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Development of Mathematics Teaching Materials for Folding, Rotating, and Circumference Symmetry Materials Build Flat

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Abstract

This teaching material is developed based on the demands of the Curriculum by considering the characteristics and needs of grade III MI/SD students, especially in the lower grades who have concrete and visual learning styles. The purpose of this development is to produce teaching materials in the form of magazines that contain materials on folding symmetry, rotational symmetry, and circumference of flat buildings that are presented in a contextual and interesting manner, so as to help students understand the material thoroughly and pleasantly. Teaching materials are designed using three-dimensional images, flat shape cutouts, interactive worksheets, and envelopes containing multiple-choice questions to support students' active engagement during the learning process. The development model used is a 4D model (Four-D Models) which consists of the stages of Define (defining student needs and characteristics), Design (initial product design), Develop (product development and expert validation), and Disseminate (limited dissemination for trials). The subject of development is grade III MI/SD students, with the object of development in the form of an interactive mathematics learning magazine. The research instruments include expert validation sheets, observation guidelines, and student response questionnaires to determine the effectiveness of the teaching materials developed. The findings of the study show that these teaching materials significantly improve students' understanding of the concepts of flat building, especially in terms of active engagement, interest in learning, and ability to solve practice problems. The novelty of this teaching material lies in the three-dimensional and interactive design of the magazine, which has not been developed much before in elementary mathematics learning, as well as the use of multiple-choice question envelopes that give students the space to determine their own learning order.

INTRODUCTION

Education can increase the potential and skills of students who are useful for themselves, society, the nation, and the state, one of which is by making students who do not know Elementary school is a period of middle and late childhood development (aged 6-11 years) where children begin to master reading, writing and arithmetic skills (Nataliya, 2015) According to Mercer, the characteristics of students at the elementary school level refer to Piaget's cognitive learning theory where the concrete preoperational stage is an age that can only understand a phenomenon that is real. Materially, mathematical objects can be tangible objects, drawings or models of cubes, colorful symbols of large or small numbers, square-shaped ponds, etc. So materially, the object of mathematics is in the environment or around students (Muhammad & Novitasari, 2020). Understanding the most prominent characteristic of the scientific discipline of mathematics is a subject that is considered difficult for students because the object of study is abstract and based on the results of the calculation process or measurement of real objects.

Teachers have a central role in guiding and accompanying students during the learning process at school. One of the basic skills that teachers must have to support this role is the skill of explaining. This skill includes the ability to convey information or learning materials in a systematic, logical, and related way to real situations in daily life. With clear and relevant delivery, students will more easily understand the material being taught and be able to relate it to their own experiences. Therefore, mastery of explaining skills is an important part of teachers' professional competence in creating effective learning (Ratih, Syah, Nurhidayat, Jarin, & Buckworth, 2021).

Mathematics is a subject considered difficult by students, so low learning outcomes are obtained (Viorika, Kurniawan, & Lubab, 2021). The high and low motivation of student learning can be seen during the learning implementation process, such as student interest, student enthusiasm for learning, and student seriousness when the teacher explains (Juniarsih, Maftuhah, & Syamsiyah, 2022). So far, teachers still use passive and ineffective learning methods, such as the lecture method, without providing opportunities for students to discuss or think creatively. Using teaching materials in the learning process is one of the efforts that can improve the quality of student learning outcomes. Teaching materials can improve students' learning process, which is expected to improve learning outcomes. Teaching materials are developed and prepared under the curriculum's demands by considering students' needs, namely teaching materials per students' characteristics and social environment (Misrawati & Suryana, 2022). Reasons related to the benefits of teaching materials in the student learning process, according to Nana Sudjana & Ahmad Rivai, include: (1) Teaching will attract more students' attention, (2) Teaching materials will be clearer in meaning so that they will be better understood by students and allow students to achieve teaching goals better, (3)

Teaching methods will be more varied, (4) Students do more learning activities because not only listening to the teacher's description but also other activities such as observing, doing, demonstrating and others(Ramadhan & Khairunnisa, 2021).

The selection of magazine teaching materials is one alternative to explaining the material to students to understand the material easily. Magazines are a solution for creating interesting teaching material, not based on a teacher's explanation. As a teaching material in print media, the magazine's design raises interesting images, and the language is not monotonous. Teaching materials in the form of magazines that can link students to understanding Islamic values and help them grow their literacy are still very rare among students (Yuhroh, 2019). These teaching materials can be practiced directly and are easy for students to use to improve their understanding. The formulation of the problem in this article is how to develop and use magazine teaching materials on folding symmetry, rotary symmetry, and flat build circumference. This article aims to teach students how to create and use these teaching materials to understand and apply what is understood to learning activities.

