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# DEVELOPMENT OF MATHEMATICS PICTURE STORY BOOK ON FRACTION MATERIAL FOR GRADE IV ELEMENTARY SCHOOL STUDENTS

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**Abstract**

Mathematics picture story books are learning media that can help students learn mathematics content both independently or through active interaction in the classroom. This study aims to develop learning media for mathematics picture story books on Fraction material and determine its feasibility for grade IV elementary school students. This research is an R&D research with ADDIE model which consists of stages 1) analyze, 2) design, 3) development, 4) implementation, and 5) evaluate. The subjects in this study were 40 fourth grade students at SD Negeri 318 Maluku Tengah, SD Negeri 254 Maluku Tengah and SD Kristen Tiouw. Before being tested, this book was first validated by material experts and media experts. This research produces a product in the form of illustrated storybooks as a medium for learning mathematics on Fraction material. Based on the assessment of material experts get a validity percentage of 89% category "Very Valid" while the assessment of media expert validators get a validity percentage of 92% category "Very Valid" to be used in grade IV elementary students. Based on the response of students, it gives a practicality value of 93.86% in the "Very Practical" category for picture storybook media products. Based on the test results, the average student score is 71.77 and it is above the Minimum Completeness Criteria, meaning that the picture story book is considered "very effective" to be used publicly. Because it meets all the criteria, the picture story book is said to be "very feasible" to use. This picture story book can help students improve learning outcomes and foster student curiosity so as to increase understanding and reasoning about mathematics, especially fraction material.

*Keywords*: fractions, learning media, media development, picture story book

## 1. Introduction

The rapid development of technology and information requires humans as IT users to be able to keep up with its development in obtaining the latest information. Information can be obtained through various ways and media such as print, electronic and digital media. Similarly, in the world of education, information related to lessons should be given or obtained through various ways and media so that the information is more easily absorbed and learning outcomes can be achieved.

Various models, strategies, techniques and learning media can be used by teachers to improve student learning outcomes, both cognitive, affective and psychomotor domains. In the learning process, communication and interaction between teachers and students require a learning medium. Especially in learning mathematics which is abstract and requires reasoning. The use of learning media as a teaching aid can provide a more concrete understanding to students, by means of understanding in the form of combining the various senses possessed by students, students can absorb more material conveyed through the media (Nugraheni, 2017).

Learning media can be described as a tool that contains information or instructional messages and can be used in the learning process. Gagne (in Mashuri, et al: 2019) defines learning media as various types of components in the student environment that can stimulate students to think. While Briggs (in Sadiman, et al: 2008) states that media is any physical tool that can present messages and stimulate students to learn. In line with Briggs, (in Widodo & Wahyudin, 2018) stated that learning media is a tool that teachers can use to convey messages to students so that learning objectives can be achieved.

The purpose of using media is to facilitate the teacher in conveying a material concept. Learning media is very important to help learners acquire new concepts, skills and competencies. (Hasan, 2021). Media can facilitate teachers in the learning process and students will be more interested in participating in the learning process (Apriliani & Radia, 2020). The impact of using media in communication and learning includes: the learning process becomes more interesting, interactive, the length of time needed to learn can be shortened, the quality of learning outcomes can be improved, and creates a positive attitude of students towards what is learned (Hasan, 2021). Teacher-centered learning that only uses the teacher's speaking ability in explaining, without being accompanied by learning media, can cause laziness and boredom in participating in learning (Apriliani & Radia, 2020).

Picture story book can be used as media in learning mathematics. This is because the use of mathematics picture story book is very simple and practical, it does not need to be supported by facilities and infrastructure. Math picture story book can also be used independently by students and can even be used anywhere including at home. In addition, mathematical picture story book can arouse students' enthusiasm, interest and attention to learning mathematics (Fahyuni & Bandono, 2015) and improve student learning achievement (Sari & Yustiana, 2021).

