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Development of pop-up book media based on project-based learning in mathematics learning about flat shapes in elementary schools

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Abstract

Flat building materials have very diverse materials and are considered the most difficult for students to understand. One of the failure factors that occur in students learning is the role of teachers and learning media that is less than optimal. The conditions that occur at SDN Mergosono 1 Malang City which experiences limited learning media to support mathematics learning so students have difficulty in understanding flat building material. Therefore, efforts are needed to optimize the use of media and learning models. This research aims to develop project-based learning-based pop-up book media on grade II elementary school flat building material with valid, practical, and interesting. This development research method uses the ADDIE model (Analyze, Design, Development, Implementation, Evaluation). The validation results of material experts obtained a percentage of 96.28%, media experts 98.86%, and teachers on average 98.33% by getting a very valid category. Student responses in small-scale and large-scale trials obtained an average percentage of 96.28% with very interesting and very practical criteria. So, it can be concluded that project-based learning-based pop-up book media in 2nd grade of elementary school flat building material is very feasible to use.

Keywords: Build Flat; Learning Media; Pop-Up Book; Project-Based Learning.

INTRODUCTION

Mathematics is one of the sciences that plays a significant role in expanding knowledge. One of the basic mathematical concepts that students need to understand is geometry. Geometry is a science that discusses points, lines, angles, planes, and shapes (Travers et al., 1987). Flat shapes are the scope of geometry. A flat shape is part of a flat plane that is bounded by straight and curved lines (Suharjana, 2009). Planar figures have very diverse material and are considered the most difficult for students to understand. Sejati (2021) stated that the source of the difficulty with flat shapes that occurs among students is not being able to define an image of a flat shape and its elements. One of the failure factors that occur among students in learning is the role of teachers and learning media that are not optimal

(Bintang, 2022). As is the condition that occurs at SDN Mergosono 1, Malang City, which experiences limited learning media to support mathematics learning, so students have difficulty understanding flat shape material. Therefore, learning media is needed that is packaged practically and interestingly for students to help deliver material in learning activities. Learning media is a vehicle for distributing material to help students explore and understand it (Hasan et al., 2021).

Based on observations and interviews conducted in class II of SDN Mergosono 1, Malang City on November 14, 2022, information was obtained that the use of learning media was still limited, tending to only use media in the form of pictures on blackboards and textbooks and there had been no development of other media. This is due to the limited time and abilities that teachers have, so teachers rarely combine project-based learning models with flat material. The presentation of plane material in textbooks is still limited and less practical and interesting for students. Apart from that, learning tends to use lectures, questions and answers, and assignments so that learning still seems teacher-centered and does not have an enthusiastic impact on learning activities. As a result, in understanding the material about flat shapes, students find it difficult to determine and differentiate the names of flat shapes and their characteristics such as vertices, sides, and angles.

Adjustments to the time, conditions, and learning objectives determined are taken into account in selecting learning media development activities (Falahudin, 2014). In elementary school learning, it would be better to use media that is adapted to the level of intellectual development and characteristics of students. Based on the results of observations, interviews, and needs analysis questionnaires distributed to 5 students in class II A and 5 students in class II B at SDN Mergosono 1 Malang City, it shows that teachers and students need practical and interesting learning media.

Based on the problems that occur, efforts are needed to help the learning process by optimizing the various media and learning models used. It is hoped that the use of media can bridge students' learning to facilitate the acquisition of the knowledge being studied (Kusno & Indah, 2018). Moreover, according to Piaget (Nuryati & Darsinah, 2021), students at elementary school age have entered into concrete operational thinking, so teachers are expected to be able to help students in the process of forming concepts appropriately in learning activities. One application is by learning media. Apart from that, through learning designs prepared by teachers, they can provide authentic experiences through the use of learning models that can trigger students to be actively involved (Solekhah et al., 2018). Development of learning media that meets the required criteria, namely pop-up book media based on project-based learning.

