Pop-up book on fractions materials: enhancing on problem-solving skills of grade v

Turini Erawati[1*], Setiyani[2*], Sri Sumarwati[3], Fuad Nasir[4]
[1]Department of English Education, Faculty of Education and Sciences, Universitas Swadaya Gunung Jati, Cirebon, West Java, Indonesia
[2*,3,4]Department of Mathematics Education, Faculty of Education and Sciences, Universitas Swadaya Gunung Jati, Cirebon, West Java, Indonesia
[3]Technical and Vocational Education, University Tun Hussein Onn Malaysia, Johor 86400, Malaysia
[2*]setiyani@ugj.ac.id
[*]Email Correspondence

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Abstract
The aim of this study is to evaluate the feasibility of a pop-up book on the topic of comparing fractions, gauge students' responses to the pop-up book, and analyze the book's effectiveness. We employed the ADDIE model and used an R&D method for this research. Data collection methods included interviews, questionnaires, pre-tests, and post-tests. The results of our study indicate that the feasibility of the pop-up media for comparing fractions, as assessed by material experts, was 82%, media experts 84%, and language experts 80%, thus falling into the category of being suitable for use. The pre-test average score of students was 63.33, while the post-test average score was 69.33. The validation results and student scores demonstrate that the pop-up book has successfully enhanced problem-solving skills in fifth-grade students.
Keywords: development; fractions; problem solving; pop-up

Abstrak
Penelitian yang kami lakukan bertujuan untuk menguji layaknya produk buku pop-up pada materi membandingkan pecahan, mengetahui respon siswa mengenai buku pop - up, dan menganalisis keefektifan buku pop–up. Jenis penelitian yang kami gunakan yaitu model ADDIE dan menggunakan jenis metode R&D. Metode pengumpulan data meliputi wawancara, angket, pretest, dan posttest. Data penelitian yang sudah kami lakukan dapat dijelaskan bahwasanya kelayakan media pop - up materi membandingkan validasi ahli materi mencapai 85%, ahli media 84%, dan ahli bahasa 80%, sehingga masuk kedalam kategori layak digunakan. Adapun hasil nilai pretest siswa sebanyak 950 dan posttest siswa sebanyak 1040, jika di rata - rata kan nilai hasil pretest siswa 63,33 dan rata - rata nilai posttest siswa 69,33. Hasil validasi dan hasil nilai siswa menunjukan bahwa buku pop-up telah berhasil dalam mengembangkan kemampuan siswa kelas V SD dalam memecahkan masalah.
Kata Kunci: pengembangan; pecahan; pemecahan masalah; pop-up

Introduction

Effective teaching materials are developed through a systematic approach and several stages of testing. One model that can be applied to the development of teaching materials is the ADDIE model. This model consists of five stages: analysis, design, development, implementation, and evaluation (Asmayanti et al., 2021; Rusdi, Sirajuddin, & Alfah, 2022). The ADDIE model is one of the approaches frequently used in instructional design to obtain the desired design (Aldoobie, 2015; Ghani, Daud, & Yusof, 2022). This model has been applied in curriculum development in various areas, including library instruction and online continuing education (Reinbold, 2013; Shahzad et al., 2023). In the study by Wang and Hsu (2009), they mention that the ADDIE model is used as an instructional design to help learners enhance their knowledge and skills (Li & Abidin, 2024). Since material developers need to determine the stages in creating or developing the materials.

Peterson (2003) states that the ADDIE model is beneficial in courses because it focuses on learners' needs, starting from analysis and design to material development. Additionally, learners play an active role in implementation and evaluation. Peterson also emphasizes that the ADDIE model can be applied in various teaching contexts that involve instructional design. In this case, choosing the right media can enhance the effectiveness of each stage of the model. According to Gagne (1970), educational media refers to tools that teachers use to facilitate the delivery of material to students. Educational media comes in various types that can be used in a student environment, where educational media provides stimuli to students. Educational media is a very influential tool in teaching. Through teaching tools, students' interest in learning can be enhanced (Ntobuo et al., 2018).