Low student interest in reading and student interest in learning math is a problem that occurs today, especially for students in remote areas. The lack of reading materials is also one of the factors that influence this. Initial observations in three schools in Saparua sub-district, Central Maluku district, showed that storybooks are not readily available in schools, students only use textbooks as literacy and numeracy materials. Students also rarely visit the school library.

In developing mathematical picture story book on fraction materials for fourth grade students, it is important to consider the developmental nature of understanding fractions. According to the Common Core State Standards, students should start learning fractions as early as grade one, with a major emphasis on fractions in grade 3, including the use of fraction symbols, exploration of unit fractions, and comparing fractions. Effective use of visuals in fraction tasks is important, and there is a lot of evidence to support this (Cramer, et al, 2002). It was also noted that textbooks often lack manipulatives and a variety of models for fractions, which can hinder student understanding.

In addition, Stohlmann, Yang, Huang & Olson's (2020) research shows that teachers make limited use of pictorial representations in teaching division of fractions and have difficulty in developing correct real-world story problems for division of fractions. Therefore, it is important to focus on developing real-world problems and appropriate pictorial representations to improve students' conceptual content knowledge of division of fractions.

Research on the development of picture story media has been conducted by Mawanto, et al in 2020. He developed picture storybooks, especially fraction material for Grade II elementary school students. The fraction concepts developed in the book are one-half, one-third, and one-fourth.

The results of his research show that pictoral story media can be used as an alternative learning medium to train students' creative thinking skills on fraction materials (Mawanto et al., 2020).

In summary, the development of mathematics picture story book on fraction materials for grade IV elementary school students should consider the developmental nature of understanding fractions, the effective use of visuals, the creation of real-world problems and appropriate pictorial representations, and the systematic introduction of fraction types to prevent overgeneralization. In addition, the use of strong visuals such as number lines should be considered to improve students' understanding of fractions (Fuchs, et al, 2021).

The existence of math picture story book is expected to be a solution to the problem. Given that the main purpose of making this picture story book product is to overcome the lack of use of math reading materials in schools, the existence of this product is expected to be a solution in the selection of effective math learning media, considering that picture story book can increase students' interest in reading, especially in math lessons (Kusumaningtyas & Listianingsih, 2017).

Based on this background, researchers developed picture story book in learning mathematics. Mathematics picture story book can be a teaching material in mathematics learning, especially in elementary schools. Thus, learning outcomes can be achieved, as well as learning outcomes and student motivation can increase.

## 2. Method

This research is a development research (R & D) with ADDIE model, which consists of stages 1) analyze, 2) design, 3) development, 4) implementation, and 5) evaluate. The initial stage of the research was a needs survey and literature review related to the scope of a learning media product and the flexibility of product use, content analysis of the mathematics curriculum, academic data analysis in the form of student learning outcomes, teacher abilities in the learning process, media and evaluation of mathematics learning. Then a product design was made as a reference for developing learning media in the form of illustrated storybooks. Draft (prototype) through validation test, small scale trial and effectiveness test. The draft was validated by two experts, namely material experts and media experts.

The product was tested in three schools in Saparua District, Central Maluku Regency, namely SD Negeri 318 Central Maluku, SD Negeri 254 Central Maluku and SD Kristen Tiouw. The test subject were all fourth grade students in the school totaling 40 students, with details shown in Table 1 below.

**Table 1.** Product Test Subject

| School | Number of students |
|---|---|
| SD Negeri 318 Central Maluku | 12 |
| SD Negeri 254 Central Maluku | 8 |
| SD Kristen Tiouw | 20 |

The instruments used are observation guidelines, expert validation sheets and student responses to products, and tests. The observation guideline is used as an initial needs analysis material. The indicators seen are 1) availability of picture story books for Grade IV students, 2) the use of picture story books in learning math for Grade IV students, and 3) students participation in learning math. Researchers also conducted unstructured interviews with teacher to clarify the result of the initial needs observation. Interview questions were developed according to the teacher's answers and the results of the researcher's observations. Test questions as many as 5 questions and are arranged in the form of short fill, match and essay.