Pop-up book learning media, namely concrete learning media in three-dimensional form and packaged in book form. The use of pop-up books has been adapted to student potential because they are practical, interesting, and simple so they can motivate student learning (Ulfa, 2020). Internal motivation in learning activities is one of the factors in achieving learning goals (Nuraini & Wisnu, 2019). The development of this learning media is also equipped with a combination of project-based learning models so that it can activate students in learning. The choice of

pop-up book learning media based on project-based learning is because it can make students more active, enthusiastic, and able to remember the material that has been taught and learning is more enjoyable (Yasinta, 2019). Project-based learning is a project or activity that is used as a medium for students to actively participate in the discovery process of transferring knowledge and skills through a series of questions prepared in projects or exercises (Ambarwati, 2015). Rahardjo (2012) also explains that project-based learning is a learning model with the initial step of applying problems in integrating and collecting new knowledge based on real activities and experiences.

The development of pop-up book media based on project-based learning on mathematical content material on flat shapes in class II elementary schools is supported by previous research. Research conducted by Fitria (2020), regarding the development of a pop-up book on flat building materials. In general, the product produced in this research only focuses on delivering material by reading and observing pop-up books. Apart from that, Yasinta (2019) regarding the development of pop-up book media based on project-based learning to foster creative thinking skills. The resulting research product focuses on science content at the junior high school level. The research conducted by Sejati (2021) regarding pop-up books based on QR code building materials. The focus of this research is to produce products that aim to foster the character of curiosity in students so that they get appropriate and precise answers regarding what is needed.

The results of the study from relevant previous research, there are differences in the research carried out so that innovation was found in research on the development of pop-up book learning media based on project-based learning on flat building materials in class II elementary schools. This media product development research combines the project-based learning model in it. In its use, students do not just observe and read the material but also produce projects in each material. The flat shape material is divided into three different projects in each material, namely triangle material with a flat shape frame project, rectangular material with a rectangular frame project, and circle material with a special project for making a flat shape combination model. This development research also contains mathematical material about flat shapes at the class II level in elementary schools.

Based on the explanation above, the objective underlying this research and development is to produce valid, practical, and interesting media products. Through this research, it is hoped that it can make theoretical and practical contributions. Theoretically, it is hoped that it can contribute to the development of knowledge and learning practices, especially in increasing the use of learning media in elementary schools. Practically, it is hoped that it will provide benefits to students, teachers, schools, and researchers.

METHODS

This research is a type of research and development. According to Hamzah (2019), this research is useful in developing and validating products. Media development uses the stages of the ADDIE model, namely Analysis, Design, Development,

Implementation, and Evaluation (Sugiyono, 2022). Tegeh et al., (2014) stated that the ADDIE model stages provide opportunities for evaluation at each stage to minimize errors at the end of the model stage activities.

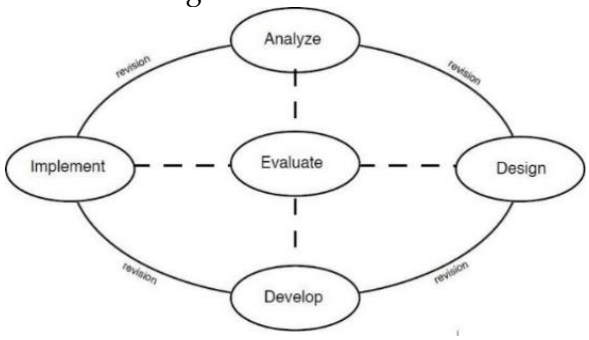


Figure 1. Stages of the ADDIE Model
Source: The ADDIE Approach (Branch, 2009)

The data subjects in this research were 2 material experts, 2 media experts, 1 teacher, 5 students in class II A, and 21 students in class II B at SDN Mergosono 1 Malang. The data collection techniques in this research are through observation, interviews, questionnaires, and documentation. The observation technique in this research is to find out information about students' learning conditions which is carried out through the process of observation and memory. The interview in this research aims to obtain information related to research through the homeroom teacher at SDN Mergosono 1 Malang. The questionnaire aims to obtain information that will be used for product development. The questionnaires used in this research were a needs analysis questionnaire, a validation test questionnaire for material experts, media, and teachers, as well as a practicality and attractiveness test questionnaire. And the documentation technique in this research is a complement to activity data in the form of photos.

The types of data used in this development research are quantitative and qualitative. Quantitative data was obtained through the results of a needs analysis questionnaire, validity tests by material experts, media experts, and teachers, and data obtained from practicality and attractiveness test questionnaires filled out by students. Meanwhile, qualitative data was obtained through appropriate suggestions and input from material experts, media experts, teachers, and students. The quantitative analysis of the data from the needs analysis questionnaire uses the Guttman scale. The Guttman scale is a "yes-no" or "agree-no" measurement scale. The Guttman scale is then used to calculate the percentage of needs analysis data that is processed using the formula (1):

$$P = \frac{f}{n} x\ 100\% \quad (1)$$

Information:
P = Percentage score
f = Frequency of answers
n = Total number of answers
100% = Constant

Next, the results of the needs analysis are converted into percentages, then the results are categorized in the table 1.

