more effective and efficient.**[6]** So that the learning material is accepted by students as a whole and attracts students to learn more**[7]**.

Previous research related to the development of ethnomathematical-based learning media applications has been carried out by**[8]**, His study produced output in the form of a learning media development product on transformation material using iSpring through an Android-based ethnomathematical approach used by SMP/MTs students. Another study was also conducted by**[9]**, namely the development of ethnomathematical-based learning media from Menara Kudus using Adobe Flash Professional CS 6 for class VIII students to be effective in learning.

This study links the ethnomathematical elements in Javanese batik motifs with learning mathematics through an Android-based learning media application. This android application is expected to make it easier for students to understand mathematics without forgetting their nation's culture. The purpose of this study is to design an android-based learning media application with flat-shaped material and its transformation properties through an ethnomathematical approach found in batik motifs on the island of Java. The purpose of this research is to create an Android-based mathematics learning application using the ethnomathematics of Javanese batik material on flat shapes and their transformation properties.

Literature Review

1.1. Etnomathematics Concept

Ethnomathematics as a research paradigm is broader than traditional concepts, mathematical concepts, ethnicity, or the current understanding of multiculturalism. Ethnomathematics is the arts and techniques (tics) developed by diverse cultural and linguistic backgrounds (ethnic) to explain, understand, and cope with their own social, cultural,

environmental, political, and economic environment**[10]**. Ethno refers to different groups identified by cultural traditions, codes, symbols, myths, and certain ways of thinking and inferring. A detailed study of the mathematical procedures and practices of different cultural groups will of course allow us to broaden our understanding of the internal logic and mathematical ideas of different groups of people and the practices found in our community in traditional and academic mathematics**[11]**.

Ethnomathematics, too, is a program that seeks to study how students understand, articulate, process, and ultimately use mathematical ideas, procedures, and practices that enable them to solve problems related to their daily activities. This holistic context helps students reflect, understand, and understand the relationships among all the components of the system being studied**[11]**.

1.2. Mathematical Concept in Batik

Figure 1: Tessela in Motif Kalangbret.

The Kalangbret (kambretan) motif comes from Tulungagung Regency, where this motif has more variations. This motif is mixed with other regional batik motifs. Most of the motifs used are motifs with bouquets but not colored. One of the famous kambretan batik motifs is the kotongan motif, an empty form that has no content in the batik carvings made, and there is a banjo flower motif.

Tessellation is a unique pattern consisting of geometric shapes arranged without a partition or distance to cover a flat plane**[12]**. There are 3 (three) types of tiles, namely: 1) regular tessellation, namely tiling using 1 (one) type of regular n-side. 2) Semi-regular tessellation uses two or more regular n-sides, and 3) Nonregular tessellation

uses irregular flat shapes. The application of tessellation to the Kalangbret motif is a nonregular tessellation because tiling uses irregular flat shapes.

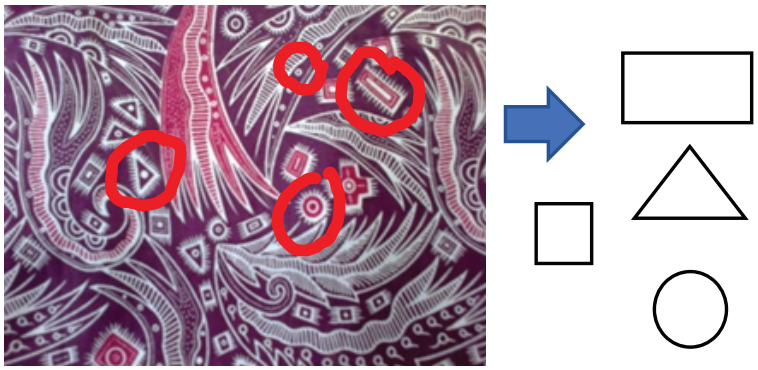

Figure 2: Geometry in Motif Kalangbret.

In Majalengka batik motifs, there are geometric concepts such as points, lines, triangles, squares, and rectangles.

2. Methods

This research is research and development. The researchers in education fields applied a research and development (R & D) method to develop and validate their educational products. Education practitioners and pedagogues have tremendously applied this method in designing their models of educational outcomes**[2]**. Hence, the favorable of this R&D Method questions whether the R&D Method is the only model design in educational research. Hereafter, this paper is intended to explore the R&D Method as a model design in academic research as well as offers some alternatives of model designs for educational products[13]. The product resulting from this research is a learning media in an android-based physics unit conversion application. Currently, research is still ongoing. What is presented in this paper is only at the product design stage related to applications made based on Android.

