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EXPLORING PEKALONGAN BATIK MOTIFS AS GEOMETRY LEARNING MATERIALS FOR ELEMENTARY SCHOOL STUDENTS

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Abstract

This research aims to develop ethnomathematics-based teaching materials on shapes for 3rd-grade elementary school students. The research method used is Thiagarajan's 4D development model, which consists of four stages: Define, Design, Development, and Disseminate. In the define stage, initial-final analysis, task analysis, concept analysis, and learning objective analysis were conducted. The design stage involves systematically organizing the content framework of the teaching materials, including the initial draft, format selection, and preparation of the teaching materials, resulting in the first draft. Validation assessments by experts and student response questionnaires were also conducted at this stage. The development stage involves creating ethnomathematics-based teaching materials, which mathematics experts evaluate. After obtaining validation assessments, the teaching materials were tested on 26 students of the 3rd-grade elementary school. The results of the validation by experts indicate that these teaching materials have a very high feasibility level. The students' responses also showed that the teaching materials are very suitable. The dissemination stage involves distributing these teaching materials to more schools to gain broader feedback. Overall, the ethnomathematics-based teaching materials developed in this study are feasible and effective for teaching mathematics in 3rd-grade elementary schools. This research demonstrates excellent potential for enhancing students' understanding of two-dimensional figure concepts through an ethnomathematics approach. This approach connects mathematics with local culture, making learning more relevant and engaging.

Kata kunci: Teaching Material; Ethnomathematics; Pekalongan Batik Motifs

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A. Introduction

One of the sciences deeply ingrained in humans is mathematics. Mathematics is a fundamental science that is crucial to mastering knowledge (Mashudi, 2016). Often, without realizing it, people solve problems in their lives using mathematics. Activities like counting, interpreting, predicting, mapping, and recognizing patterns have become part of the cultural process of solving human problems. Therefore, the contribution of mathematics is significant for various societal activities and needs (Fatimah & Puspaningtyas, 2020).

Formally, education begins from kindergarten to higher education. Education in elementary school not only equips students with knowledge but also develops attitudes and skills essential for personal and social development, preparing them for the following stages of education (Sulfemi & Minati, 2018). According to government regulations, formal education consists of several subjects, one of which is mathematics. Mathematics plays a crucial role in supporting the development of science and technology. As an effective tool, mathematics is used to solve various problems in scientific fields (Rahayu & Hidayati, 2018). According to Prihandoko (2006), mathematics is a fundamental science that has become a tool for studying other sciences, such as logic regarding form, structure, quantity, and related concepts. Mathematics is divided into three main fields: algebra, analysis, and geometry. For example, when students are asked about the shape of a window, and they answer "square," they are already applying the geometric concepts of mathematics in everyday life.

Mathematics will be considered abstract and only filled with formulas and numbers if not applied to everyday life (Maskar & Wulantina, 2019). Integrating mathematics learning into the culture present in society is a teaching method that can be practiced in the classroom, allowing students to apply real-life experiences. Innovative and interactive mathematics teaching involves the treatment of mathematics within cultural contexts, known as ethnomathematics (Puspaningtyas, 2019).

In the era of globalization and technological advancement, mathematics education in Indonesia faces various challenges, especially in making learning

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materials more relevant and engaging for students. One emerging innovative approach is the integration of local cultural elements into mathematics education, known as ethnomathematics. This approach combines "ethno," referring to ethnicity or culture, and "mathematics," the science of calculation. Its goal is to enhance students' attention in mathematics by introducing cultural contexts close to their everyday lives (Dedi, 2018).

Research on developing ethnomathematics-based teaching materials is gaining interest in mathematics education. For example, Abdullah dan Rahmawati (2021) showed that applying ethnomathematics to Krebet Bantul wooden batik contains important geometric concepts for learning. Additionally, Rohma (2021) found that the batik-making process at Rezti's Mboloe Production House in Jember contains ethnomathematical elements in activities such as counting, measuring, and calculations, which can be integrated into mathematics lessons.

Batik, which has been globally recognized and holds significant value in the context of ethnomathematics, is one such cultural form. Batik, recognized by UNESCO as a world cultural heritage in 2009, is not just a fabric with beautiful motifs but also contains mathematical elements, particularly in geometry. Motifs such as circles, triangles, and other geometric patterns reflect mathematical principles that can be used as learning media. It presents an opportunity to combine mathematical understanding with preserving local culture, which is crucial amid modernization and globalization that often erode traditional cultural values (Churota'ayun & Sybilia, 2022).

In previous literature, Maskar and Wulantina (2019) highlighted the importance of teaching materials that not only enrich formal education but also emphasize the socio-cultural aspects of the local community. Based on this, the present study develops ethnomathematics-based mathematics teaching materials focusing on the Jlamprang batik motifs of Pekalongan, which are expected to enhance students' interest and understanding of geometric concepts in mathematics.

