ICEE-2

Development of Pop-up Book Mediafolding Symmetry and Rotating Symmetryfor Class III Students Basic School

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Abstract. The use of media in the learning process is very helpful for students' understanding, but in mathematics learning especially the traveling material and the wide flat area the use of media is still rarely used. One of the media that can be used is the pop-up book media which is a form of book packed with a three-dimensional structure with a part that can be moved and played. Researchers developed a pop-up book media concept around and wide flat area for fourth-grade elementary school students. The method used is Design-Based Research (DBR) which goes through four stages including problem identification, prototype development, due diligence, and reflection to produce the final product. This research shows that; 1) the development of pop-up book media is made according to the curriculum as well as from predetermined indicators, 2) pop-up books are made using the canva application and printed on 260 gsm art paper A3 size, 3) the use of pop-up book media the circumference and area of the flat build area are suitable for use in the learning process, in terms of the results of validation and testing. Product trials were conducted at two schools, which were reviewed from students' responses and observations during learning. In the learning process students are very enthusiastic about learning using pop-up book media, this is indicated by the positive response to the pop-up book media with the results achieved 96.54% and 99.78%, 4) the final product of this study is in the form media pop-up book concept around and wide flat area that is suitable for use. From the results of the study pop-up, book media around and wide flat area for fourth-grade elementary school students is suitable for use in learning mathematics.

Keywords: Pop-Up Book Media, Flat Build, Circumference, and Area.

INTRODUCTION ~ Mathematics is a field of study taught at various levels of education. Mathematics is a universal science and underlies the development of modern technology, has an important role in various scientific disciplines, advancing human thought power and aims to prepare for productive life in the 21st century (Romli, 2010; National Research Council, 2012; Division CP, 2013; Sustainable, 2013). Mathematics underlies many aspects of life, in line with several mathematical objectives based on Permendiknas No. 22 of 2006 namely that students have the ability to understand, explain, and apply concepts in problem solving, mathematical reasoning, problem solving, mathematical communication, and attitudes in the form of curiosity, confidence in solving problems and interests in learning mathematics.

Mathematics teachers often find it difficult to give a concrete picture of the material presented so that it results in low and uneven results achieved by students. Mathematics is considered a difficult subject and makes some students not interested in learning mathematics (Indiyani&Listiara, 2006; Widjajanti&Wahyudin, 2011; Rahajeng, 2012; Supriyanto, 2014). This situation will continue as long as the teacher considers itself as the only source of learning whereas the teacher is not the only source

of learning and the messenger of education (Sundayana, 2015; Marwani, 2006; Abdullah, 2012). There needs to be facilities that help teachers to convey learning. Teachers as communicators as well as in the defense of mathematics (Corte, 2000; Cohen, 2014). The teacher's communication process in conveying mathematics learning can be assisted with learning media.

Media as a messenger in learning activities to be better understood by students and allow students to learn more and improve abilities according to learning objectives (Sundayana, 2015; Riyana, 2012). One form of visual media is a pop-up book. Pop-up books can be used as a defense media. Pop-up books are books that provide the potential for movement and interaction through the use of paper so that it has an appeal to the reader and gives pleasure to readers both children and adults (Lee, 1996; Bluemel& Taylor, 2012; Khoirotun, 2014).

Pop-up book media is not new in the world of education, but this media still has an opportunity to be developed because of the lack of availability of pop-up books that support mathematics lessons and the absence of pop-up book media on symmetry material. Symmetry is an important geometrical concept and it is found that students' understanding of symmetry material which is often misunderstood will be diagonal in a flat shape which is considered to be the axis of symmetry (NCTM, 2000; Rismaya, 2018). The results of previous pop-up book media research on flat shapes and language learning in elementary schools show that pop-up books are worthy of being used as learning media and make learning more effective because students more easily understand learning material (Rahmatillah, 2017; Solichah, 2018).

