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Implementation of Batik Art in Elementary School Mathematics Learning: A Case Study

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Abstract

This study aims to conduct a study related to the integration of batik art in elementary school mathematics learning, especially in content design and use of learning methods. The author conducted a case study of learning experiments in two different elementary schools in grade 6 with a total sample of 41 students. Learning experiments using circle patterned batik as an art aspect and project based learning (PjBL) as a learning method. The research data collection was carried out using 3 different instruments, namely: a test instrument, an interview instrument for teachers and students; and a questionnaire instrument for students. After conducting experiments and analyzing research data, we summarize the results of research related to the integration of batik art in mathematics learning showing positive results by increasing student learning outcomes, interest and activeness in learning mathematics and concern for local culture and national identity through the introduction of batik. From the aspect of using learning methods and media, project based learning (PjBL) and the use of the TPACK approach in the design of procedures and learning content have succeeded in increasing learning outcomes, student activity and interest in the process of inculcating concepts during learning.

Keywords: Mathematics, Project Based Learning (PjBL), Elementary School, Batik Arts, and TPACK.

Introduction

Currently mathematics has become a vital support for the development of other sciences (Agazzi, E., 1997), so it requires direct and specific action to improve students' mathematical accuracy and understanding. This condition is of course inversely proportional to the ability and interest of students in mathematics. In the latest survey results show that fear of mathematics reaches 82% for the level of students in grades 7 to 10 (ASER, 2018).

Problems in learning mathematics that have actually existed for a long time certainly require attention in solving them. The main problems encountered in learning mathematics are that students' interest in mathematics is still low (Azmidar, A., et al., 2017) and anxiety about mathematics itself (Trujillo, K. M., & Hadfield, O. D., 1999). This is of course the main focus on how to make the classroom atmosphere relaxed so that it can help relieve tension in learning and can improve students' mathematics learning outcomes (Gregor, A., 2005). An art-based

interdisciplinary learning approach is certainly an alternative in relieving tension/fear or even reducing student stress while studying (Winner, E., & Cooper, M., 2000).

The art-based interdisciplinary curriculum actually has a long history of implementation, it can even be traced since Plato's academy (Gutek, 2004) that art has been integrated in the learning process. Since the late nineteenth century, modern educational philosophers and researchers such as Francis Parker and John Dewey have sought to provide schools with theoretical and curricular support for this type of comprehensive, integrative teaching approach. For example, Dewey (1938) undertook a series of exploratory research studies that examined the impact on student development resulting from the integration of curricular subjects into interdisciplinary pedagogical approaches. This of course can be used as the basis for the development of more meaningful interdisciplinary learning (Fitzgerald, S. L., et al., 2021).

The integration of art in children's mathematics learning is certainly very rational considering that children are naturally curious and involved in object-based games and have sensitivity in responding to music or colors (Axel, E. S., et al., 2003). Even from infancy, they enjoy the interaction of light, sound, movement, shadow, shape, and color. As children grow up, the images or forms produced from their toys begin to reflect artistic sensitivity and creativity which are inherent aspects of their growth process (Almutlaq, Z., 2018). This needs to be a universal impetus in basic education, where in the process of drawing shapes in mathematics it would be better to involve art because it can encourage their creative expression as well as class control so that students stay busy in the learning process (Gude, O., 2009).

Using art connected to the immediate environment brings up diverse perspectives, enriching the learning process by enabling students to observe, explore, think and learn (Henriksen, D., et al., 2019). However, the problem that arises next is how and what the process of integrating art in learning, especially mathematics, is asked by many teachers. Even in the use of STEAM in learning, there are still many teachers who do not include art in the learning process (Quigley, C. F., & Herro, D., 2016).

From the findings and literature review that has been carried out, this research will focus on conducting case studies related to the integration of batik art in elementary school mathematics learning. So it is hoped that this research can produce descriptions related to content and stages of learning in the use of art in learning mathematics.