Learning will succeed, in part, with the support of appropriate learning media, which should be adjusted to the developmental level of the children. In an educational media, both software and hardware are necessary. Software refers to the information related to the material within the media, which must be relevant, easy to understand, and aligned with the curriculum. Hardware refers to the physical media of instruction, such as the choice of colors, fonts, and creative images to capture students' attention to the instructional media (Paggara et al., 2022). Educational media can help teachers deliver material more clearly, making the learning process more systematic. It is evident that educational media can assist in enhancing learning and students' outcomes from what they learn (Nurrita, 2018). There are various types of educational media, and one type is the Pop-Up Book. The Pop-Up Book is an effective learning tool for creating more interactive and engaging learning experiences (Jasmaniah et al., 2022).

A Pop-Up Book is a book with elements that attract attention in every part. This book contains images or animated pictures that appear when the book is opened, and the

images feature 3D elements, giving the book a visually appealing and interesting look. This can provide both entertainment and attract students' attention while reading (Putri et al., 2019). Moreover, the 3D elements in this book can enrich the reading experience, making it more memorable. According to Dzuanda (2011), a Pop-Up Book is a book with various elements that can move and appear three-dimensional (Sunarti et al., 2023). This statement aligns with Dzuanda (2009), who mentions that presenting material through attractive images provides a 3D effect and is effective in capturing the reader's attention (Ratnasari, 2018). Pop-Up Books can capture students' attention more effectively in subjects that are less favored, such as mathematics.

Mathematics is an important subject, especially in elementary school, and it plays a crucial role in science. One of the topics discussed in mathematics is fractions (Novalia & Noer, 2019). Kristanto (2016) defines a fraction as a number written in the form a/b, where b cannot be zero. The fraction topic consists of various subtopics, one of which is comparing fractions. Comparing fractions means evaluating two fractions and determining which one is smaller, larger, or equal. The way to determine this is by comparing the numerators if the denominators are the same, or by cross-multiplying if the denominators differ. The concept of comparing fractions can also be applied in daily life (Azmy & Ningrum, 2021). Since this topic is relevant to daily life, it aligns with Bruner's theory, which emphasizes the importance of using concrete objects in learning.

Bruner's theory, also known as discovery learning, encourages children to be active and not just memorize the material but truly understand it. Bruner also suggests that the most important aspect of the learning process is selecting, storing, and conveying information (Budiman et al., 2023). In Bruner's theory, the focus is more on the learning process of the participants. Does the learning process lead to changes in knowledge, understanding, attitudes, behavior, skills, and habits of the learners. In Bruner's theory, there are three stages of cognitive development: enactive, iconic, and symbolic. In the enactive stage, learners gain learning through direct experience with concrete objects. In the iconic stage, they begin to understand material through images and imagination. Finally, in the symbolic stage, learners understand and use mathematical symbols, solve problems without concrete objects, and recognize the structure of mathematics comprehensively (Bruner et al., 2021).

Method

The research used is development research that utilizes the ADDIE model and employs the Research and Development (R&D) method (Listiani, 2022; Mudjisusatyo, Darwin, & Kisno, 2024). This method also involves the process of developing a product and evaluating it to ensure that the product created aligns with the set objectives. The subjects involved in the

trials conducted by the researcher are fifth-grade students at SDN Pegajahan 01 Cirebon. The data sources obtained by the researcher come from interviews with teachers and pre-test and post-test results from the students. The data collection system employed by the researcher includes interviews and questionnaires in the form of product research questionnaires from subject matter experts, language experts, media experts, student questionnaires, as well as student learning outcome tests using tests administered before the learning begins (pre-test) and after the learning ends (post-test). The data analysis system used by the researcher is both quantitative and qualitative. The qualitative data analysis technique is collected from the results of interviews, initial analysis, suggestions, and comments from validators, while the quantitative data analysis technique is used for analyzing the test results (Khoa, Hung, & Hejsalem-Brahmi, 2023).