Based on a number of things explained, researchers are interested in conducting research on Fold symmetry and Fold symmetry Media Pop-up Books for Third Grade Elementary School Students. This study aims to produce a symmetry learning media in the form of pop-up books as a facilitation of the mathematics learning process and increase student interest in learning mathematics.

METHOD

This research was designed by DBR (Design Based Research) or research based design. The stages are carried out systematically in accordance with research methods that refer to the Reeves model. According to Amiel and Reeves (2008) this method has four stages:

1. Collaborative identification and analysis of problems by researchers and practitioners. This stage is carried out by observing elementary schools and conducting documentation studies of existing media to find out the aspects that need to be developed in making symmetry pop-up books.

2. Develop a design or prototype solution based on theoretical benchmarks, existing

design principles. This stage is carried out by analyzing the curriculum to match the media with learning objectives, designing the media according to the required aspects, printing, then arranging them.

3. Trials and improvements. At this stage, validating the 4 experts and trials in two different schools.

4. Reflections to produce design priciple. At this stage a reflection is carried out based on the results of the trial. The deficiencies found previously were corrected in order to produce a product in the form of a symmetrical pop-up media that was appropriate and representative for use by third grade students in elementary schools.

RESULTS AND DISCUSSION

Aspects Required for the Development of Pop-Up Book Media

1) Conformity with the curriculum

The symmetry pop-up book media is designed to adjust the basic competencies that exist in the 2018 revised 2013 curriculum.

Table 3.1 Basic Competency and Indicator

Basic Competency	indicator
3.9 Explain fold symmetry and rotary symmetry on a flat shape using concrete objects	1. Explaining the meaning of fold symmetry, axis of symmetry and symmetrical shape
4.9 Identifying fold symmetry and rotary symmetry on a flat shape using concrete objects	2. Explain the meaning of rotary symmetry 3. Determine the amount of symmetry fold the flat figure through experiments 4. Determine the amount of symmetry of the rotary geometry through experiment

2) The mechanism for making pop-up books

The mechanism of making media must pay attention to several things such as the

type of paper, paper size, paper weight, paper thickness, manufacturing technique, and the availability of tools and materials that support making pop-up books. In accordance with Ives (2009) the main material used is glossy art paper A3 size 42 x 29.7 cm which is made into 2 pages. This material is suitable because it has a strong thickness, paper size makes it easy for students to read and see objects in books, and glossy material that makes the book durable. The techniques used are step-fold, mosaic, twist, carousel, volvelles, waterfalls, and pull-tabs in accordance with the pop-up techniques presented by Puleo (2011) and Jr. (2014). In addition there are other supporting materials such as thick mica concorde paper, tacks, duplex, glue, origami, ribbons, and magnets. While the tools used such as scissors, cutter, pencil and ruler. The application used by researchers is Canva because it is easy to operate.

3) Media production skills

Skills and patience are needed in cutting, measuring, gluing, or sticking paper neatly and carefully.

Decent Pop-Up Book Media Development Plan

1) Making a design with an application on a computer with a canva application.

2) Determination of technique. There are many techniques in making pop-up folds but only a few techniques that researchers use are flaps, step-fold, mosaic, twist, carousel, volvelles, waterfalls, and pull-tabs.

3) Color selection. The color theme of the media that the researchers made was bright but still moist and not as striking as light blue, light green, pink, light yellow, and ash.

4) Selection of Font Types. In the cover section, the main title on the front uses regular adumu, the author's name uses abibas, the author's profile title uses adigiana, and the profile content uses advent pro. While the contents of the average use adigianatoybox, anaktoria, abhayalibre, and arimo.

5) Selection of Paper Type and Size. The paper used is A3 size art paper to be made into two pages with glossy material and partly mate.

6) Design Processing Process. The designs that have been printed are then assembled using a material that is provided and then glue and the pages are put together to form a book.