METHODS

This research is a type of research and development that aims to produce innovative teaching materials in the form of magazines for grade III MI/Elementary School students. This magazine is designed to facilitate students' understanding of the materials of folding symmetry, rotary symmetry, and flat building circumference. The development of this teaching material refers to the 4D (Define, Design, Develop, Disseminate) model, which begins with the analysis of student needs in the digital era through literature studies and field observations. The results of the analysis show that students need visual and interactive learning media that are easy to understand and visually appealing.

The developed products consist of two types of magazines. The first magazine contains KD 3.9 and 4.9 on folding symmetry and rotational symmetry, complete with material summaries, practice questions, and three-dimensional worksheets. Students can directly cut and fold flat shapes to find symmetrical lines and rotary symmetry, making learning more meaningful. The second magazine contains KD 3.10 and 4.10 about the circumference of flat buildings, presented with a different approach, namely using an envelope containing selected questions that students can choose and work on. Each magazine is equipped with a cover, student identity, KD, learning objectives, material summary, exercises, as well as author bio and bibliography.

The instruments used in this study include validation sheets by material and media experts, as well as student response questionnaires during the limited trial. Data was also obtained from literature studies on mathematics teaching materials,

both in print and digital form, as well as references from journals and other scientific sources. Preliminary findings show that these teaching materials are able to increase students' enthusiasm in learning mathematics and encourage their active involvement in the learning process. Thus, this magazine's teaching materials have the potential to be an effective and fun alternative learning media for elementary school students.

RESULTS AND DISCUSSION

The development of magazine teaching materials for folding symmetry, rotary symmetry, and flat build circumference in grade III MI / SD students uses the development of a 4-D model. This development model consists of four stages: define, design, develop, and disseminate (Nurjanah & Hakim, 2018). Because the instruments used to create teaching materials are library-based, the development model used is only up to the defining, designing, and developing stage.

The steps for developing teaching materials for class III MI/SD folding symmetry, rotary symmetry, and flat build circumference are as follows:

1. The defining stage includes analysis of learning needed by students, curriculum analysis, analysis of student characteristics, task analysis, and analysis of the concept of the material to be explained.
2. The design stage to prepare magazine teaching materials is (1) Determine the title of the magazine based on KD and the material to be delivered, (2) Use references that follow the material, (3) Prepare materials and practice questions, (4) Make the magazine design as attractive as possible.(Maharani & Farida, 2022)
3. The development stage is to produce revised teaching materials based on experts. This stage includes (1) validation of teaching materials through sending files to lecturers of the Mathematics Teaching Material Development course. (2) Simulation, which is an activity to operationalize the learning plan, is carried out during the presentation of the Mathematics Teaching Material Development course.

In the first magazine, the author developed mathematical material on basic competence 3.9, explaining folding and rotary symmetry on flat shapes using concrete objects. And 4.9 identifies folding and rotary symmetry on flat shapes using tangible objects. The material contained in the magazine's teaching materials is as follows:

Fold Symmetry

Quoting from the book Patas Mathematics in Elementary School, Sobirin, folding symmetry is the number of folds that can make a flat building squeeze with the building itself. According to another opinion, the notion of folding symmetry is described as the number of folds present in a flat shape. When the shape is folded, it can produce two folds of equal size or symmetry. In mathematics, folding symmetry can also be referred to as axis symmetry.

This folding symmetry material is the medium used, namely folding paper. In the magazine, folding paper was provided and inserted into the envelope. The folding paper was shaped to resemble a flat shape to make it easier for students to understand the material of folding symmetry. The ways to use the folding paper media include folding it once so that the sides squeeze together and cover each other. If there is another possibility, then unfold and repeat the activity above. Observe the traces of the existing folds, then give a dotted line. The number of dotted lines from the crease results determines the amount of symmetry. (Ati, 2013)

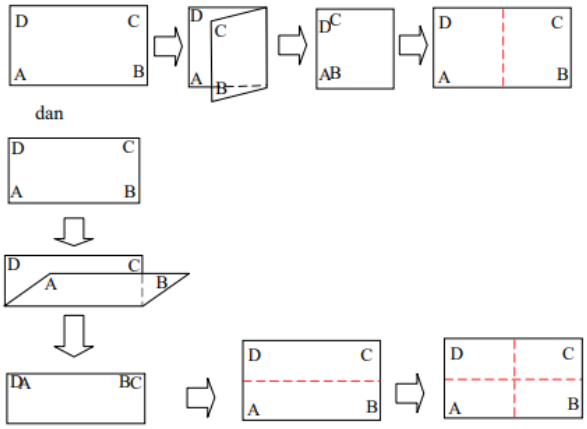


Figure 1
Examples of the Use of Folding Paper Manipulative Media

Folding symmetry is possessed by symmetrical flat shapes only. If a flat wake is folded in such a way that the two halves of the fold are equal in size and exactly cover each other, then the wake is said to have folding symmetry. The fold is called the axis of symmetry of the flat wake.

