PAEDAGOGIA
Jurnal Penelitian Pendidikan,
http://jurnal.uns.ac.id/paedagogia

DOI: 10.20961/paedagogia.v26i2.78299
Page. 192-199
Vol. 26 No. 2, August 2023
p-ISSN 0126-4109; e-ISSN 2549-6670

NEED ANALYSIS FOR IMPROVING MATHEMATICS EDUCATION WITH STEAM: EXPLORING BATIK PATTERN DESIGN

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Abstract: Mathematics has historically been perceived as challenging for many students. However, mathematics has significant potential for developing creativity, especially in solving problems in complex scenarios. The STEAM approach (Science, Technology, Engineering, Arts, and Mathematics) systematically integrates mathematics with various disciplines to foster intellectual growth, critical thinking, and creative thinking by highlighting the interrelationships between these fields. STEAM positions mathematics as a field that can build on other areas, including the arts. This idea is clearly illustrated through its integration with culture, especially the art of batik, where mathematical elements such as geometric patterns, symmetry principles, rotation, and reflection are depicted in the process. This study aims to increase students' understanding of the art of batik and the application of mathematics to arouse students' interest in mathematics. The study involved 41 elementary school students covering grades 4, 5, and 6. They initially completed a pre-test questionnaire comprising 25 questions that investigated their basic knowledge of batik and their level of interest in mathematics. Educational activities with the theme of mathematics, including geometry, batik, and the use of Microsoft Word, to explore creative digital batik pattern designs are given as initial treatment. After this treatment, participants were given a post-test. This study showed a marked increase in students' understanding of batik and their knowledge of geometric mathematics, especially in designing batik patterns.

Keywords: Need analysis, STEAM, batik pattern.

INTRODUCTION

Mathematics is often perceived as a challenging and unpopular subject among some students. This perception arises due to several contributing factors, such as the need for more variation in teaching materials and the absence of creativity in content delivery. Mathematics provides ample opportunities for fostering creativity, particularly when solving complex problems. Unfortunately, students' creative potential often remains untapped or goes unnoticed, as education tends to prioritize rote memorization of formulas and mechanical procedures.

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Received: August 01, 2022 Accepted: August 22, 2023 Online Published: August 31, 2023

Consequently, the opportunities for nurturing creativity through mathematics are frequently overlooked. However, by incorporating interactive teaching methods, real-world applications of mathematical concepts, and modern technology, educators can transform the learning experience and help students develop a more positive attitude toward mathematics (Bukhatwa et al., 2022).

Mathematics learning has evolved, and one notable development is using the STEAM approach (Science, Technology, Engineering, Arts, and Mathematics). This approach integrates mathematics with various disciplines, fostering critical thinking and creativity. Buinicontro (2017) defines STEAM as integrating art disciplines into the curriculum and learning in Science, Technology, Engineering, and Mathematics (Nurhikmayati, 2019). By embracing the STEAM approach, educators can further enhance mathematics education, making it more engaging and relevant to students. This holistic approach not only helps address the negative perceptions associated with mathematics but also opens doors to exploring the creative aspects of the subject.

Recognizing its potential benefits, STEAM is regarded as a promising option for the academic community to establish a more engaging learning environment. Furthermore, STEAM offers practical and visually stimulating experiences that can activate children's potential and creativity (Amran et al., 2021). Doing so addresses the issues of students' apprehension or disinterest in mathematics, presenting teachers with an innovative approach to their teaching activities. Moreover, this learning method provides direct opportunities for students to cultivate creativity and problem-solving skills effectively, ultimately producing innovative solutions and products (Ayuningsih et al., 2022). When combined with the aforementioned interactive media strategies, real-world applications, and technology integration, STEAM contributes significantly to reshaping perceptions and fostering a more positive attitude towards mathematics among students.

STEAM enhances the appeal of mathematics and illustrates that mathematics is not merely an abstract concept. This is exemplified by its connection with culture, such as in the case of batik, where mathematical

elements manifest in geometric patterns, concepts of symmetry, rotation, and reflection. By integrating these cultural aspects with mathematics, students gain a deeper appreciation for the subject as it becomes more tangible and relatable. Consequently, the STEAM approach fosters creativity and problem-solving (Ayuningsih et al., 2022) and helps students recognize the real-world significance of mathematics in various aspects of their lives, including art and culture (Tresnawati et al., 2020).