Pekalongan is known as the "City of Batik" due to its rich cultural diversity, including Jlamprang batik. Buaran subdistrict in Pekalongan is famous as the centre of Pekalongan Batik, as many people there are batik artisans, with their production

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known for its high quality and export to various countries (Amalia et al., 2021). The Jlamprang motif features geometric decorations such as circles, squares, rhombuses, and triangles arranged in a compass-like pattern. This batik was initially influenced by Arab culture and is classified as geometric batik with the distinctive coastal colours of Pekalongan (Amalia et al., 2021).

The novelty of this research lies in integrating the Jlamprang batik motif, which has yet to be extensively studied in the context of mathematics learning in elementary schools. This research is expected to significantly contribute to developing more engaging and culturally relevant mathematics teaching methods, which can improve students' learning outcomes in this field.

Thus, this research is critical not only in the context of mathematics education but also in efforts to preserve culture. Integrating ethnomathematics in elementary education will enrich students' learning experiences and contribute to preserving cultural heritage and a nation's identity (Amalia et al., 2021). For example, Pekalongan batik is known for its bright colours, soga dyes, and floral or plant motifs with a distinctive Chinese touch (Churota'ayun & Sybilia, 2022).

Batik has rhythmic or patterned regularity that forms geometric transformations. The geometric shapes in batik include points, lines, and shapes such as circles, ellipses, and quadrilaterals. The art of batik is created through transformations of points, lines, or shapes by translation, rotation, reflection, or dilation. The beauty of batik is expressed through these geometric transformations, showing that batik motifs are a form of ethnomathematics.

However, in 3rd grade, the topic of shapes still needs to be clarified for most students. Many still need to understand the names of shapes and the concepts and characteristics associated with each one. Observations show that teachers rely solely on textbooks as the only source of teaching material. In interviews, teachers revealed that lessons are conducted using the available teaching materials in schools without innovating new teaching methods.

One of modernization's impacts is the decline in students' interest in learning and understanding culture. Mathematics education is seen as an effective medium for instilling good moral character in students. For meaningful learning to occur,

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students' active participation in each session designed by the teacher is crucial. The ethnomathematics approach has emerged as an innovative solution to bridge the gap between culture and education in elementary schools. This approach incorporates cultural elements into the understanding of mathematics and is expected to activate student attention.

As explained above, this research uses batik as a learning material connected to mathematics to make it easier to understand. Batik is also a culture that needs to be preserved. With technological advancement and the Industrial Revolution 4.0, batik as a cultural heritage is often overlooked. Therefore, it is important to link the batik culture with education through relevant activities and exhibitions.

This research develops teaching materials that combine Pekalongan batik motifs with shapes in mathematics. The goal is to simplify students' understanding and use of these teaching materials not only for formal education but also for learning that emphasizes the socio-cultural aspects of the surrounding community (Maskar & Wulantina, 2019).

Based on the context of the problem, the researcher identified several issues: students face difficulties in understanding the topic of shapes and cannot yet describe their characteristics; teachers have never used new teaching materials, relying only on the materials provided by the school; students' interest in mathematics lessons is insufficient; and students have not received enough ethnomathematics-based teaching materials to support independent learning.

The scope of this research is focused on two main aspects: 1) the development of ethnomathematics-based teaching materials on shapes, using Pekalongan batik motifs to facilitate students' understanding, and 2) the development of engaging mathematics teaching materials to increase students' interest and involvement in the learning process.

This research explored how ethnomathematics teaching materials can be developed by integrating the Jlamprang type of Pekalongan batik motifs into mathematics learning in elementary schools.

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B. Methods

The method used in this research is Research and Development (R&D), which aims to develop and test the effectiveness of a product in the form of batik cloth-based learning media to improve students' understanding of Mathematics. This study was conducted at SDN Kepuh Kiriman I, located in Sidoarjo City, East Java Province. The research subjects were 28 students in the 3rd grade of class C.

Data was collected through three main techniques: observation, interviews, and documentation. Observation was conducted to observe learning activities and students' responses to the developed learning media. Interviews were conducted with the class teacher and several students to gather their views on using batik cloth learning media. Documentation, such as photos, video recordings, and field notes, supported the data obtained from observations and interviews.

Qualitative data from observations and interviews were then converted into quantitative data using a Likert Scale. This data was analyzed using percentage calculations to assess the quality and effectiveness of the developed learning materials.

The success indicators in this research include an improvement in students' understanding of mathematical concepts, measured by an increase in test scores before and after using the batik cloth learning media. In addition, student and teacher satisfaction with the learning media was also a measure of success, assessed through a questionnaire using the Likert Scale.

C. Results and Discussion

This research aims to develop batik cloth-based learning media for 3rd grade Mathematics at SDN Kepuh Kiriman I, Sidoarjo. The media was developed to assist teachers in delivering lessons and to facilitate students' understanding of Mathematics. This research successfully produced batik cloth-based learning media suitable for mathematics education, particularly in shapes. The media helps with student comprehension and integrates learning with local cultural identity, aligning with the ethnomathematics theory. Ethnomathematics demonstrates that mathematics education, connected to cultural contexts, is more meaningful for

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students. Another study by (Abdullah & Rahmawati, 2021) also demonstrated similar results when using culturally rooted methods in the application of mathematics.