Rotary Symmetry

According to Marini, rotary symmetry is the rotation of a flat shape determined by the center point of rotation, the angle of rotation, and the direction of rotation, which is determined by a center point P with a certain direction of rotation. Based on this understanding, a flat shape will know the amount of rotational symmetry if the center point can determine its clockwise rotation.

According to Winarnin, rotation, or so-called rotary symmetry, is a rotation determined by a point P with a large angle and clockwise direction of rotation. Thus, rotary symmetry is determined by the center point through rotation or rotation performed clockwise.

Zuliana concluded that rotary symmetry falls into the scope of geometry related to transformations whose object of study is in mathematics learning. Based on this understanding, rotary symmetry material is used to study mathematical objects as students understand the mathematical learning process of the scope of geometry. So that students can learn more clearly about the material of rotary symmetry (Zuliana, 2017). So rotary symmetry is the number of revolutions that a

flat shape can make centered on one point in the middle until it returns to the starting position.

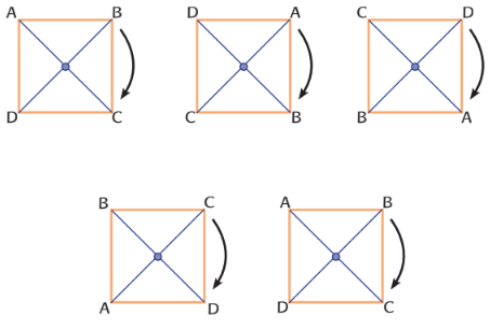


Figure 2
Examples of Rotary Symmetry

This rotary symmetry material can be introduced to students using rotary media. The way to use the rotary media is (1) Place the flat shape according to the available image, (2) Place the index finger on the midpoint of the flat build, (3) Turn the available flat wake reference point clockwise by 90°, (4) Do the third movement repeatedly until the reference point returns to the initial position.

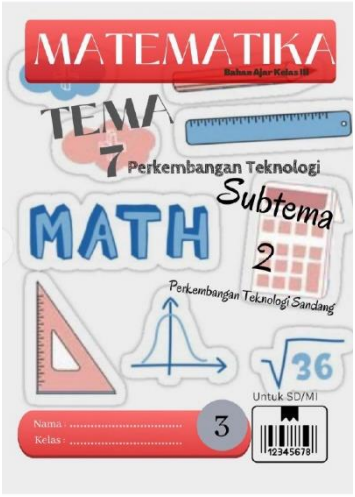


Figure 2
Cover Materials Teach Symmetrical Material Magazine

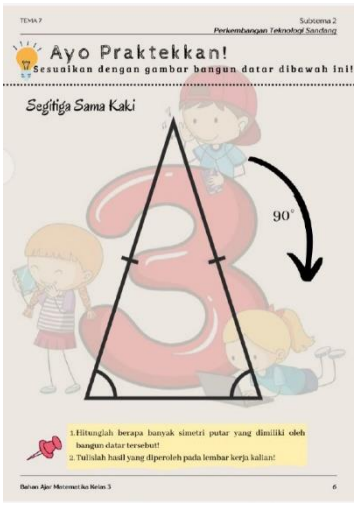


Figure 3
Spin Symmetry Material in Magazines

Swivel symmetry is a flat shape rotated at the same center (spin point) that can reoccupy its frame. Some flat shapes have more than one rotary symmetry (Aisyah, 2012).

In the second magazine, the author develops mathematical material on basic competence 3.10, explaining and determining the circumference of a flat build. 4.10 presents and resolves problems related to flat build circumference. The material contained in the magazine's teaching materials is as follows:

Square Flat Build Circumference

There are various quadrilateral flat shapes, each consisting of four sides, four corner points, and an area bounded by these four sides. The sum of the four sides is called the circumference (As'ari, Tohir, Valentino, Imron, & Taufiq, 2017). In learning mathematics in grade III elementary school / MI, calculating the perimeter of a flat building does not use a formula but a unit square or unit length. In the magazine, there are some practice questions in the worksheet. The worksheet questions are put in envelopes, and then students are asked to choose two questions, which will then be done on the worksheet.

