Batik Nusantara Pattern In Design Of Mathematical Learning Model For Elementary School

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Abstract. The focus of education is not only on skill development but also on character building. The purpose of this study is to produce a product of mathematical learning model that combines the mathematics and cultural values of batik Nusantara. The development model used in this research is ADDIE (Analysis, Design, Development, Implementation, and Evaluation). Development stage generates mathematics learning model using Batik Nusantara setting with the main product such as learning model book, student book, teacher book, syllabus, learning implementation plan, and student worksheet. In the final product, cultural values in the form of character building to students by learning process produce a very positive student response with a score of 86.6%. In addition, by expert assessment, test and non-test data collecting, and limited trials show that learning model is valid with practicality score of 3.90 and effectiveness score 3.93. The scores indicate that the student’s response to the learning model is positive and better maths learning outcomes. Base on the result, this learning model is said to be feasible to use.

1. Introduction

Education is a means of ability and character building for the future generation. Suyitno [1] stated that education is not just a transfer of knowledge but also a process on how to apply the knowledge. Thus, the focus of education should be not only on the students’ ability but also on the character that must be instilled in the students through learning [2]. There are several components in learning that can support the achievement of learning objectives. This is in accordance with a statement from Rahmawati & Suryanto [3] that there are some components which affect the achievement of learning objectives. These components include learning steps, the role of teachers and students in learning, how teachers respond in education, and learning support systems. These supporting components are included in the learning model. Therefore, the selection of the right learning model also affects the success of learning, including in mathematics learning.

According to D’Ambrioso [4], "...Mathematics is the most universal mode of thought, and that survival with dignity is the most universal problem facing humanity". Mathematics needs to be learned because it plays an important role in our life. According to UNESCO [5], "both national and international evaluations show that on the completion of basic education, many pupils' mathematics knowledge and competencies fall short of the expected level." This indicates that there is a need to improve the competence and knowledge of mathematics along with the importance of mathematics to be taught to students since elementary school.
Teaching mathematics for elementary school students becomes a challenge for teachers themselves. The mathematical concepts installation for the elementary school students should be done appropriately so that it will become meaningful and fun learning. Steffe [6] said that the learning of mathematics as a meaningful activity refers both to the process of technically mastering mathematics as a historically developed activity and to the process of attaching personal meaning to the action, methods, and results involved. According to Alexon and Sukmadinata [7], meaningful learning is learning that is packaged according to the characteristics of students. Characteristics of elementary school students who still think concretely and realistically require concrete and integrated learning packaging. Elementary school students are still in the age of cognitive development that is tied to concrete objects. This is the basic idea for teaching mathematics in elementary schools in which it should be begun with concrete objects, experience, and knowledge that related to students real life. As explained by Astuti & Purwoko [8], "teaching and learning mathematics in elementary school should be begun with concrete things and tangible as well as close to life, knowledge, and experience of students." Furthermore, it is the task of teachers to create new innovation in the learning process which is able to overcome the problems and based on educational goals [9].

In general, there is no ultimate learning model for mathematics learning. However, the selection of the learning model can optimize the mathematics learning and help to achieve learning goals on the concept and certain level. Therefore, the learning model in elementary school has to be directed toward concrete or realistic learning [10]. According to the theory of noted Swiss psychologist Jean Piaget in Bell [11] that children from age seven to age twelve, thirteen or even later are at the concrete operational stage of mental development.

Realistic learning in mathematics is possible because mathematics is part of human culture. As explained by Chambers [12], mathematics is a universal science, but mathematics is a cultural activity that displays all civilizations in the same way as language and community regulations.

Mathematical learning model that links mathematics to local culture is called ethnomathematics. According to Shirley's in Isnani [13], "ethnomathematics is a teaching method which emerges and develops in the social community with local culture ...". Pais in Abdullah [14] explained that an ethnomathematical program sullies mathematics with the human factor, not an abstract human, as the subject of modern science, but a human situated in space and time that implies different knowledge and different practices. Learning by linking the culture can be used as a concrete learning innovation in elementary school.

One of the cultures is batik. Batik is one of Indonesia's cultural heritage which has gained worldwide recognition. Batik has been known to the world community since the decree of batik as Humanitarian Heritage for Oral and Intangible Culture (Masterpieces of the Oral and Intangible Heritage of Humanity) on October 2nd, 2009 by UNESCO, Steelyana [15]. According to Parmono [16], batik contains many values of local wisdom and full of symbolic meaning in the beautiful pattern. Batik also has moral messages that can be integrated into learning model and character development.