While the ethnomathematics application development model based on Android uses the ADDIE model, the ADDIE model is one of the most commonly used models in the instructional design field as a guide for producing effective designs**[2].** The ADDIE Learning Model includes the stages of analysis, design, development, implementation, and evaluation**[14]**.

The stage of this research is to collect and identify batik motifs in West Java, Central Java, and East Java. The next stage is the analysis, where there are two analyzes,

namely needs analysis and ethnomathematical analysis of batik motifs from each region. The design stage is to design the screen display on each material page. Currently, the research is still ongoing and in the development stage. The research team is developing an application program with Android. The design of the application uses flowcharts and Pseudocode by displaying several screen display designs on Android.

3. Result and Discussion

In this study, the stage of designing a screen display in the form of a design will later be developed in mathematics learning applications, especially for flat material and its transformation properties based on Android through an ethnomathematical approach found in batik motifs on the island of Java. The combination of culture and mathematics is then implemented into learning technology and developed this learning technology to eliminate the notion that learning mathematics is boring and find ways to learn mathematics and study culture simultaneously with ease and fun, so an Android-based ethnomathematical learning media is needed to make it easier for students to understand the learning material.

The next step is to collect information related to batik motifs found in West Java, Central Java, and East Java. From the data results, it is found that there are many batik motifs in each region. These motifs are identified by determining which batik motifs contain mathematical elements and which do not. This identification process is carried out in consultation with ethnomathematics experts so that it is hoped that the validity of the list of batik motifs can be accounted it. However, it is unavoidable that there may be similarities in the mathematical elements of one batik motif with another batik in each region.

Next, Flowchart and Pseudocode design stages are carried out for ethnomathematical applications on Android smartphones as learning media. The desired goal of this stage is to simplify the data into a form that is easy to understand and interpret so that the relationships that exist in the variables can be studied and tested to make it easier for programmers to implement to Android**[15]**.

After that, the stages for the design of research products are carried out in the form of a screen display on the android application. The screen design will be seen in table 1.

In the future, the team will enter the data obtained using an application system compatible with the Android base joining data the author coordinates with ethnomathematical experts and elementary school teachers related to mathematics material to