Table 1. Category Percentage

Percentage	Category
0 – 1%	There isn't any
2% - 25%	Fraction
26% - 49%	Less than half
50%	Half of it
51% - 75%	More than half
76% - 99%	Most of the
100%	The whole thing

Source : Munggaran (2012)

Furthermore, the results of the data from filling out the questionnaire in the validation analysis of material experts, media experts, and users were analyzed using a Likert scale (Table 2).

Table 2. Likert Scale Score

Category	Score
Very good	4
Good	3
Poor	2
Very poor	1

Source: (Sugiyono, 2022)

The scores obtained from the questionnaire are then processed using the validity criteria value formula as in Sugiyono (2022) as Table 3.

Table 3. Criteria Product Validity Category

Achievement Level	Category	Description
81,00 – 100,00	Very valid	Can be used without revision
61.00 – 80.00	Fairly valid	Can be used with minor revisions
41.00 – 60.00	Valid	It is recommended not to use it because the revision is too large
21.00 – 40.00	Invalid	Cannot used
00.00 – 20.00	Very invalid	Very not applicable

Source: (Sugiyono, 2022)

The results of the needs analysis questionnaire and student response questionnaire were also analyzed using the Guttman scale. The Guttman scale is a form of a "yes-no" or "agree-no" measurement scale. Users of this scale aim to obtain a firm answer or the level of attractiveness of the product being developed. The Guttman scale is then used to calculate the attractiveness value of the processed product using the formula (2).

$$P = \sum \frac{x}{n} \; x \; 100\% \qquad (2)$$

Information:
P = Percentage of scores
∑x = Number of scores obtained
N = Maximum number of scores
In addition, the results obtained from the percentage of scores from the student response questionnaire are interpreted using the criteria presented in the Table 4.

Table 4. Criteria for Practicality and Attractiveness Category

Achievement Level	Category	Description
81,00 – 100,00	Very practical and very interesting	Can be used without revision
61,00 – 80,00	Quite practical and interesting	Can be used, but needs minor revisions
41,00 – 60,00	Less practical and less attractive	Can be used, but needs major revision
21,00 – 40,00	Not practical and not interesting	Cannot be used
00,00 – 20.00	Very impractical and very unattractive	Very unusable

Source: (Sugiyono, 2022)

Qualitative analysis in this research was carried out to analyze the results of interviews, criticism, and suggestions from teachers and experts descriptively. Analysis of interview results is used to obtain needs analysis and product development information. Analysis of suggestions and input by experts and users was carried out to revise the pop-up book.

RESULT AND DISCUSSION

Analysis

The analysis stage is carried out through several stages including analysis of student needs and curriculum analysis. Needs analysis is carried out through observation, interviews, and filling out a needs analysis questionnaire. Based on the results of interviews and observations, information was obtained that due to limited energy and time teachers used the learning media, they tended to use blackboards and textbooks. The presentation of plane material in textbooks is still limited and less practical and interesting for students. Apart from that, learning tends to use lectures, questions and answers, and assignments so that learning still seems teacher-centered and does not have an enthusiastic impact on learning activities. This has an impact on understanding the material related to flat shapes, namely that students find it difficult to determine and differentiate the names of flat shapes and their characteristics such as vertices, sides, and angles. Apart from that, it is strengthened

by the results of needs analysis through filling out questionnaires. This needs analysis questionnaire was completed by 5 class II A students and 5 class II B students at SDN Mergosono 1 Malang City on June 10, 2023. The results of filling out the questionnaire are presented in the Table 5.

Table 5. Results of the Needs Analysis Questionnaire

No	Indicator	Question number	Total score of "yes" answers	Percentage	Average percentage	Categories of needs analysis results
1.	Difficulty in learning mathematics	1,2,3	24	80%		
2.	Availability of mathematics learning media	4,5	14	70%		
3.	Need for mathematics learning media	6	9	90%	83,75%	Most require
4.	The desire for mathematics learning media	7,8	19	95%		

Category percentage analysis of student needs in the questionnaire results has the average percentage is 83.75%, which shows that the level of student needs is included in the mostly needy category. The results of the needs analysis indicate that students need learning media to help the process of learning shape material. It is hoped that the learning media can be packaged in a practical, interesting, and complete manner.