Data analysis in this study used a combination of qualitative and quantitative analysis. Data in the development of mathematics picture story book in the form of data from design validation results, learning outcomes tests and student responses to media and field notes during the trial. The data were analyzed by stages (1) data reduction, (2) data presentation, and (3) data analysis. Data analysis focused on 3 aspects, which were related to the quality of the prototype. By referring to the criteria (Plomp & Nieveen, 2014), The quality of the prototype is determined by the aspects of validity, practicality, and effectiveness.

The validity indicators are adapted from the Children's Storybook Writing Guide (Trimansyah, 2020). Table 2 shows the indicators and statements in the media expert and material expert validation questionnaires.

**Table 2.** Expert Validation Questionnaire

| No. | Statement |
|---|---|
| **Indicator: Product Design** | |
| 1 | Storybooks use standardized Indonesian language in accordance with the Big Indonesian Dictionary |
| 2 | Storybooks use appropriate vocabulary in accordance with pictorial language for ages 8-12 years |
| 3 | Storybooks use clear and concise language |
| 4 | The storybook has an attractive cover by paying attention to the writing of the title, selection of colors and images |
| 5 | The storybook uses a type of typography that is easy to read and simple for writing titles so that it is attractive and easy to read by children aged 8-12 years old. |
| 6 | The conversation and writing of the story content use typography that is easy to read, not angled and has characters that have a funny and simple impression with a font size of 12pt so that it is clear and easy to read by children aged 8-12 years. |
| 7 | Storybooks use artpaper that is suitable for printing color pictures |
| 8 | Storybooks use a 1.5 pt line spacing |
| 9 | Storybooks using UNESCO paper size (15.5 × 23 cm) |
| 10 | Storybooks use image layouts that are adjusted to the paper size |
| 11 | Storybooks contain pictures that support the content of the story |
| 12 | Storybook using colorful pictures |
| **Indicator: Story Content** | |
| 13 | The content of the story is conveyed through concrete learning media in accordance with the development of grade IV elementary school students. |
| 14 | Story content facilitates students to learn independently |
| 15 | The content of the story directs students to understand the mathematical concept of fractions |
| 16 | The content of the story is conveyed in short and clear language |
| 17 | The content of the story helps students obtain learning results above the Minimum Completion Criteria |
| 18 | The content of the story fosters students' curiosity so that it can increase understanding of mathematics |
| 19 | Story content increases students' motivation in learning math |
| 20 | The content of the story provides benefits for students in everyday life |

The validation results were calculated using the average formula:

$$X = \frac{f}{N} \times 100\%$$

Description:
X = Final score
$f$ = gain score
$N$ = total score

Categories of validity, effectiveness and practicality of learning media for mathematics picture storybooks developed using the Likert scale category formula as shown in Table 3 as follows.

**Table 3.** Picture storybook eligibility category

| Eligibility Criteria | Final score |
|---|---|
| Very good | $80\% \leq X \leq 100\%$ |
| Good | $60\% \leq X < 80\%$ |
| Good enough | $40\% \leq X < 60\%$ |
| Less | $20\% \leq X < 40\%$ |
| Very Less | $0\% \leq X < 20\%$ |

Picture story book is said to be valid, effective and practical if it reach at least good criteria

## 3. Results and Discussion

### 3.1. Results

### Analysis stage

This stage begins with a needs survey and literature review related to the scope of a learning media product and the flexibility of using picture story products in learning mathematics. Needs analysis was obtained from interviews, field observations, and distributing questionnaires. Interviews were conducted with fourth grade teachers of SD N 318 Central Maluku, SD Negeri 254 Central Maluku and SD Kristen Tiouw. The interviews were related to the availability of reading resources, math learning outcomes and student learning motivation.

Through interviews with teachers, researchers can provide an opinion that teachers understand the role of picture storybooks for students which can help students read and make it easier for students to understand the mathematical concepts contained in the storybook. However, the lack of availability of picture storybooks in the school library has reduced students' interest in reading. The availability of picture storybooks is also rarely used in classroom learning, especially math learning. Teachers more often use textbooks as teaching materials and literacy numeracy materials.