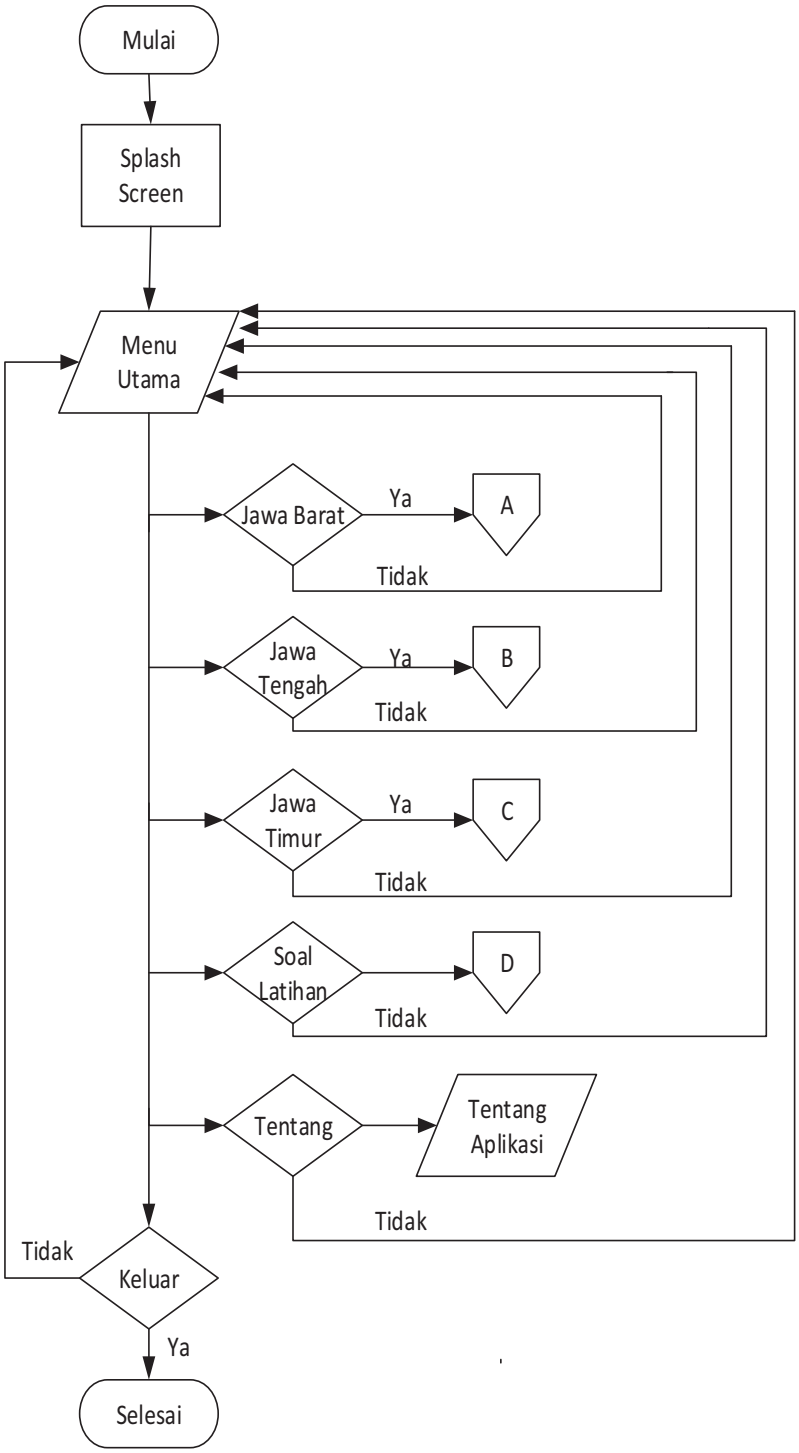

Figure 3: Main Menu Flowchat.

adjust ethnomathematics for which there is already data. This research is still long enough so that the resulting application can be helpful to increase student interest in studying mathematics and culture in Indonesia through batik motifs.

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Mulai
Read (Splash Screen)
IF Tombol_Utama.clicked() Then
Menu_Utama.finish()
Menu_Jawa.start()
ENDIF
ELSE IF Tombol_JawaBarat.clicked() Then
Menu_Utama.finish()
Menu Jawa_Barat.start()
ENDIF
ELSE IF Tombol_JawaTengah.clicked() Then
Menu_Utama.finish()
Menu Jawa Tengah.start()
ENDIF
ELSE IF Tombol_Latihan Soal.clicked() Then
Menu_Utama.finish()
Menu Latihan Soal.start()
ENDIF
ELSE IF Tombol Tentang.clicked() Then
Menu_Tentang Aplikasi.finish()
Menu Menu Utama.start()
ENDIF
Selesai
```

Figure 4: Main Menu Pseudocode.

4. Conclusion

Based on the research results that have been done, it can conclude that the making of this android-based ethnomathematical learning application is only limited to screen design. For the next stage, there will be a stage of filling in data and batik material with its ethnomathematical elements, namely the flat fabric and its transformation properties. This application is expected to be helpful to improve students' understanding of mathematics with a cultural approach.

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Table 1: Application Screen Design.

Visual	Descriptiom
	Splash Screen Page The Splash Screen page is the start page that will appear when the application is run.
	Main Menu Page The page in the picture below is a display of the application's main menu. The main menu display opens with several menus with different functions. Some of the menus include three buttons that are used to enter material about batik in the Java region, including West Java, Central Java, and East Java, the fourth button is used to enter the practice questions menu, the fifth button is used to enter the about menu, and the sixth button used to exit the application.
	Batik Material Page When the user clicks the menu button for West Java, Central Java, and East Java, the application will display several sub-menus of various motifs in that area. The number of buttons in each region is different, depending on the variety of batik motifs in the region. Then, the back button is used to return to the main menu page.
	Motive Material Page When the user clicks the Motif button, it will display several submenu buttons, namely history, ethnomathematics, and sample questions. The back button is used to return to the previous menu page.
	History Pages When the user clicks the history sub-menu button on the motif menu, it will display information about the history of the formation of batik for that motif. The back button is used to return to the previous menu page.
	Practice Questions Page When the user clicks the practice questions sub-menu button on the motif menu, it will display math questions and answer options; then, the user can answer the questions on the next button. The correct/false answers will automatically appear based on the user's responses. The back button is used to return to the previous menu page.
	About Page The about page on the main menu displays an explanation of the application, and there is a logo for the application. The back button is used to return to the main menu page.

in West Java, Central Java, and East Java. They have given the author permission to research schools under his auspices.

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