This research employs the 4D Thiagarajan development model, which includes the stages of definition, design, development, and dissemination.

In the definition stage, an in-depth analysis was conducted to understand the needs and challenges in teaching. The analysis included a front-end, learner, task, and concept analysis. The results of this stage served as the basis for designing the batik cloth learning media.

The design stage involved creating assessment instruments, selecting media, choosing a format, and making an initial design. The assessment instruments were used to measure the quality of the developed product. The chosen media was batik cloth with an attractive design to facilitate Mathematics learning.

In the development stage, the product was evaluated by experts to ensure its suitability. The process involved evaluations by media, material, language experts, and respondents (students). The evaluation results indicated that the batik cloth learning media had an eligibility percentage between 81% and 88%, demonstrating that it is highly suitable for use. The assessments, which involved media experts, subject matter experts, and students, all provided positive feedback on the media.

Table 1
Small Group Product Trial Assessment Results

No	Aspects	Indicator	Score	Criteria
1.	Accessibility	Easy-to-access media	85,00%	Very Feasible
		Clarity of content	78,00%	Feasible
2.	Motivation	Interest	85,00%	Very Feasible
		Attention	80,00%	Feasible
3.	Attractiveness	Display quality	80,00%	Feasible
		Attractiveness	80,00%	Feasible
4.	Usefulness	Positive impact on students	78,00%	Feasible
		Assists in learning	80,00%	Feasible
Overall Assessments			80,75%	Very Feasible

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Table 2
Results of Student Responses in Small Group Trials

No	Name	Questions					Total Scores	Average Score	Category
		1	2	3	4	5			
1	ADA	4	3	3	4	4	18	90%	Very Feasible
2	BJN	4	4	4	4	3	19	95%	Very Feasible
3	PH	3	4	3	3	2	15	75%	Feasible
4	ZNJ	4	3	3	4	3	17	85%	Very Feasible
Average							17	85%	Very Feasible

Table 3
Validation Assessment Results

No	Validators	Assessment Criteria	Score	Description
1	Media Experts	Display Quality	85%	Very Feasible
2	Material Experts	Accessibility	84%	Feasible
3	Language Experts	Usefulness	88%	Very Feasible
4	Respondents	Attractiveness	81%	Very Feasible

The dissemination stage is conducted to spread the developed product so it can be used by a wider audience, including individuals, groups, or educational systems. This learning media is expected to enhance students' understanding of Mathematics by incorporating the cultural context of Pekalongan batik.

The objectives of this research are to (1) address the research questions and problems, (2) demonstrate how findings were obtained, (3) interpret the findings, (4) relate the results to established knowledge, and (5) propose new theories or modify existing ones.

This research successfully developed a valid and appropriate batik cloth-based learning media for Mathematics education. The media helps students better understand the concept of shapes through the cultural context of Pekalongan batik.

The findings were obtained through several systematic stages, including expert validation and trials with students. The process involved a needs analysis, media design, media development, and feasibility evaluation.

The research shows that batik cloth-based learning media improves students' understanding of shapes. The media captures students' attention and makes learning more contextual and relevant to local culture.

These findings align with the ethnomathematics theory, which suggests that Mathematics education can be more meaningful when connected to the students'

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cultural context (Abdullah & Rahmawati, 2021). In this case, the Pekalongan batik motifs explained geometric concepts.

This research strengthens the concept of ethnomathematics in Mathematics education by adding a new dimension: using batik cloth-based learning media. It can serve as a reference for future research on developing other learning media based on local culture.

D. Conclusion

Several conclusions can be drawn from the research and development of ethnomathematics-based teaching materials of shapes for 3rd-grade students.

The teaching materials' development followed Thiagarajan's 4D research and development method, consisting of the Define, Design, Develop, and Disseminate stages. The Define stage involved several analyses, such as front-end analysis, task analysis, concept analysis, and learning objective analysis. The design stage focused on systematically structuring the content framework of the teaching materials through an initial draft, format selection, and preparation of the materials. This stage resulted in draft and validation instruments that experts and a student response questionnaire tested. The development stage was the creation of the ethnomathematics-based teaching materials. Mathematics professors assessed these materials and adjusted them according to the validators' suggestions to ensure their suitability. The teaching materials were tested on 26 3rd-grade elementary school students.

Based on expert validation and student responses, the feasibility of the ethnomathematics-based teaching materials of shapes for 3rd grade was deemed highly suitable. Overall, the materials are suitable for use in 3rd-grade Mathematics lessons.

Ethnomathematics helps students understand Pekalongan batik motifs in geometry lessons through a cultural perspective, making students more interested and facilitating their understanding of geometric concepts. The shapes and sizes of batik motifs are introduced through practical activities and visual media to reinforce basic concept comprehension. Batik geometric patterns, such as symmetry, rotation,

translation, and reflection, are explained with concrete examples and design exercises. Introducing geometric concepts through batik motifs connects students to local cultural heritage and shows the relevance of Mathematics in everyday life. Challenges in integration can be addressed through teacher training, appropriate curricula, and local resources.

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