Method

The focus in this research is on the implementation of art in mathematics learning on the topic of circles in elementary schools as a more holistic pilot project (Baron, IS, 2018) in developing classroom learning content and procedures to find out how students respond to the learning process and review the results. what students get during the learning process.

Class Teaching Experiment.

The teaching experimental methodology was taken because it allows researchers as teachers to observe more broadly (Steffe, LP., 1991) and has high control in observing the causal process (Lipsey, MW, 1990) that occurs from content design and teaching plans on variables and subjects study. To avoid the subjectivity of the research results, the researcher also involved other teachers who were trained to implement content design and teaching plans related to the implementation of art in learning mathematics. Teaching experiments were carried out in 2 classes in 2 different schools.

Teacher Learning Subjects and Procedures.

There were 3 teachers outside of researchers involved in this study, one of whom had teaching experience for more than 5 years. To ensure the implementation of learning is in accordance with the focus of the research, the teachers involved have been trained in the process of implementing art in mathematics learning with the content and teaching plan provided by the researcher. The school where the experiment was carried out was 2 classes in two elementary schools located in the Sukabumi district, these schools were chosen considering that the condition of the facilities and infrastructure supporting the experimental process was adequate.

The selection of the experimental class level was carried out based on the class where the circle material was taught based on the curriculum, namely grade 6 elementary school. The number of subjects in the experimental class was 41 students who were divided into 2 different classes. The experiment was divided into 2 meetings where the first meeting was conducted to master the concept of circumference and area of a circle using a Technological Pedagogical Content Knowledge (TPACK) approach which is expected to improve 21st century skills for students. (Mishra & Koehler, 2006) and PjBL methods to improve problem solving skills (Priatna, N., & Juandi, D., 2021) needed in the project completion process and the ability to connect concepts (Albanese, M. A., & Mitchell, S., 1993) by using geogebra and youtube in learning. Meanwhile, at the second meeting, the integration of art in learning related to batik art with circular motifs was carried out using the same approach and method as the first meeting. From the two meetings, there were 3 lessons each (JP) of which 1 JP was 35 minutes each, so

that each meeting was 105 minutes with a total of 210 minutes for 2 meetings or 3.5 hours for each class.

Data Collection

The data used in this study are primary and secondary data from the condition of the research subjects before and after the study (Hox, J. J., & Boeije, H. R., 2005). The method used is a questionnaire related to student responses to the method/approach, implementation of art during learning, interviews to obtain open responses (Burkard, A. W., et al., 2012) from students and teachers as well as test and project instruments to determine the impact of implementation on student learning outcomes.

Research Results and Discussion

Research Subject Description

Overall, the learning process went well according to the schedule and target time that had been set. From the results of initial data collection, as many as 71.43% of students said the most difficult subject was mathematics, this is certainly not a new problem in mathematics, because researchers and academics have long found mathematical anxiety experienced by both teachers, students and even parents (Li, Y., & Schoenfeld, A. H., 2019; ASER, 2018). The condition of students' mathematical ability in the experimental class based on the average daily value of the two classes was relatively the same, namely 75.17 and 75.03, respectively. Meanwhile, based on the cognitive development aspects of students from the two samples, the age distribution is in the range of 10-12 years or with an average of 11.57 years, this means that the cognitive stage of students has reached the stage of transition from concrete operations to formal operations (Piaget, J., 1976) so that the research experiment uses four main stages, namely: situational, referential, general and formal to facilitate the process of thinking from concrete to abstract (abstraction) (Gravemeijer, K. P. E., 1994).

Interview data from teachers showed that standard learning support facilities were adequate. At least each class had a projector, geometry toolkit, and student books. However, in the aspect of preparation before learning, the teacher seems to prioritize learning administration rather than the preparation of content, media or teaching aids. One teacher also informed that the readiness of teachers to change technology and its use is a significant obstacle so that the use of technology is still not optimal in learning.