Result

The development conducted by the researcher uses the R&D method, which consists of research results as well as the development of teaching media. The type of research model used by the researcher is the ADDIE model, which consists of 5 stages: analysis, design, development, implementation, and evaluation. The ADDIE model in Research and Development (R&D) can be used as research to develop instructional products, both in terms of content and design. Based on the researcher's analysis related to the ADDIE model, the stages are as follows:

Analysis (Analysis)

In developing effective instructional materials for use in learning activities, detailed analysis needs to be carried out. In the initial step, the researcher conducts a brief interview with the teacher of class V as well as making observations and administering a pre-test to the students to assess their characteristics and abilities. The interview took place on June 4, 2024. Below is the information obtained from the interview with the class V teacher.

Table 1. Results of interviews with grade V teachers

Question	Answer
What are the difficulties you have in providing material on comparing fractions in grade 5?	The difficulty is that some students have difficulty understanding, so sometimes students have difficulty grasping the material. The solution to this problem is that those who do not understand will be given additional lessons and more realistic learning tools will be added.
Do 5th graders prefer to learn visually, auditorily, or kinesthetically?	All can be included depending on the teacher wants to use what kind of learning. In making learning media depends on the teacher's ability because students in the digital era are already able to master learning visually, auditorily and kinesthetically.

How do you deal with challenges when teaching in grade 5?	First, we must first know whether the source of the problem is from within, which is usually associated with the student's condition at home, one of which is that parents do not support and guide students to study at home, but teachers will of course provide the best for their students.
When you apply problem-solving learning to students, what obstacles do you face? And how do you overcome them?	The challenge is the learning hours, because in elementary school the learning hours are few while mathematics requires a lot of time for both teachers to explain the material and students to understand the material. Other disturbances come from outside, one of which is when other classes have gone out for a break, students in the class will be disturbed and cannot focus.
In your opinion, what kind of learning do 5th grade students like and what kind of teaching materials do they like? (video, animation, 3D, etc.)	So the teaching materials used can be adjusted to the learning needs can use videos, animations, images, 3D, concrete, and others. So the teaching materials do not only focus on one teaching material.

Based on interviews with homeroom teachers of grade V, mathematics learning media in schools are limited to textbooks, which are considered less interesting and difficult to focus students, especially before recess or after school. Therefore, the researcher aims to develop learning media in the form of Pop-Up Books for fraction material in mathematics lessons. Before the product was made, the researcher distributed a pre-test to grade V students to identify errors and measure their understanding of the material comparing fractions and their ability to solve problems.

Table 2. Results Pre-test Before Product Manufacturing

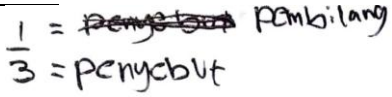
<table>
<tr><td colspan="2">Question 1
Perhatikan pecahan $\frac{1}{3}$ di bawah ini, menurut kalian manakah yang di sebut penyebut dan mana yang disebut pembilang?
  </td></tr>
<tr><td> 

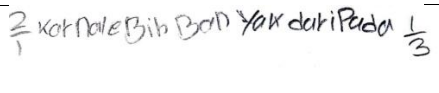
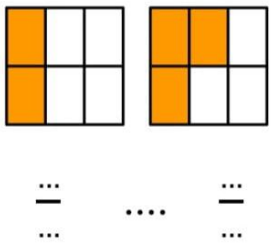
Figure 1. Subject A's response</td><td> 

Figure 2. Subject B's response</td></tr>
<tr><td colspan="2">Based on the results of the student pre-test in the image above, subject A was able to determine which part was the denominator and which part was the numerator, while subject B was not yet able to determine which part was the denominator and which part was the numerator.</td></tr>
<tr><td colspan="2">Question 2
Write down the fractional values, then compare them by giving the signs >, <, or =.</td></tr>
</table>