Feasibility Test for Pop-Up Book Media

Four experts validated the developed pop-up book media. There has been a slight revision of the media regarding the improvement of some parts of the sentence which tend to be confused, the neatness of numbering, the addition of arrows and ropes to make it easier for students to unfold the paper. However, in general the experts considered that the media developed was in accordance with

the indicators of the design of a representative pop-up book media, according to the characteristics of elementary school students and was appropriate for use.

Trials were conducted at two different schools with the following responses:

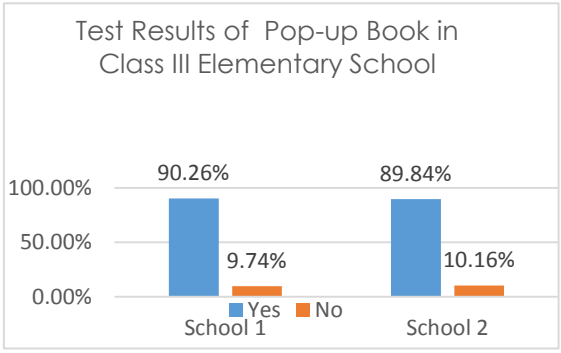

Figure 3.1 Diagram of the results of the pop-up book

In general, from the two trials the students commented that they enjoyed learning to use pop-up books, fold symmetry and rotary symmetry. However, it was found that the lack of caution of students when playing media made an object almost damaged and had to be repaired by researchers with stronger material. The media is indeed not suitable for use in groups with a large number of students because students tend to scramble to use media and teachers must pay close attention so that each student can use them fairly.

Reflection on Pop-Up Book Fold and Play Symmetry Media Products for Third Grade Elementary School Students

Product reflections that have passed validation, trials, and some improvements are in the form of fold symmetry pop-up media and rotary symmetry for representative third grade elementary school students that are representative and suitable for use. According to Dzuanda (2009) that the advantages of pop-up books are the appearance of dimensions, giving a surprise, the impression conveyed is getting stronger, and the display has dimensions that make objects more tangible. Besides the drawbacks are the processing time and the price is relatively expensive. These strengths and weaknesses are evident from the results of the trial and research implementation process. As for the other deficiencies found by researchers, the pop-up book is not suitable for use by students in groups in large numbers because it reduces conducive learning. Next is the display of the pop-up book media that has gone through several improvements to the validation and trial results.

Figure 3.2 cover, pages 1 and 2

The technique used in the book use section is the twist technique, while the table of contents uses the waterfalls technique.

Figure 3.3 pages 3, 4, 5, 6

Page 3 and 4 of the title use the step-fold technique, the notion of fold symmetry using the carousel technique, triangles and squares using the flaps technique. Page 5 uses the mosaic and flaps technique, page 6 the rotary symmetry section uses the pull-tabs technique and the object below uses the volvelles and flaps technique.

Figure 3.4 pages 7,8,9,10

Pages 7 and 8 use the volvelles and flaps technique while pages 9 and 10 use the stef-fold technique

Figure 3.5 back cover

CONCLUSION

1. Aspects in the development of fold symmetry and rotary symmetry pop-up media that is according to the curriculum, the mechanism of making pop-up book media, and media making skills.

2. The design of the fold symmetry and rotary symmetry pop-up book made namely 1) the design is made using the canva application; 2) letters use regular adumu, abibas, adigiana, advent pro types. adigianatoybox, anaktoria, abhayalibre, and arimo; 3) The background uses bright but unobtrusive colors namely white, light blue, light green, pink, light yellow, and ash; 4) type of paper uses 260 gsm art paper; 5) paper size using A3 for two pages; 6) Techniques using flaps, step-fold, mosaic, twist, carousel, volvelles, waterfalls, and pull-tabs.

3. The feasibility of fold symmetry and rotary symmetry pop-up books for third grade students in two schools showed positive responses, namely 90.26% and 89.84%, thus proving that the media for fold symmetry and rotary symmetry books for third grade students elementary school is feasible to use in the learning process.

4. Reflection of product development is to produce a fold symmetry and rotary symmetry pop-up media that is appropriate and representative for third grade elementary school students.

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