Next, the curriculum analysis stage involves analyzing the curriculum, core competencies, and basic competencies in learning in class II at SDN Mergosono 1, Malang City. The curriculum for learning uses the 2013 curriculum. Meanwhile, the basic competencies in learning mathematics regarding flat shapes in schools are based on Permendikbud, (2018), namely using KD 3.3 Explaining flat shapes and spatial shapes based on their characteristics. 4.3 Classify flat shapes and space shapes based on their characteristics. Then, basic competencies are determined that are appropriate to the material and look for references in books, journals, and other related sources.

Design

The product design stage consists of three stages, namely product design, product manufacture, and preparation of validation instruments. The initial step in designing this media product is to adapt the basic competency analysis that has been determined, and then indicators and learning objectives are developed. Referring to KI and KD in the Minister of Education and Culture Regulation, this media product contains material on flat shapes in class II elementary school with sub-topics on various flat shapes, their characteristics, along examples. This plane material includes triangles (isosceles triangles, equilateral triangles, arbitrary triangles), quadrilaterals (squares, rectangles, parallelograms, trapezoids, kites, rhombuses), and circles.

The presentation and preparation of this material are also adapted to the syntax of the project-based learning model in product development. The model steps used are determining the underlying questions, designing product planning, scheduling, monitoring students, testing results, and evaluating (Widiarso, 2016). Next, design the product by determining the contents of the pop-up book and designing the cover and content template. After designing the contents of the product, proceed with creating the product through several steps, starting from designing the product with the Canva application. Then the product design is printed on A4+ size art paper. The media product being developed is made using the v-fold twist technique. The v-fold technique is a technique that is shaped similarly to the letter V attached to the surface of the paper so that the pop-up stands upright when opened fully 180 degrees (Birmingham, 2006). Meanwhile, the twist technique is a folding technique that, when opened, will emerge to convey a message or image (Hamzah & Baalwi, 2022).

Figure 2. Pop-Up Book Products Based on Project-Based Learning.

The final step is preparing a validation instrument by compiling an assessment instrument for validity, practicality, and attractiveness according to the specified criteria. Validation assessment to assess the validity of products that have been developed. This validity is assessed by experts and teachers, while the practicality and attractiveness are assessed by students, it can be seen on Figure 2.

Development

The development stage carries out three activities, including the development and validation of research instruments, as well as product development and validation. In the first step in the development and validation stage of research instruments, the previously prepared instruments are first consulted with the supervising lecturer to ensure that the aspects prepared meet the aspects. The instruments used

are the material expert validation questionnaire, media expert validation questionnaire, user validation questionnaire, and student response questionnaire.
The next step, the product instrument development and validation stages are carried out. At this stage, the media product is validated by material experts, media experts, and users. Next, it was analyzed quantitatively and qualitatively from the results of filling out the validation questionnaire. The results of the validation can be presented in the Table 6.

Table 6. Validation results

No.	Validator	Validation Values	Category
1.	Material Expert	91,66%	Very valid
2.	Media Expert	98,86%	Very valid
3.	Teacher	98,33%	Very valid

Based on the results of material validation carried out on June 7, 2023, the percentage of material experts was found to be 91, 66%, which means the product developed is very valid so it can be used without any revisions. This value was obtained after revisions were made based on suggestions and comments from the validator. Suggestions and comments are provided to improve the product on the media being developed. First, when learning, explore students' knowledge based on experience in the field. According to Dale, learning is based on real experience which is designed in such a way by the teacher, that around 90% of the material will be quickly understood and retained in the long term (Hadini, 2022). Second, the placement of indicators, learning objectives, and distribution of material coverage are still inaccurate. This is following the criteria for selecting appropriate learning media, some conditions must be met, namely learning objectives, student needs, and student learning conditions (Kristanto, 2016).
The results obtained from the validation of material on pop-up book learning media products based on project-based learning are in line with and comparable to research conducted by Munadzifah et al., (2021) in developing pop-up book media on flat material which obtained a validation value of 96.2% which means it is valid so that the media is suitable for use in learning. Another research was conducted by Satriawati et al., (2023) who said that learning media combined with a project-based learning approach was valid so that it could be used in learning with validation of 96%.
In terms of content, this media material received an assessment of 95.83% in the very good category. This indicates that the media developed has been prepared according to the criteria for good learning media. By paying attention to the alignment of learning objectives and the suitability of the material regarding the scope of discussion (Kristanto, 2016). So, the media developed indicates that it has fulfilled aspects of the material content.
In the aspect of presenting media material, it received an average rating of 81.25% in the very good category. This indicates that the presentation of the material is prepared following the criteria for presenting the material. Aspects of material presentation include consistency in organizing the material, ease of understanding