Description of Teaching Materials

To maintain the objectivity of the experiment, teaching materials were prepared by the research team by taking into account 4 aspects of the learning abstraction process. This is expected to help students find alternative teaching materials other than textbooks that are already available. The teaching materials used are designed to follow the development of technology, art and the realities of life (Jungnickel, P. W. Et al., 2009) where the technology used is Geogebra (Picture 1), Video and PPT with circular batik motifs (Pictures 2, 3 and 4) as the main art aspects that are displayed in the learning process (Picture 1).

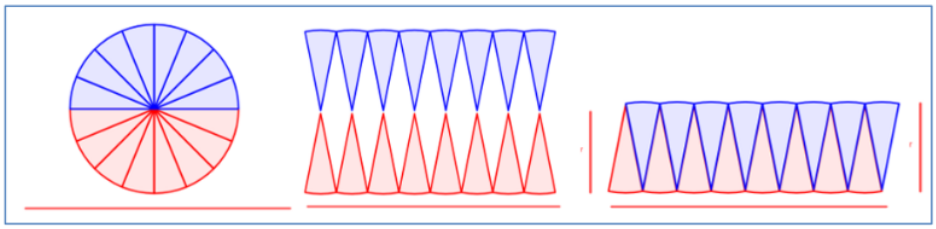

Figure 1. Geogebra Design Proving the Area of a Circle

To strengthen the concept of art in learning, the teaching materials used in the experiment introduce the concept of batik as an effort to maintain the values or beliefs system of batik artwork which is one of the identities, social strata, cultural language, spirituality, discoveries and evidence of the historical journey of Indonesian civilization. which is already known and has received recognition from UNESCO as an Indonesian Cultural Heritage (Kustiyah, I. E., 2017). The integration of art in this experiment is an effort to help students enjoy the learning process using an aesthetic frame of reference and make learning mathematics more interesting (Eisner, E. W., 1998). In particular, the sample of batik art used as teaching materials is a batik motif that resembles a circle (Figure 2 and Figure 3).

Figure 2. Sample of Batik Art with a Pattern Resembling a Circle

Description of Learning Activities

In the experimental process, the research was carried out in 2 meetings with an allocation of 105 minutes for each meeting. At the first meeting, the TPACK approach was carried out with the use of technology to facilitate the visualization of circle images, both abstract and those referring to context (Mishra & Koehler, 2006).

First day of learning

The learning process at the 1st and 2nd meetings was carried out in small groups consisting of 3 students to facilitate the learning control process (Webb, N. M., et al., 1995). In the first meeting, the students' activities were generally divided into 2 parts, namely: the first part, introduction to the shape and elements of a circle; second, find the concept of the value of phi, the formula for the circumference of a circle and the concept of the formula for the area of a circle. In the first stage, the teacher shows pictures of real objects and batik motifs that are shaped like circles, this is to provide an overview regarding the context of the circle material and an introduction to the aspects of batik art that will be studied (Figures 2 and 3). Based on observations when students were asked to make inferences about the shape of the pictures displayed, three different answers were obtained, namely "round" and "circle". This shows that when the learning process begins with orientation in real space, students are easier to recognize the basic meaning from the shape of the wake (Hershkowitz, R., et al., 1996), especially the circle. At the stage of introducing the elements of a circle, the teacher uses images of batik motifs as a learning medium in the introduction of arcs, center points, radius (Figure 2; Number 1), bowstring, apothem, diameter (Figure 2; Number 2), area section and area of sections (Figure 2; Number 3).