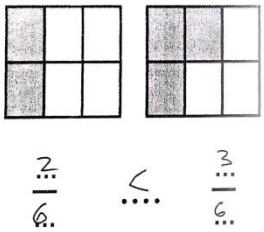


Figure 3. Subject B's response

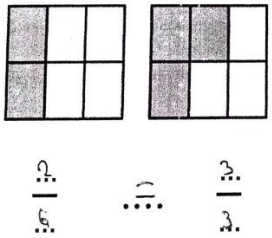
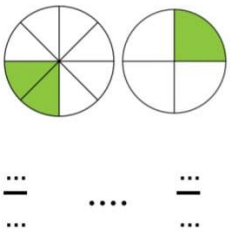


Figure 4. Subject B's response

Based on the pre-test results, subject A already understands the concept of determining fractions from a shaded image and determining them using symbols, while subject B has not been able to determine the symbols and determine the fractional value.

Question 3

Write down the fractional values, then compare them by giving the signs >, <, or =.



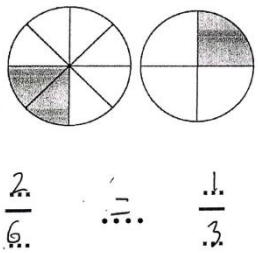


Figure 5. Subject B's response

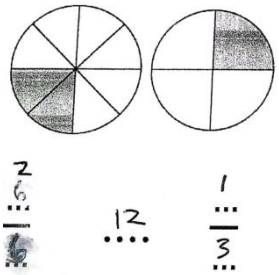


Figure 6. Subject B's response

Based on the results of the pre-test, subject A was able to determine the symbol for the quantity but was still unable to determine the number of fractions, while subject B was unable to determine the fraction and determine the symbol for the fractional quantity.

Design

After the analysis stage by conducting a short interview with the homeroom teacher of class V and giving a pre-test to students, then the researcher formulated the objectives that would be targeted in the study. At this design stage, it was carried out through two stages, namely:

1. Design Theory

At this stage, the researcher used Brunner's learning theory to design a pop-up book that improves students' problem-solving skills. Brunner's theory facilitates the understanding of mathematical materials, especially comparing fractions, by starting from concrete objects before moving on to abstract concepts. This book is designed following Brunner's principles, providing a clear structure to help students understand the material and hone problem-solving skills.

Table 3. Brunner's Learning Theory

Brunner's Theory Stages	Implementation
Active	Pop-up books make it easier for students to learn about concrete objects by displaying three-dimensional objects, so that students can more easily identify the fractions contained in the object.
Iconic	Students are asked to observe the pictures in the pop-up book, so they can compare the size of which object is larger based on the visualizations they see.
Symbolic	At this stage, students are given examples of problems that use symbols, so that they can work on problems without relying on concrete objects.

2. Product Design

After completing the theoretical design stage, the next step is to develop a product design to make the product in concrete form. The stages that need to be done include:

a. Selection of Teaching Materials

After conducting interviews, observations, and analyzing the results of the pre-test of grade V students, the researcher decided to choose pop-up books as teaching materials. This decision was taken based on the results of the evaluation which showed that pop-up books could meet learning needs and improve students' understanding of the material being taught.

b. Determining the Book Title

In determining the title of the book, the researcher obtained recommendations by considering the previously selected learning theory. The agreed title is "Pop-Up Book Comparing Fractions Based on Brunner's Theory."

c. Pop-up Book Media Design

Pop-up book media design includes creating designs and content in three-dimensional formats to enrich the learning experience. The goal at this stage is to create an initial design that will be developed into a more complete final product.

a) Determining the Flow of Learning Objectives

Determining the learning objective flow in creating a pop-up book involves planning clear steps to ensure that each design element supports the achievement of the learning objectives that have been set.