the flow, attracting students' attention, student activity, integration of material and training activities (Hernani, 2018). So, the media developed indicates that it meets the appropriateness of presenting the material.

In the linguistic presentation, the media received an assessment of 93.75% in the very good category. This indicates that the media developed meets language appropriateness. Aspects include linguistic appropriateness which consists of the appropriateness of students' level of development, order and unity in the preparation of ideas, and communicativeness (Rismawati et al., 2015). So, the media developed indicates that it meets the appropriateness of language presentation.

In the aspect of loading project-based learning, validation was obtained at 93.75%. This indicates that the learning media developed is following the content of project-based learning. In line with and comparable to (Rahardjo, 2012) learning by combining project-based learning uses problems as the first step to building new knowledge based on real experiences and activities. Apart from that, it can help students learn actively and interestingly, as well as be skilled in problem-solving (Rahmawati et al., 2023).

Furthermore, media validation was carried out on June 11 2023 by media experts and obtained a percentage of 98.86%, which means the product developed is very valid so it can be used without any revisions. This value was obtained after revisions were made based on suggestions and comments from the validator. Suggestions and comments are provided to improve the product on the media being developed. First, carefully review the writing so that there are no editorial errors. Following the benefits of the media, the media is expected to be in harmony with students' perceptions so that students can have the same knowledge of the information provided (Sanjaya, 2012). Second, the campus logo needs to be placed in the top corner of the page cover and the developer's identity is placed on the main cover, while information on the identity of the supervisor can be placed on the second cover. In line with and comparable to Government Regulation No.19 of 2005 (Ghasya et al., 2019) concerning the feasibility of writing a book, it consists of four aspects that must be fulfilled, one of which is the graphic aspect of the cover design regarding the appearance of images, letters, colors, and layout must be in harmony. The results of obtaining material validation on pop-up book learning media products based on project-based learning, it is also in line and comparable with research conducted by Febriani (2022) which states that if pop-up book media obtains validation of 87.49%, the media is valid so it is suitable for use. in learning activities. Furthermore, the media presentation aspect of the pop-up book received an assessment of 98%. These results indicate that the media has been prepared to meet the criteria for good learning media. Based on BSNP (2014), one of the criteria in preparing learning media is that it has appropriate components for media presentation. So the media developed indicates that it meets the appropriateness of media presentation.

Furthermore, validation by teachers carried out on June 19, 2023, media products obtained a validity of 98.33%, which means the product developed is very valid so it can be used without any revisions. This value was obtained after revisions were made based on suggestions and comments from the validator. The suggestions and

comments given to improve the product on the media being developed are that there are pop-up book pages that need to be improved because some of these pages are difficult to fold back when the page is closed. In line with Government Regulation No.19 of 2005 (Ghasya et al., 2019) concerning the feasibility of writing books, one of which is the appropriateness of presentation required in terms of the ability to provide ease of use.

The results obtained from the validation of material on pop-up book learning media products based on project-based learning are in line with and comparable to Baiduri et al., (2019) who developed pop-up book media with flat building material which obtained a validation value of 88.16%, which means it is valid and suitable for use. in learning.

Implementation

The implementation stages of the small-scale trial were carried out on small groups of class II A at SDN Mergosono 1 Malang City with a sample size of 5 students and had different levels of achievement, namely low, medium, and high. Meanwhile, large-scale trials were carried out in class II B at SDN Mergosono 1, Malang City with a sample size of 28 students. Data from the results of this trial are used to assess the practicality and attractiveness of media products. The results of this trial are in the form of score percentage data from filling out student response questionnaires and in the form of suggestions and input from students regarding the media being developed. The following are the results of the trials obtained as Table 7.