Example:

A sunny Sunday. Aza and her father and mother worked together. They share tasks. Aza is in charge of feeding the chickens. Mother is in charge of planting tomato trees. So that chickens do not eat tomato plants, the father installed a fence on the edge of the tomato garden.

Take a look at the location map of the tomato garden below!

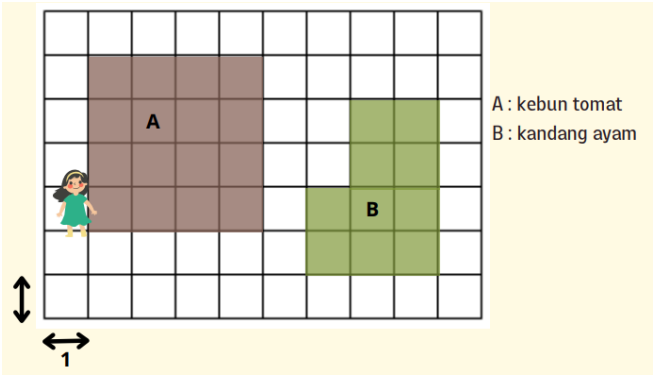


Figure 5.
Example of the 1st Question Circumference Build Flat

In the tomato garden, one side of the square shows one unit of length. If the unit of length is equivalent to one step Aza. So, the circumference of the garden is 16 units in length or 16 steps.

Example:

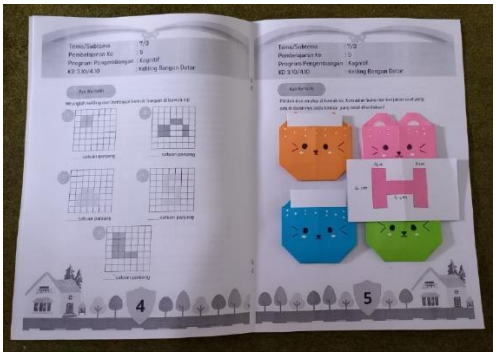


Figure 6.
Example of the 2nd Question Circumference Build Flat

Figure 7
Cover of Teaching Materials Magazine Traveling Material

Table 1.
Understanding the Concept of Square Circumference

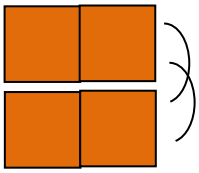
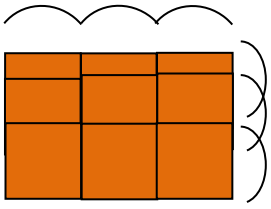
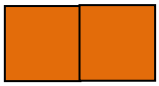
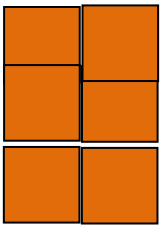
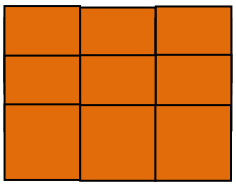
Number	Square Image	Long Side	Short Side	Around
1.		1	1	4
2.		2	2	8
3.		3	3	12

Table 2
Understanding the concept of rectangular circumference

Number	Square Image	Long Side	Short Side	Around
1.		2	1	6
2.		3	1	8
3		3	2	10
4		4	3	14

CONCLUSION

Teaching materials in the form of magazines are made to improve students' understanding of the concepts of folding symmetry, rotational symmetry, and flat building circumference in grade III MI/SD. This teaching material is perfect for introducing basic concepts because it is designed in an interactive and contextual way. The first magazine contained KD 3.9 and 4.9 on folding symmetry and rotary symmetry, presented in three-dimensional format. In the folding symmetry section, an envelope contains flat pieces that allow students to directly practice determining the line of folding symmetry. As for the rotary symmetry section, there is an exercise sheet that helps students in determining the amount of rotary symmetry of various flat shapes. Furthermore, the second magazine contains KD 3.10 and 4.10 about the circumference of flat buildings with a different approach from the reference book. There are envelopes containing questions that students can freely choose to work on, thus fostering curiosity and motivation to learn. The findings from the use of these teaching materials show that students are more active, enthusiastic, and faster

to understand concepts through the contextual and manipulative approaches offered in the magazine. Therefore, this magazine's teaching materials are effective as an alternative learning medium in improving understanding of basic mathematics concepts in elementary schools.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author(s)

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