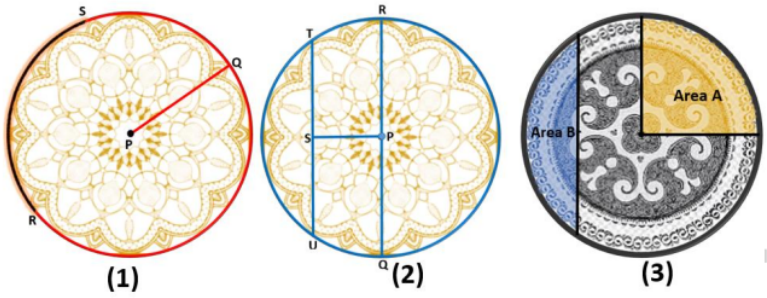

Figure 3. Introduction to Circle Elements

For the stage of finding the value of phi and the concept of the formula for the circumference of a circle, in the experimental process students are asked to measure the circumference, diameter and the ratio of the circumference to the diameter of any circular object

(Ekowati, D. W., & Suwandayani, B. I., 2020) then students compare the measurement results with other groups. In the activity of finding the concept of the formula for the area of a circle, the teacher displays an animated demonstration of proving the circle formula through geogebra (Figure 1), which is followed by giving a project to each group to change a circle shape into a rectangle or parallelogram.

2nd day of learning

Activities at the second meeting had higher artistic content than the first meeting, where in this meeting the history and philosophical values of batik, especially the circle motif, were presented. In the learning process, students are asked to draw a simple batik with a circle motif which then determines the mathematical elements that can be described or measured using the knowledge they already have.

Figure 4. Student Project Results

In the process of completing the project, students look enthusiastic and able to develop their creative ideas in completing their respective tasks (Krajcik, J. S., & Blumenfeld, P. C., 2006), this can also be seen from the results of the project that students as a whole are able to complete the task in accordance with the allotted time. In Figure 4 it can be seen that students have been able to draw their own batik designs and can implement circle formulas to calculate the circumference and area of a circle on their respective batik designs. However, from the results of the evaluation of the project results, students have been able to use the procedure for determining the circumference and area of a circle but still found some errors in the process of measuring the length of the diameter or radius (Figure 5), this must be a pending concern for the teacher, because measurement is the main requirement in higher geometry learning (Hwang, W. Y., et al., 2015).

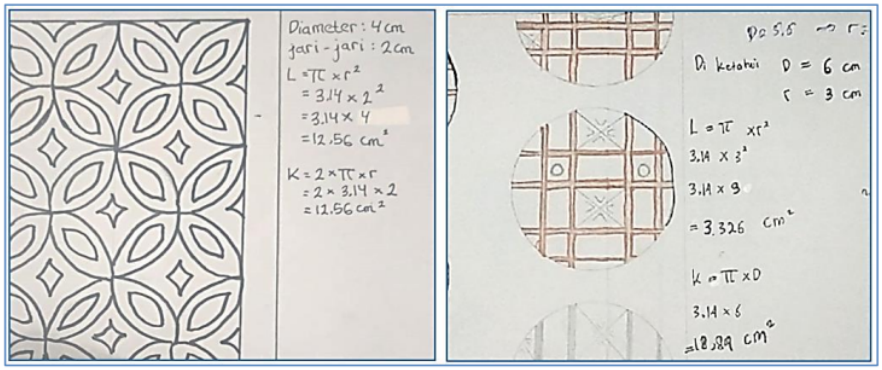

Figure 5. Sample of Student Calculation Results

Description of Research Results

The initial condition of students in the experimental class had a fear of mathematics even reaching 71.43% this was obtained from questions given to students related to the subjects they thought were the most difficult or least liked. Even though this seems not good, basically this condition is almost all over the world (Li, Y., & Schoenfeld, A. H., 2019; ASER, 2018). Although interest in mathematics from the experimental class was not good with the previous average daily score of 75.10, in Figure 5 the graph of mathematics learning achievement shows a slope to the right, this shows that the average achievement of students' mathematics learning is quite high, namely 84.13 and has increased by 12.03% compared to the average daily score of the previous students.