After the researcher conducted a needs analysis, the researcher decided to make an illustrated storybook by paying attention to typography that is suitable for children aged 8-12 years, color and layout in book design. Furthermore, the researcher analyzed the contents of the applicable mathematics curriculum. From here, adjustments can be made to the competency standards and basic competencies, developing indicators, subject matter and evaluations that are suitable for students. Based on the results of interviews with classroom teachers and the results of field observations, Fraction material was chosen as the topic in writing this illustrated storybook.

**Design stage**

At this stage researchers design products based on planning with the following steps.

(1) Book Concept

Researchers create picture storybooks that have the concept of one of the math materials, namely fractions. Presents a cake made by Mom and then distributed to each child. This illustrated storybook is intended for grade IV elementary school students in the 2013 Curriculum with Theme 2 Always Save Energy Subtheme 2 Benefits of Energy.

(2) Book Content

The content in this picture storybook is about fraction material, but it is packaged in a story with the title "Math is Fun: The Mystery of the Lost Cake". The storyline is written by the researcher herself, which is about Anya and her friends who are given a cake by Anya's mother, it appears that there are mathematical activities that occur in the story, so that students can understand the concept of fractions and reason and solve everyday problems and contextual problems presented in the book.

(3) Design

The researcher made a design for the contents of the book from the results of the story that was compiled together. Researchers digitally sketched images using the sketchcbook application on tablets and compiled them into books using the canva edu application.

(4) Figures

The characters who participate in the book "Math is Fun: The Mystery of the Missing Cake" are the main characters: Anya, Anya's mom, and her friends Cira, Nisa, Andre, Hani, and Sean.

(5) Storybook format

In this picture storybook, the typography used is a type of typography that is easy to read and has characters that have a funny and simple impression, such as Argandir Tight, Angelina, Glacial Indifference and League Spartan. The font size used for the title is 12 pt and 41.7pt, while for the content of the story, the font size is 12pt. The size of the storybook is UNESCO paper (15.5 × 23 cm) and printed on ivory paper for the book cover and art paper for the book content.

The picture story book "Math is Fun: The Mystery of the Missing Cake" consists of 52 alternating pages. The first page is the front cover of the book, page 2 is intentionally left blank for publication purposes, page 3 the purpose of making the book, page 4 the identity of the book owner, page 5 teaching materials, page 6 the author's name, page 7 introduction, the contents of the story starting from page 8-50, page 51 the author's biography, page 52 the back cover. Here is a picture of the initial book draft.

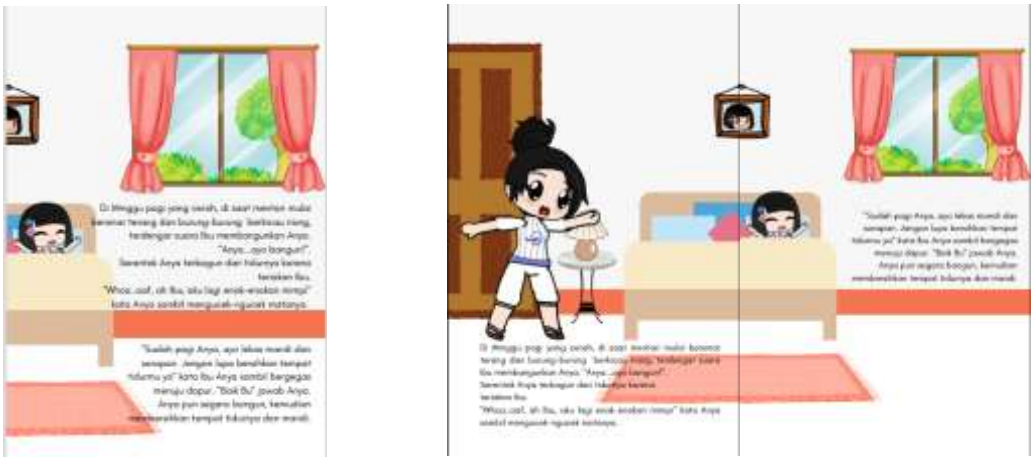

(a) (b) (c)

