The Geoboard Teaching Aid on Similarity and Symmetry Topics for Elementary School Students

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Abstract. Learning media in the form of teaching aids was necessary for learning in elementary schools caused students in this grade were in the concrete operational stage. This study aimed to determine the feasibility, attractiveness, and effectiveness of the Geoboard teaching aid on similarity and symmetry topics for fifth-grade of elementary school students. The development of the Geoboard teaching aid in this study used the Borg and Gall model. Subjects of feasibility consisted of three experts and one practitioner, attractiveness subjects consisted of 6 students, and effectiveness subjects consisted of fifth-grade students in one public elementary school in Mojokerto, East Java. The results showed that the feasibility of the Geoboard teaching aid on similarity and symmetry topics obtained a percentage score of 91% on the material aspect, 96% on the media design aspect, 90% on the mathematics learning aspect, and 90% on the practical aspect. The percentage of the attractiveness test score reached 99.03%. The data analysis results by independent sample t-test showed that the Geoboard teaching aid significantly improved student learning outcomes. Overall, it could conclude that the Geoboard teaching aid on similarity and symmetry topics was feasible, attractive, and effective for fifth-grade students.

Keywords: Elementary School Students; Geoboard Teaching Aid; Similarity and Symmetry

Abstrak. Media pembelajaran berupa alat peraga penting digunakan untuk pembelajaran di sekolah dasar sebab siswa pada jenjang ini berada pada tahap operasional konkret. Penelitian ini bertujuan untuk mengetahui kelayakan, kemenarikan, dan keefektifan alat peraga Geoboard pada topik kesebagunan dan simetri di kelas V sekolah dasar. Pengembangan alat peraga geoboard dalam penelitian ini menggunakan model Borg and Gall. Subjek kelayakan terdiri atas tiga ahli dan satu praktisi, subjek kemenarikan terdiri atas 6 siswa, serta subjek keefektifan terdiri dari siswa kelas V di salah satu SD negeri di Mojokerto, Jawa Timur. Hasil penelitian menunjukkan bahwa kelayakan alat peraga Geoboard pada topik kesebangunan dan simetri memperoleh persentase skor 91% pada aspek materi, 96% pada aspek desain media, 90% pada aspek pembelajaran matematika, dan 90% pada aspek praktik. Persentase skor kemenarikan subjek uji coba mencapai 99,03%. Hasil analisis data dengan uji sampel bebas menunjukkan bahwa alat peraga Geoboard terbukti efektif secara signifikan dapat meningkatkan hasil belajar siswa. Secara keseluruhan dapat disimpulkan bahwa alat peraga Geoboard pada topik kesebangunan dan simetri dinyatakan layak, menarik, dan efektif untuk siswa kelas V SD.

Kata kunci: Alat Peraga Geoboard; Kesebangunan dan Simetri; Siswa Sekolah Dasar

INTRODUCTION

Similarity and symmetry are topics of learning mathematics in elementary schools (Kim & Bolger, 2017; Nugraha, 2018). These topics are recorded in the list of learning objectives for mathematics in elementary schools. Nevertheless, the learning objectives have not been achieved perfectly (Wiharja, 2019). The learning process is far from effective (Pellegrini, Lake, Neitzel, & Slavin, 2021). Teachers and students cannot interact well. It has an impact on learning outcomes and student motivation. Elementary school students' mathematics learning outcomes have not been satisfactory (Sulfemi & Desmiati, 2018). Students still struggle to learn mathematics (Asriyanti & Purwati, 2020). So do teachers; teachers have difficulties in teaching mathematics (Fauzi, Sawitri, & Syahrir, 2020). These arguments show that there are problems in learning mathematics.