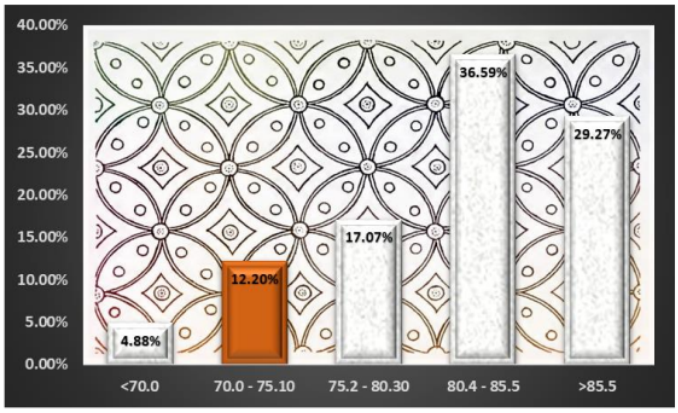

Figure 6. Data on the Distribution of Learning Evaluation Values

In Figure 5 it can also be explained that there are 82.93% of students who have exceeded the daily average score and only 17.07% of students still have not exceeded, however it cannot

be denied that there are still around 4.88% of students who have to undergo remedial because they have not met the minimum score set by the school.

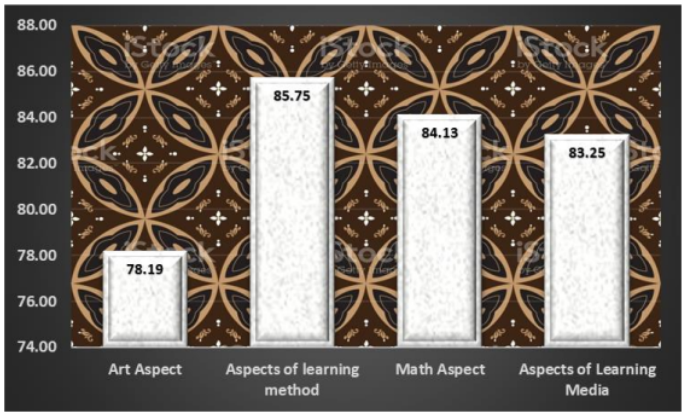

Figure 7. Data on the Distribution of Learning Evaluation Results

In further evaluation related to the learning process and results, the aspect of students' artistic abilities based on the assessment made by art teachers, project results and knowledge of students' batik art got an average score of 78.19. Although this achievement is lower than the average math score of 84.13, this result is considered very good, considering that the art aspect is only used as a support for students' mathematical achievement as the main goal of the experiment. From the data from the questionnaire, students assume that the integration of art in learning makes mathematics learning more interesting, not boring (DeMoss, K., & Morris, T., 2002) and eliminate fear in learning mathematics (Winner, E., & Cooper, M., 2000). In the aspect of learning methods and media, what is quite visible in the learning process is the enthusiasm and activeness of students when completing projects (Ferreira, V. G., & Canedo, E. D., 2020). Regarding the discovery of the value of phi, the concept of the circumference formula, the area formula and in the process of drawing circle motif batik, this shows that the use of the TPACK approach in the design of learning content and the PjBL method in the concept planting process is considered successful (Purwaningsih, E. et al., 2020) with response scores of 85.75 (3.38/4 attitude scale) for PjBL and 83.25 (3.33/4 attitude scale) for TPACK.

Conclusion

The integration of Art in interdisciplinary learning, especially in learning mathematics, can increase students' enthusiasm and activeness and make mathematics learning interesting and not boring. The integration of art in mathematics learning requires pedagogic abilities that can take advantage of real dimensions in learning that are supported by visualization in the form

of real objects, images and videos, so that the TPACK approach is an alternative approach that is suitable for interdisciplinary learning (integration art in learning mathematics). The use of the PjBL method in experimental learning looks very appropriate because one way to see creativity and artistic skills in mathematics learning is through project completion. This is also supported by the success of all students in completing projects and the average student attitude score in the questionnaire related to the use of the method PjBL is in the category of strongly agree.

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