Table 7. Product Trial Results

No.	Trial Phase	Value	Category
1.	Small Scale Trial	95,55%	Very practical and interesting
2.	Large Scale Trial	95,76%	Very practical and interesting

The small-scale trial was carried out on June 20 2023 with a sample size of 5 students in class II A at SDN Mergosono 1 Malang City. In small-scale trials, the percentage was found to be 95.55%, which means the product developed is very practical and interesting to use without any revisions. The responses given by students to the media developed during product testing through a questionnaire of comments and suggestions were, 1) the appearance of the book is good and pleasant, 2) there are pop-up book pages that are difficult to fold or close, 3) there are project creation activities which is exciting. In the trial, students also looked enthusiastic and interested in opening the pop-up book pages. This learning media provides a learning experience for students because it displays attractive visualizations and increases student involvement in using the media, because not only do teachers use it in delivering the material but students are also actively involved in using the learning media (Fajriah et al., 2022). Additionally, for reluctant readers, children with learning disabilities, and English as a Second Language (ESL) students, this medium assists in understanding meaning through attractive visual representations and promotes the desire and drive to read independently with the ability to do things skillfully (Bluemel et al., 2012). Then there is a suggestion that

there are parts of the pop-up book page that are difficult to fold and close. The use of media is related to ease of use in accessing and clear instructions, this will make it easier for students to use the media so that the media developed can be used very practically (Milala et al., 2022). In addition, in working on each project students are actively involved in working in groups to complete it together. Project-based learning helps in forming concepts and students' creative thinking skills collaboratively to be able to solve problems by creating products or ideas and discovering new things (Wulandari et al., 2019). However, in its implementation, there were problems with several pop-up book pages which were difficult to fold and close again.

Figure 3. Small Scale Trial.

Based on Figure 3, a large-scale trial was implemented in class II B at SDN Mergosono 1 Malang City on 21 - 23 June 2023 with a sample size of 21 students. Based on the table on the quantitative data results in this trial, the results were 95.75%, which means the product developed is very practical and interesting to use without any revisions. The responses given by all students to the media developed as a result of product trials through a questionnaire of comments and suggestions were, 1) the appearance is attractive, funny, enjoyable, 2) the material is easy to understand, and 3) easy to use. In carrying out product trials, students also showed enthusiasm, enthusiasm, and interest in using pop-up books. Febriani (2022) states that the advantage of pop-up books is that they have a different appearance from other books because the three-dimensional visualization created in the image presentation is attractive so that when the image is opened or a part is shifted the image can move and make the book more meaningful. Apart from that, it was found that students easily used and understood this media during the trial. Because this media makes it easy to receive study material, makes it easy to use, and can accommodate a lot of material without needing a lot of space (Kusno & Indah, 2018).

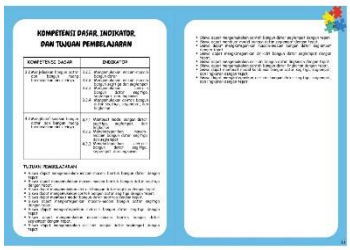
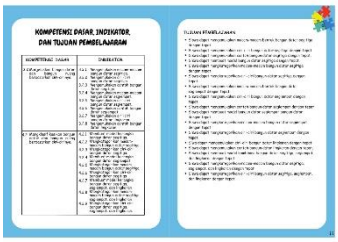
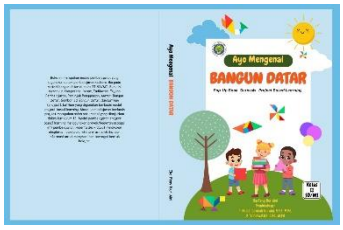
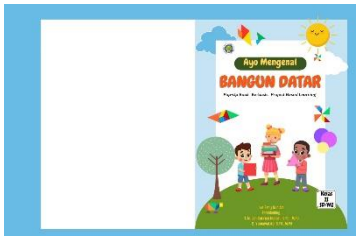
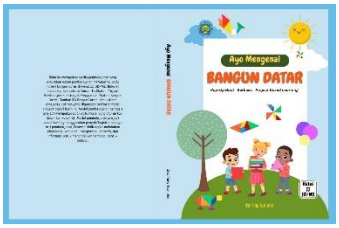
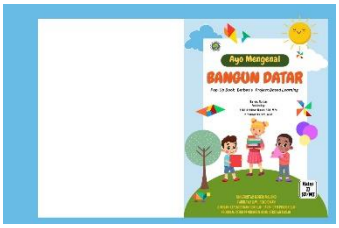
Figure 4. Large Scale Implemantation.