The respondent of a teacher who teaches in fifth grade at one public elementary school in Mojokerto stated that half of the students' scores were below the minimum completeness criteria (*KKM*). Learning outcomes in learning mathematics are still having problems. Students' enthusiasm for participating in learning is also very low (Sukasno, 2012). There are complaints that students often experience difficulties (Asriyanti & Purwati, 2020). The results of interviews with a teacher respondent stated that students had difficulty with some materials in mathematics. There are difficulties in the material geometry of similarity and symmetry. Students tend to have difficulty visualizing plane figures that have a similar plane. Likewise, students find it difficult when study the topic of folding symmetry and rotary symmetry (Wendi & Margiati, 2017). Memorization becomes an effective technique for students learning rotational symmetry and folding symmetry in each flat shape. The limitations of learning media can be one reason for the problems in the learning process. A teacher respondent stated that there was no learning media for a similarity topic. However, on the topic of symmetry, there are media made of cardboard.

There needs to be an effort to develop and improve the quality of learning mathematics. The goal is to solve the existing problems. One of the efforts to improve the quality of mathematics learning can be made by teachers by innovating in the implementation of mathematics learning. It is supposed that students can participate in learning enthusiastically. One form of innovation in learning that can attract students is using the media. Under Wahab's statement (2015), media can cause students to be pleased to participate in learning. The use of media can improve the quality of learning (Annisah, 2014; Anwar & Nurmina, 2019; Komala, 2017; Prasdita, 2013; Yatimah, 2015). Following the results of Prasdita's (2013) research, geoboard media can improve the ability to recognize flat shapes in geometry at the kindergarten level. Another study reported that students who use artificial objects are more effective than those who do not use media. Artificial objects can directly connect objects that are around students' lives. Thus, they can provide a meaningful learning experience (Yatimah, 2015).

The existence of problems in the field of learning similarity and symmetry topics that are supported by the results of previous research is the reason for developing teaching aids. The teaching aid on similarity and symmetry topics for fifth-grade students is an effective medium for visualizing similarity and symmetry topics. The teaching aid for similarity already exists, namely Geoboard. However, this study developed Geoboard by adding symmetry topics. Developing the geoboard teaching aid on similarity and symmetry topics is expected to contribute to the effectiveness of learning activities. The teaching aid for similarity and symmetry topics is learning media with pins on the board. With this media, students can directly visualize plane figures. Students can also look for other forms of plane figures by attaching rubber to the pins found in the similarity and symmetry teaching aids. This study aimed to determine the feasibility, attractiveness, and effectiveness of the Geoboard teaching aid on similarity and symmetry topics for fifth-grade of elementary school students.

METHOD

The development of the Geoboard teaching aid in this study used the Borg and Gall model. This development research involved three experts and one practitioner in measuring the feasibility of the geoboard teaching aid. The validation questionnaires were compiled based on an assessment of material content, design, learning, and practical aspects. The other questionnaire was used as a data collection instrument to measure the attractiveness of the geoboard teaching aid. The indicators of attractiveness were easy to use, suitability of the material, practical, could motivate students, efficient, and it caused easier to understand the topic.

Additionally, the attractiveness questionnaire was given to 6 students in the moderate group trial. The attractiveness questionnaire contains six statement items. Each statement item accommodated one attractiveness indicator. Those indicators were satisfied, provided enthusiasm in learning, made learning easy and interested, made it easier to understand the material, and contained clear instructions. The pretest-posttest questions were used as a data collection instrument to measure effectiveness.

The data collection technique was carried out by providing validation questionnaires to a material expert, a learning expert, a design expert, and an education practitioner. The practicality questionnaire was given to 6 students who had used the geoboard teaching aid in the moderate group trial. The pretest-posttest questions were given to students during the field test. The type of data in this study consisted of qualitative in the form of comments and suggestions obtained from questionnaires and quantitative data in the form of score data obtained from questionnaires and the pretest-posttest results.

Table 1. Feasibility and Attractiveness Criteria of The Geoboard Teaching Aid (Subali & Handayani (2012)

Percentages	Criteria		Decision
	Feasibility	**Attractiveness**	
$81 \leq$ score ≤ 100	Valid	Attractive	No revision
$61 \leq$ score ≤ 80	Quite valid	Quite attractive	
$41 \leq$ score ≤ 60	Less valid	Less attractive	Partial revision
$0 \leq$ score ≤ 40	Invalid	Not attractive	Revision