Therefore, the model of mathematical learning which is related to batik is able to be utilized as an innovation in learning to instill mathematical concepts. Besides, the model of mathematical learning by linking batik is useful to introduce culture to elementary school students. Culture and learning are different, but they can be integrated into realistic and constructive learning. The development of mathematics learning model with batik Nusantara setting is necessary. The purpose of this research is to develop a learning model that is able to integrate Indonesian batik culture into mathematics learning.
2. Literature review

2.1. Batik

Batik is a local culture that cannot be separated from the life of Indonesian society. The world has known batik since the decree of batik as Humanitarian Heritage for Oral and Intangible Culture (Masterpieces of the Oral and Intangible Heritage of Humanity) on October 2, 2009, by UNESCO and October 2 becomes national batik day. The beauty of Batik Nusantara is various. Batik pattern consists of several categories. Batik variants according to Steelyana are Javanese Kraton Batik (Batik Keraton Jawa), Batik Pesisir, and Indonesian Batik from other areas. Batik contains many values of local wisdom and symbolic meaning. Pattern diversity and values contained in the batik pattern is one of the reasons why Batik Nusantara needs to be appreciated.

2.2. Mathematics

Our life cannot be separated from mathematics. Mathematics is close to reality. It means that mathematics cannot be separated from our daily activities. According to Astuti & Purwoko, "mathematics is seen as a cultural product developed through various activities, such as counting, placing, measuring, designing, playing and explaining." Everyone does these activities every day consciously or unconsciously. This is why mathematics is said to be close to human life. Based on this opinion, mathematics becomes a subject that must be taught in elementary and high school. Nevertheless, learning should be done properly so that the implementation of mathematical concepts to the students is appropriate.

2.3 Batik in mathematics learning

Mathematics is a human activity which is close to reality in life. Freudenthal in Jaelani et al. [17] stated, "Mathematics must be connected with reality." Therefore, mathematics learning has to be designed closely to real life so that students are able to accept mathematical concepts effectively, especially in the elementary school where mathematics learning is still in the level of concrete learning. It's relevant with Cognitive Development Theory by Piaget in Ernawati & Kurniawati [18], that "children in this age range included in the category of operational concrete for their cognitive development." Learning that relevant to such a thing is real learning.

Main principles of teaching and learning in realistic learning are constructing and concretizing, levels and models, reflection and special assignment, social context, and interaction, and structuring and intertwining. This learning leads students to construct knowledge, improve knowledge levels, reflect, interact, and associate knowledge with a concrete model. In this case, the batik pattern can be used as a concrete model so that students can do these activities to obtain a concept. Realistic learning has relation with constructivism. Principles and steps in realistic learning include one of the constructivism principles, which are the principle of constructing and concretizing.

In learning mathematics with Batik Nusantara setting, there is a theory of realistic and constructivism. Mathematics learning with Batik Nusantara setting is used as a learning medium and for directing the students to construct their own understanding. Process for gaining insight can be constructed through the experience. From observing and exploring batik patterns, students bring the mathematic concept into implementation. Therefore, the essence of learning mathematics with batik culture is tied closely to realistic and constructivist learning.

3. Methods

This research is based on ADDIE (Analysis, Design, Development, Implementation, and Evaluation). The stages of development are as follows:

The first stage in this research is analysis stage. In the analysis stage, it analyses: (1) whether the development of mathematics learning model with Batik Nusantara setting is required; (2) whether the development of mathematics learning model with Batik Nusantara setting can solve existing learning problems; (3) whether the development of the mathematics learning model with Batik Nusantara
pattern is supported by facilities so that it can be applied; and (4) whether teacher can apply a model of mathematics learning with Batik Nusantara pattern setting which has been developed.

The second stage is designed to stage. In the design stage, activities are learning goals setting and scenarios for the teaching-learning process, learning tools, learning materials, learning media, and learning outcomes evaluation tools design.

The third stage is the development stage. Development stage creates products that have been designed in the previous stage, such as learning model book with Batik Nusantara setting, learning tools, and teaching materials.