In our rapidly globalizing world, the pace of change poses challenges to preserving local cultures, which risk erosion over time. A notable solution to this issue is incorporating mathematics, such as batik, within cultural contexts. This approach offers an appealing option for students, allowing them to engage with their local heritage while learning mathematics, particularly focusing on transformation geometry concepts. Moreover, it instills character education in students, emphasizing the importance of preserving local culture and wisdom (Irawan et al., 2022; Andriani & Septiani, 2020). By intertwining mathematics with cultural elements like batik, educators can create a learning experience that enhances mathematical skills and cultivates a sense of cultural identity and responsibility among students.

Implementing the STEAM approach using batik as a learning context presents significant opportunities to enhance students' creativity and introduce them to art and culture. Through integrating mathematics with a rich local culture like batik, the provision extends beyond the development of students' mathematical skills to instill pride in their cultural heritage. Nonetheless, before the implementation, conducting a preliminary analysis becomes a crucial step to ensure successful execution. Therefore, this research aims to conduct a comprehensive need analysis, identify potential challenges, and design an appropriate implementation plan. This research also carries urgency, as it contributes to improving mathematics education, supports the preservation of local culture, and strengthens students' cultural identity, which is paramount amidst the rapid waves of globalization.

METHOD

This research employed a survey method involving 41 elementary school students, encompassing 6 students from

Grade 4, 8 from Grade 5, and 27 from Grade 6. The initial phase involved completing a pre-test questionnaire comprising 25 questions to evaluate their foundational knowledge of batik and their level of interest in mathematics. Subsequently, students were exposed to an initial treatment, primarily consisting of educational activities revolving around themes such as mathematics, geometry, batik, and using Microsoft Word.

The aim of this initial treatment was to introduce and familiarize students with the fundamental connections between mathematics, particularly geometry, and the world of batik. Furthermore, this phase aimed to illustrate how these two domains could be harmoniously integrated by creating intricate batik patterns using Microsoft Word. It is important to note that the research has not yet implemented the full STEAM approach at this stage. However, the goal was to elucidate the inherent connections between STEAM and the realms of batik and mathematics. The intention was to pave the way for future implementation of STEAM principles by highlighting the synergistic potential of integrating science, technology, engineering, art, and mathematics with the art of batik.

Following this initial treatment, a post-test was administered to gauge the extent of students' comprehension of the material. The data collection process was facilitated through the utilization of Google Forms. This research was conducted at one of the State Elementary Schools in the Jatisrono area, Wonogiri, Central Java, with the primary focus being the dissemination of essential knowledge relating to the intersection of mathematics, particularly geometry and the art of batik. The intent was to promote an understanding of how these two distinct domains can be synergistically blended through Microsoft Word, creating intricate and creative digital batik patterns.

RESULTS AND DISCUSSION

Result

After the initial treatment, which encompassed topics in geometry and batik, post-test questionnaires were administered to the students. The outcomes of these assessments are presented in Figure 1, while a comparison depicting the initial knowledge about batik is illustrated in Figure 2. These figures provide a visual representation of the results obtained from the study, offering a comprehensive view of the

impact of the educational intervention on the student's understanding of mathematics and batik.

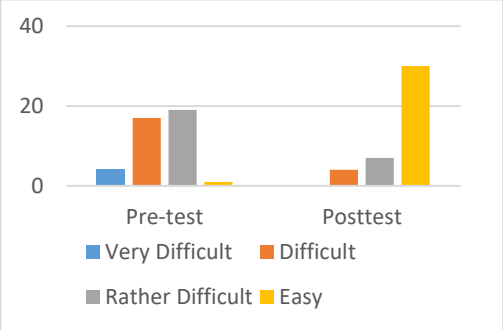

Figure 1. Comparison perception of mathematics subject.