The questionnaire in this study used a Likert scale which was then analyzed by percentage analysis. Determination of the feasibility and attractiveness of the geoboard teaching aid using the criteria in Table 1. The final analysis stage was carried out after all the necessary data was collected. The data were analyzed by conducting a *prerequisite* test followed by hypothesis testing. Hypothesis testing used *a gain* score test. The provision of pre-test and post-test questions aimed to determine increased student learning outcomes before and after using the media. The improvement of student learning outcomes as measured by using the normalized index formula (Mabruri, Ahmadi, & Suminar, 2019).

$$Index\ of\ Gain\ (g) = \frac{Score\ of\ posttest - Score\ of\ pretest}{Maximal\ score - Score\ of\ pretest}$$

The level of normalization of a gain score was categorized into three categories shown in Table 2.

Table 2. Gain Score Normalization Category (Hake, 1998; Rahim, Hamdi, & Arcana, 2020)

Gain Score Normalized	Category
$(g) \geq 0{,}7$	High
$0{,}7 > (g) \geq 0{,}3$	Moderate
$(g) < 0{,}3$	Low

The hypothesis of this study was tested with gain score analysis using an independent sample t-test.

RESULTS AND DISCUSSION

The material expert gave a questionnaire score of 91%. It showed that the geoboard teaching aid on similarity and symmetry topics was a valid criteria. The materials expert recommends refining the usage guide. According to the material expert, the usage guide used many sentences that were not clear, making it difficult to understand. Revisions based on reviews of the material expert shown in Figure 1.
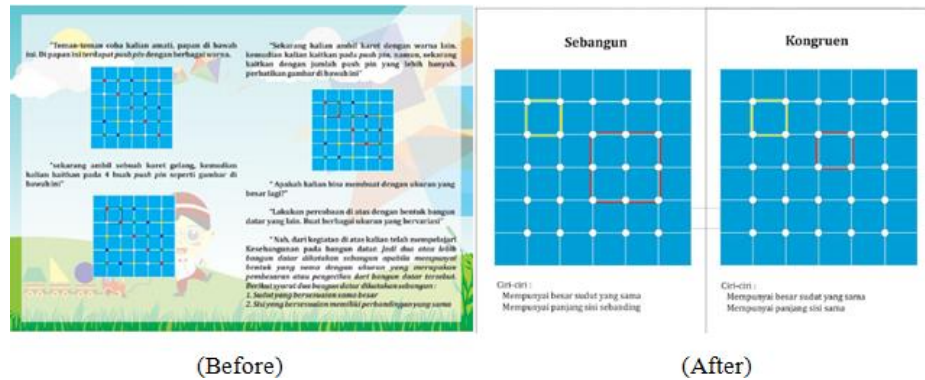
Figure 1. Enlarged Text and Image sizes on Usage Guide

The expert in media design gave it a score of 96%. It showed that the geoboard teaching aid on similarity and symmetry topics was a valid criteria. The expert in media design suggested that the cover design should be changed to use characters that children like (Figure 2). Therefore, the colored pins on the board needed to be changed to homogenous color (Figure 3). The second suggestion was to make instructions for each buffer box (Figure 5). The third suggestion was to assemble the rotating symmetrical support material into transparent cardboard or mica, and it needed to be equipped with a label (Figure 4).

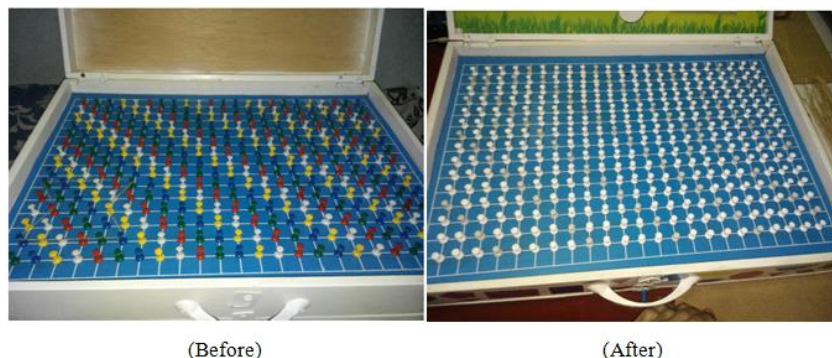Figure 2. The Characters and Text Colors on Front Cover Design have Changed