The fourth stage is the implementation stage. In the implementation stage, design and product of the learning model with Batik Nusantara setting is implemented in a real situation, such as classroom by experimenting mathematics learning model with Batik Nusantara setting.

The last stage is the evaluation stage. Evaluation stage uses a test to determine the feasibility of the product. Data collection for this research uses two methods, test and non-test. Non-test methods are observation, field note, questionnaire, and documentation. Therefore, this study has quantitative and qualitative data for analysis.

4. Results and Discussion
Mathematical learning model by using Batik Nusantara setting is realistic and constructive learning that integrates batik culture into mathematics learning. In learning model, Batik Nusantara has roles to inculcate the concept of two-dimensional shape to students and as a media to instill character through the moral message of batik patterns. Development of this learning model uses the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. The final products are book, teacher book, student book, syllabus, learning media, and tools. The initial stage of this learning model development is an analysis of needs for learning model development. From previous research and interviews to mathematics teachers, the development of mathematical learning model with Batik Nusantara setting is necessary.

After analysis of the needs, the next step is designed to stage. In this stage, researchers design the learning model. It is started with teaching and learning activities. Then, researchers make products that have been developed at the previous stage. Products are books for student and teacher, syllabus, and learning tools. Before they are processed into the implementation stage, experts validate the products and results whether they are valid or not with several revisions.

After declared as valid products, mathematical learning model with Batik Nusantara setting is implemented for 21 students of fourth grade of SD Muhammadiyah Purworejo. Learning activities are conducted in groups with realistic and constructivist learning. Learning begins with the introduction of the problem using the batik as a real model, and then the students are directed to solve and find the concept of mathematics. students responded to the model of mathematics learning with Batik Nusantara setting is very positive with a score of 3.90, and there is no issue during implementation process so that it can be said that this learning model is practical.

The last stage in the development of this learning model is an evaluation. In this stage, researchers do the evaluation to determine the result based on a learning model that has been developed. From the evaluation, students learning mastery is 80.95%, and there is the improvement after applying the learning model. Therefore, the product of a mathematical learning model with Batik Nusantara setting is effective. Development of the mathematics learning model with Batik Nusantara setting has fulfilled valid, practical, and effective criteria so that development of this learning model is considered feasible to be used as an innovation in learning.

In this research, the mathematization process and character building are done in one learning. Mathematization is done by dividing the class into several groups and learning by discussion. The learning is started by giving a contextual problem that use Batik Nusantara pattern as a media to find mathematics concept as a solution of the contextual problem. Batik pattern in this research is used to understand the concept of two-dimensional form. The example of the use of batik as a media for instilling the concept of two-dimensional form is as follow.
Batik Tambal pattern above can be used to introduce the shape of quadrilateral and triangle and how to find the circumference and large of the shape.

\[ L_{\text{square}} = 2 \times L_{\text{triangle}} = 2 \times \left( \frac{1}{2} \times BC \times AD \right) = 2 \times \frac{1}{2} \times BC \times AD = BC \times AD \]

In this process, researchers instill cultural values in the form of character in every batik pattern by learning. For example, through the pattern of batik Tambal, we can learn always to improve ourselves because the Tambal pattern has a moral message that human must cover all the bad things by good things. The concept of mathematics and cultural values is conveyed simultaneously. So, this learning model can be used to reach the purpose of combining mathematics and Batik Nusantara values. Based on the trial, the student response is very positive with a score of 86.6%.

The final products of the research are learning model book, student book, teacher book, syllabus, learning implementation plan, and student worksheet. Based on the expert assessment, test and non-test data collection, and limited trials show that products are valid, practical with a score of 3.90 and effective with a score of 3.93. The result shows that the learning model has passed the feasibility criteria so that this learning model is feasible to be used.

5. Conclusion
Based on the results and discussion, it can be concluded that the purpose of this development study is to develop a mathematics learning model by using Batik Nusantara setting. This research uses ADDIE
(Analysis, Design, Development, Implementation, and Evaluation) to produce main products in the form learning model book, student book, teacher book, syllabus, learning implementation plan, and student worksheet. The elementary student's responses to this learning model are very positive with a score of 86.6%. Products are considered valid, practical in a good category with a score of 3.90, effective in a good category with a score of 3.93. The student mastery is 80.95%, and there is the improvement after applying the learning model. So, it can be said that this learning model is feasible to be used as an innovation in mathematics learning.

6. References

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