**Figure 1.** Excerpts of the initial draft (a) front cover, (b) back cover, (c) contents of the book containing fractions

**Development stage**

At this stage, validation of picture storybooks is carried out. It was conducted by two experts, namely media experts and material experts. The media expert is Mr. Fentje J. Sapulette, M.Pd. a lecturer who teaches courses in Introduction to Computer Science, Graphic Design, and Web Programming. While the material expert is Prof. Dr. Th. Laurens, M.Pd who is an expert in the field of mathematics education and realistic mathematics (RME).

Based on the validation results with expert lecturers, the picture storybook with the title "Math is Fun: The Mystery of the Lost Cake" already reflects the story of the Mystery of the Lost Cake by incorporating the concept of fractions into it, but there are pages that are too dense sentences so they need to be made in 2 pages. The following picture is an excerpt of the picture storybook before revision and after revision.



(a) (b)

**Figure 2.** Page 10 (a) before revision (b) after revision made into 2 pages

According to media experts, picture storybooks have displayed pages that are sequential and neatly organized. The typeface used is also good, meaning that it is easy and clear to read by students. However, there are pictures that are still poorly placed, backgrounds that are still blank and the wrong expression of one of the characters. The following is a picture of the page in question.

(a) (b)

**Figure 3.** Page 39 (a) before revision (b) after revision to page 40 and 41

The results of media expert and material expert validation of picture story book are presented in Table 4 below.

**Table 4.** Expert validation results

| Indicator | Media expert (%) | Material expert (%) |
|---|---|---|
| Product Design | 93 | 90 |
| Story Content | 91 | 88 |
| **Average** | **90.5** | |

Based on the results of the expert lecturer validation, the average score is 90.5 with the category "very valid" and suitable for use with revisions according to suggestions.

**Implementation stage**

The author conducted trials in two schools, namely SD N 318 Maluku Tengah, SD Negeri 254 Maluku Tengah and SD Kristen Tiouw to 40 students. The author distributed books to students during math lessons in class. Students are very interested in picture storybooks, as seen from the enthusiasm of students when books are distributed. They immediately read it before the author and teacher gave instructions. The author asks students to read the story and answer questions and work on practice problems in the book. The author also prepared an observation sheet to observe the implementation of the trial.

(a) (b) (c)

**Figure 4.** Field test at (a) SD N 318 Maluku Tengah, (b) SD N 254 Maluku Tengah, (c) SD Kristen Tiouw

The effectiveness obtained from the results of using picture story book in an effort to improve student learning outcomes is known through the post-test. Students were asked to do 5 post-test questions. The test results can be seen in Table 5below.

**Table 5.** Average learning outcome test score

| School Name | Average Value |
|---|---|
| SD N 318 Malteng | 75.38 |
| SD N 254 Malteng | 72.25 |
| SD Kristen Tiouw | 67.60 |
| **Average** | **71.77** |

Based on Table 5, the average score of the 40 students is 71.77 and above the Minimum Completion Criterion of 70. This means that picture storybook can help students improve learning outcomes and also means that the picture story book is effective for audience application.

Furthermore, the author conducted a question and answer session and distributed student response questionnaires. The recapitulation of student response scores to the picture story book is presented in Table 6 below.

**Table 6.** Product trial results

| Indicator | SD N 318 Malteng (%) | SD N 254 Malteng (%) | SD Kristen Tiouw (%) | Average score |
|---|---|---|---|---|
| Product Design | 94.92 | 95.03 | 95.17 | 95.04 |
| Story Content | 92.87 | 92.65 | 92.53 | 92.68 |
| **Final score** | | | | **93.86** |

Based on the responses of students, it gives a practicality value of 93.86% in the "Very Practical" category for picture storybook media products.