Figure 3. The Pins on the Board have Changed to Homogenous Color

Figure 4. The Rotary Symmetry Material on the Board Using Transparent Cardboard

Figure 5. The Instructions Put on the Buffer Box

The mathematics learning expert gave a 90% questionnaire score. That was, the geoboard teaching aid on similarity and symmetry topics was valid criterias. The mathematics learning expert suggested that rubber material for geoboard teaching aids should be resized. If the size of the rubber varies, students are more flexible in making similar shapes. Revisions based on reviews from the mathematics learning expert are shown in Figure 6.

Figure 6. Geoboard Using Rubber with a Larger Size

The practitioner gave the questionnaire a score of 90%. It showed that the geoboard teaching aid on similarity and symmetry topics was a valid criteria. The practitioner suggested that the cover design provides an attractive ornament, for example, by providing colored field ornaments that attract students' attention (Figure 7).

(Before)   (After)

Figure 7. Adding Ornaments to the Cover Design

The reviews from experts showed that the geoboard teaching aid fulfilled the aspects of material feasibility, media design feasibility, and mathematics learning feasibility. Additionally, the result of the practitioner review showed that the geoboard teaching aid fulfilled the indicators of attractiveness. Based on the feasibility of aspects reviewed by experts and the feasibility of indicators reviewed by the practitioner, so declared that the geoboard teaching aid was feasible. Furthermore, the results of the attractiveness questionnaire given to 6 students in the moderate group trial obtained a score of 99.03%. One statement item (the indicator satisfied) gained a percentage score of 91.67%. The other five statement items received a perfect score percentage of 100%. It showed that the geoboard teaching aid on similarity and symmetry topics was in the attractive category. Furthermore, it has analyzed the effectiveness of the results of the pre-test and post-test experimental group, as shown in Figure 8 and the control group, as shown in Figure 9.
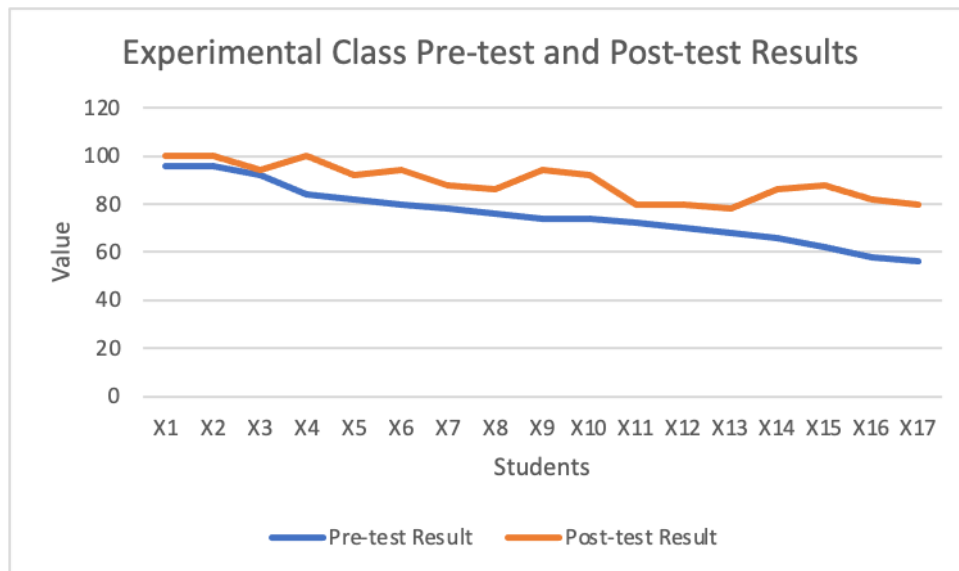