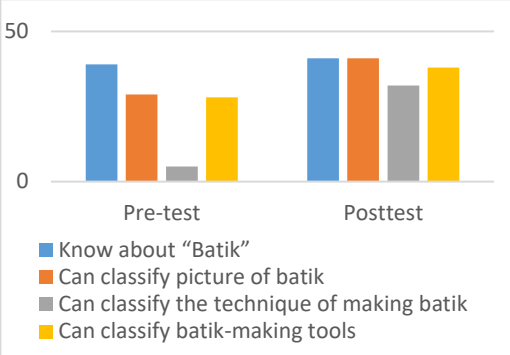

Figure 2. Comparison initial knowledge about batik.

In addition to applying mathematics to batik, technology was also incorporated into this study, specifically involving computers or laptops and Microsoft Office applications as part of the STEAM implementation. Out of the 41 participants, the majority (97.6%) reported using laptops, primarily for tasks like typing in Microsoft Word and accessing the internet. Interestingly, one participant (2.4%) had initially stated no prior experience with laptops; however, this individual was provided with guidance and support to learn how to use laptops and computer devices as part of this research activity.

Discussion

The way an educator conveys teaching materials significantly impacts the success of the learning process, as highlighted by Mapilindo et al.'s research (2020). According to the findings presented by Kusumawati et al. (2020), an engaging and captivating teaching approach captures students' attention, resulting in a heightened comprehension of conveyed concepts. This, in turn, empowers students to recognize and explain these concepts and collaborate, differentiate components, provide illustrative examples, and ultimately draw well-founded conclusions regarding the subject matter, as delineated by Hariyono and Widhi (2020). Furthermore, Bruner's seminal work delineates three distinct modes of learning: enactive, which involves tactile interaction with tangible objects; iconic, encompassing visual learning through direct observation; and symbolic, entailing the comprehension and articulation of concepts through the use of abstract symbols, as elucidated by Dwijaanti et al. (2017).

The strategic introduction of batik, characterized as an art form intrinsically intertwined with mathematical patterns, serves as a potent means to facilitate student learning through an enactive process. This enables students to engage in hands-on experiences while concurrently observing and comprehending exemplar batik patterns, capitalizing on the iconic learning mode. Importantly, this pedagogical strategy aligns seamlessly with the cognitive developmental stages typically encountered by elementary school students.

Students engage with mathematics not solely as a formal classroom endeavor but through diverse activities that establish mathematical connections with other disciplines and real-life contexts. One such avenue is found in the realm of batik. As an art form, Batik serves as a medium that fosters meaningful learning experiences. Meaningful learning objectives encompass nurturing students' comprehension of the subject matter and its relevance to real-life situations (Polan et al., 2020). Furthermore, the utilization of digital-based learning media presents several advantages. Beyond being engaging and enjoyable, these digital tools can be tailored to suit the specific needs of both educators and students (Chandra et al., 2016).

Microsoft Office serves as a tool that enhances students' interest and understanding of mathematics and delves into the cultural aspects of batik. This aligns seamlessly with the principles of STEAM (Science, Technology, Engineering, Arts, and Mathematics), which promotes an integrated learning approach, encouraging students to consider real-world problems from a multidisciplinary perspective. STEAM emphasizes meaningful learning experiences, problem-solving, and the interconnectedness of Science, Technology, Engineering, Art, and Mathematics (Tresnawati et al., 2020).

The results indicate that introducing batik activities infused with mathematical patterns significantly enhances students' knowledge. Consequently, it is imperative to proceed with implementation within the classroom setting. This can be initiated by conducting teacher training sessions on designing mathematics lessons incorporating batik. To facilitate this process, the development of software tailored to assist teachers in creating mathematical patterns on batik could be considered. A study by Maulana et al.

(2021) corroborates the potential benefits of such software, noting that it expedites the design of various batik patterns, resulting in both basic and modified patterns.

CONCLUSION

From this activity, it can be inferred that students display notable enthusiasm when engaging with the material related to batik creation using geometric mathematical patterns. This inference is supported by the post-test results, which indicate a discernible improvement in students' knowledge and comprehension of sub-geometric mathematics and its practical application within batik-related activities.

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