Trial In the student response questionnaire used as a research and development instrument, the practical aspect focuses on several indicators as follows, namely (1) Ease of understanding the contents of the Pop Up Book, (2) Ease of understanding the Pop Up Book material, (3) Ease of use. Meanwhile, the attractiveness aspect focuses on several indicators, namely (1) Pop Up Book Appearance, (2) Colors, Images, and Effects on Pop Up Books, and (3) Pop-Up Books attract students' interest in learning mathematics. There is also a readability aspect focusing on indicators (1) readability and (2) language comprehension. In this way, the media developed can be used practically and interestingly, can be seen on Figure 4.

Evaluation

The final stage of this development research is the evaluation stage. In this stage, the product is reviewed again to indicate errors that need to be corrected in the previous stage. There are suggestions given by experts to improve products developed at the development stage (Table 8).

Table 8. Product Revision

No.	Before Revision	Suggestions and Input	After Revision
1.	In the design of product trials, students were given less stimulation related to the students' real experiences.	When learning, explore students' knowledge based on experience in the field.	During product trials, students are given stimulation related to real experiences that students have regarding flat shapes.
2.		Incompatibility of KD, indicators, and learning objectives used.	
3.		Carefully review your writing to avoid editorial errors.	
4.	 	Incorrect logo placement, supervisor identity, and addition of campus affiliation.	 
5.	On the triangular pop-up book page, the page is difficult to see.	Some pages are difficult to fold.	The pop-up book pages are fixed and can be folded back easily

Learning using pop-up book media based on project-based learning about flat shapes, apart from showing visualization of flat shapes in three dimensions, also

invites students to be actively involved in a series of producing flat shapes projects. Students not only read and observe but also create ideas and discover new knowledge about flat shapes through a series of project-based learning. Students who initially did not have enthusiasm and motivation to learn mathematics became enthusiastic and enthusiastic. Students are also more interested in the interesting visualizations and surprises provided on each page of the pop-up book. In line with and comparable to Fitria's (2020) research on the development of pop-up books, the material on flat shapes received a good response from students. Other research by Munadzifah et al., (2021) on pop-up books on flat building materials and Oktaviana et al., 2020) on CTL-based pop-up books.

Based on the studies that have been described, pop-up books based on project-based learning on flat building materials in class II elementary schools have advantages and disadvantages. The advantages it has are, 1) it has a practical appearance that can cover a lot of material without requiring a large space. 2) has an attractive appearance with pop-up presentations and colors that attract students, and 3) this media is combined with flat building project activities in each part of the material. Apart from having advantages, the disadvantages are, 1) printing costs are expensive, 2) it has only been developed to introduce material for flat shapes.

CONCLUSION

The research and development of pop-up books based on project-based learning on flat building material for class II elementary schools has been validated by 2 material experts and 2 media experts and teachers. This media has also been tested on a small scale with 5 class II A students and a large scale with 21 class II B students at SDN Mergosono 1 Malang City to determine the level of practicality and attractiveness of the media being developed. The development of this media follows research and development objectives which produce media with valid, practical, and interesting qualifications so that it is suitable for use in learning. Based on the results of validation by material experts, the percentage was found to be 91.66% if it was categorized as very valid so it was suitable for use without any revisions. Media experts found a percentage of 98.86% if it was categorized as very valid and suitable for use so it was suitable for use after revision. The teacher obtained a percentage of 98.33 if it was categorized as very valid so it was suitable for use after revision. Based on the results of student responses, a percentage of 96.28% was obtained if it was categorized as practical and interesting so it was suitable for use without revision.

The suggestion in implementing this development and research is that teachers must have a strategy to organize students when creating projects related to flat-frame projects and flat-built combination models so that students can be more conducive and effective, especially when this learning activity is carried out in groups. Apart from that, teachers must provide emphasis and understanding regarding plane frame projects and combinations of plane models. Before the learning process, students read material about flat shapes so that when the project is made, children already understand the meaning of flat shapes and the components that are prepared. The teacher also provides assistance when the

project is being made so that the construction of the flat frame project and the combination model of the flat shape can be according to the size.

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