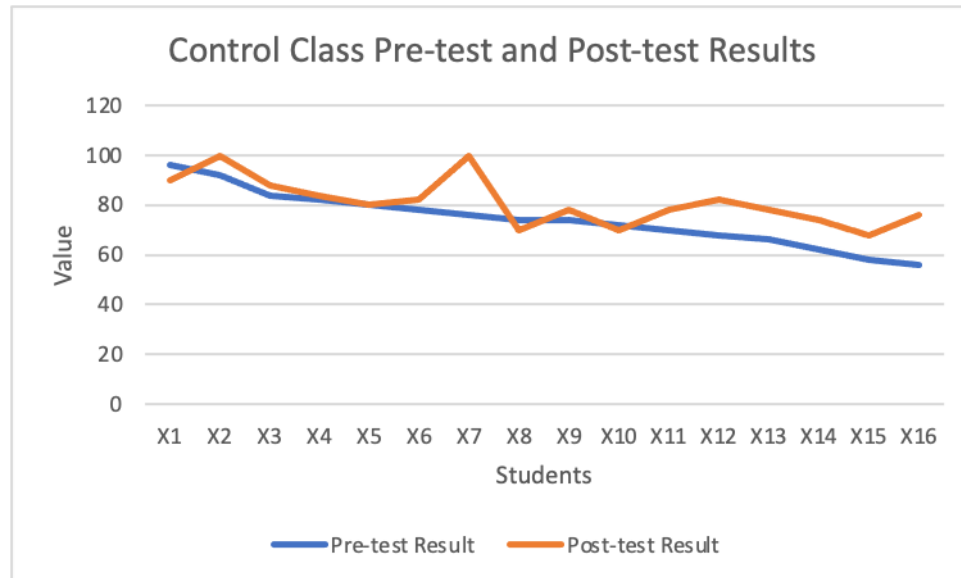Figure 8. The Results of Experimental Group Pre-test and Post-test

Figure 9. The Results of Control Group Pre-test and Post-test

The description of the results of the gain score calculation in the experimental group consisting of 17 students there were 23.53% of students achieved the high category. 64.71% of students reached the medium category. Furthermore, 11.76% of students reached the low category. While the control group consisted of 16 students, there were 12.5% of students reached the high category. 25% of students reached the medium category. Moreover, 62.5% of students reached the low category. These gain scores are described in more detail in Table 3.

Table 3. Gain Score Categorization

Gain	Criteria	Experimental		Control	
		f	%	F	%
$(g) \geq 0,7$	High	4	23,53	2	12,5
$0,7 > (g) \geq 0,3$	Moderate	11	64,71	4	25
$(g) < 0,3$	Low	2	11,76	10	62,5

The results of gain score analysis used an independent sample t-test indicated a significant difference in learning outcomes between students in the experimental group that used the geoboard teaching aid on similarity and symmetry topics and students in the control group without the geoboard teaching aid. Thus, it can be concluded that the geoboard teaching aid on similarity and symmetry topics significantly improves student learning outcomes.

The geoboard teaching aid on similarity and symmetry topics was attractive based on practitioner review and students so that it could increase students' interest in learning. This fact is from previous research that engaging learning media can increase students' interest in learning (Setiawan & Soeharto, 2020; Taufiq & Sainuddin, 2016; Widodo & Wahyudin, 2018; Zuhri, Maimunah, & Yuanita, 2020). Thus, the development of the geoboard teaching aid can attract students' interest in learning mathematics. Additionally, the geoboard teaching aid on similarity and symmetry topics significantly improved student learning outcomes. Because improving learning

outcomes is one indicator of success in learning at school. That means the Geoboard can be recommended for use in learning at school.

CONCLUSION

The results of the validation assessment analysis showed that the geoboard teaching aid on similarity and symmetry topics gets validity of the material content 91%, the validity of media 96%, the validity of mathematics learning 90%, and the validity of learning 90%. The products developed interesting for students. Based on the results of the percentage score of the attractiveness questionnaire obtained 99.03%. The geoboard teaching aid on similarity and symmetry topics developed has a good quality and effective use in learning activities similarity and symmetry. Based on test results calculation, the geoboard teaching aid on similarity and symmetry topics meets the feasible, attractive, and effective elements for fifth-grade students of the elementary school. Thus, this geoboard teaching aid was recommended to support learning on similarity and symmetry topics for fifth grade. The other teaching aids could also be developed to support learning on other mathematics topics at the elementary school.

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