**Evaluation stage**

At this stage, checking the suitability of the product produced with the research objectives is carried out. The author revises the draft product according to the suggestions for improving the picture story book. Based on the results of the validation of media experts and material experts, student responses to picture story book and learning outcomes tests, it was found that picture story book met all the eligibility criteria, with the category "very feasible".

### 3.2. Discussion

The mathematics picture story book has been developed using the ADDIE model and through the five stages of analyze, design, development, implementation, and evaluate. Based on the results of the study, this picture storybook is declared feasible because it has met all three eligibility criteria, namely valid, practical and effective.

Picture story book with the title "Math is fun: The Mystery of the Lost Cake" has an appeal to students, this can be seen in terms of design and story content. Picture storybooks use standard Indonesian as the introductory language (prologue), and colloquial language with appropriate vocabulary in accordance with pictorial language for children aged 8-12 years.

Huck, et al (in Nurgiyantoro, 2005) explains that picture books refer to the notion of books that convey messages in two ways, namely through illustrations of images and writing.

Based on the average validation score of media experts who gave a score of 93 and material experts who gave a score of 90 and student responses to product design of 95.04, it means that the design of this picture storybook is considered very good. Illustrated storybooks are designed with High Definition (HD) images, interesting animations, colorful, appropriate typography for children, have a "let's reason" and "let's practice" math section that characterizes this book. While in terms of story content, media experts gave a score of 91 and material experts gave a score of 88 and student responses gave a score of 92.68, meaning that the story content of this book was rated very well. The content of the story is delivered with a realistic approach with situational, mode-of, mode-for, and formal knowledge stages. The delivery of story content through concrete learning media is in accordance with the development of grade IV elementary school students. Concrete media used include cakes, paper and tree branches. The use of concrete objects as media in learning can increase the motivation and learning outcomes of elementary school students (Saputro et al., 2021; Umardiyah, 2020; Noviarni et al., 2020).

The story content in picture storybooks can also facilitate students to learn independently and direct students to understand the concept of mathematics, namely fractions. Students in elementary school generally tend to prefer, prefer to read if the contents of the book have interesting pictures, and prefer to read illustrated storybooks (Suryaningsih & Fatmawati, 2017). Picture storybooks can also be utilized as a support for the main book (Sari & Yustiana 2021; Khairiah et al., 2020). Especially to understand subjects that are considered difficult such as mathematics, it needs to be facilitated with media that attracts students' attention.

Based on the test results, the average student score is 71.77 and is above the Minimum Completeness Criteria of 70. This means that picture story book can help students obtain learning outcomes above the Minimum Completeness Criteria and foster student curiosity so as to increase understanding and reasoning about mathematics. This is reinforced by the results of research (Mawanto et al., 2020) who also examined elementary school students, that picture story book can improve creative thinking skills.

Another advantage of math picture storybooks is that they can develop students' communication skills. With picture storybooks, students are trained to be able to understand the content of the story and retell the story in their own language (Fatimah & Maryani, 2018; Rosyadi, 2020). Other benefits include: increased vocabulary, improved reasoning skills, improved reading culture and strengthened student character.

## 4. Conclusion

The development of picture story book in learning mathematics, especially fraction material, is made with the concept of introducing fractions through real events that are easily imagined by students and concrete objects that can be imitated by students to understand the concept of fractions worth, fraction comparison and fraction order. This book is made with the concept of several characters that can attract students to read and colorful pictures. This book is also equipped with a "let's reason" and let's "practice" section that can be done by students and filled directly in the book as a substitute for student worksheet. In the end, the picture story book with the concept of fractions was declared feasible for public use. By reading and using this picture storybook in learning, students are expected to be able to explain and identify equivalent fractions with pictures and concrete models, simplify fractions, compare and ordering fractions. This book is expected to be a solution in the selection of reading materials for fractions as well as a solution to the lack of availability of literacy numeracy reading materials in schools. This research can be taken into consideration for similar research in larger trial classes and for other mathematics materials.

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