Table 4. Learning Objectives Flow

Learning Outcomes	Learning objectives
C1: Students are able to understand the meaning of the denominator and numerator in fractions.	Students can understand and identify fractions correctly after seeing several examples and pictures of fractions provided by the teacher.
C2: Students are able to explain how to compare fractions.	Students can identify the difference between the denominator and numerator in fraction material accurately after being given explanations and exercises by the teacher.
C3: Students are able to practice how to solve problems comparing fractions using concrete objects.	Through observation of concrete objects and symbols provided by the teacher, students can correctly state fractional comparisons.
C4: Students can analyze questions comparing fractions in story problems.	After observing concrete objects and symbols given by the teacher, students can compare fractions correctly and precisely.

b) Compiling Materials

In making pop-up books, the materials used are taken from fifth grade mathematics textbooks and learning videos available on the internet. Learning books provide the basic theory and concepts of mathematics, while videos from the internet offer various additional methods and explanations that enrich the content and provide visual examples that support student understanding.

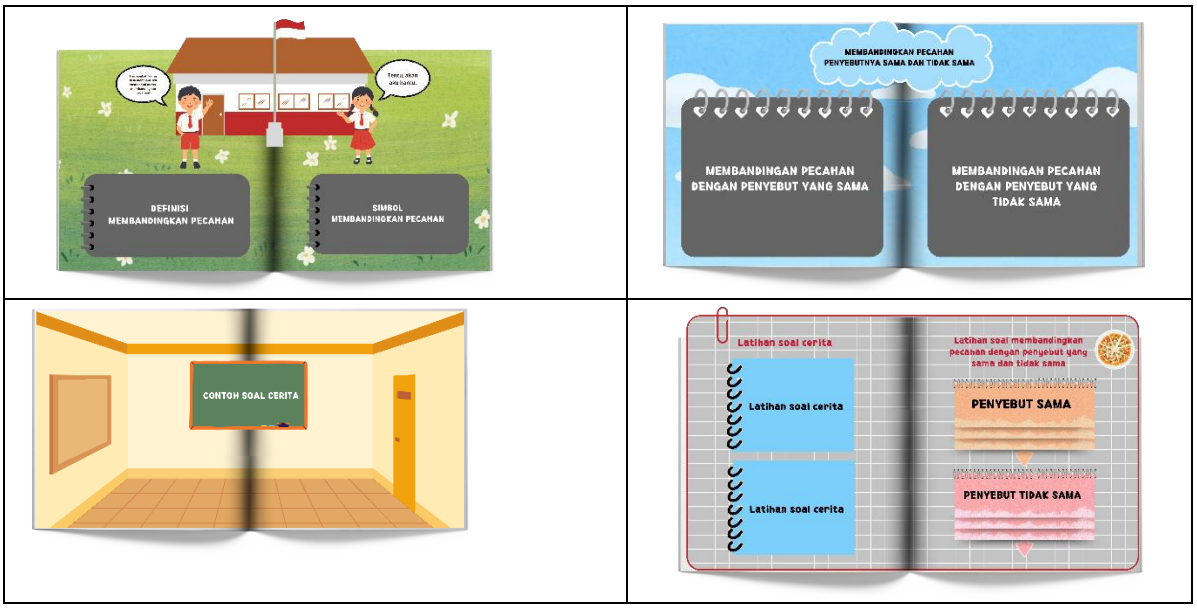
c) Determining Evaluation Tools

In addition to compiling the materials, researchers also developed evaluation tools that are in accordance with the principles of Brunner's learning theory. This evaluation involves various instruments designed to comprehensively measure student understanding, taking into account concrete, representational, and abstract approaches according to the theory.

d) Creating a Story Board

At this stage, the design process involved creating initial sketches for a pop-up book on comparing fractions. These sketches helped visualize the concept and design of the book, ensuring that the interactively designed elements supported students' understanding of how to compare fractions.

Table 5. Story Board Design



Development

The stage of developing a product in the form of a Pop Up book is a three-dimensional learning media that focuses on fractions and fraction comparisons. At this development stage, researchers carry out various activities, such as creating image illustrations, editing, and arranging the Pop-Up Book layout. The next step is to validate the product draft, which is carried out by two validators, namely a fifth-grade homeroom teacher and a mathematics lecturer.

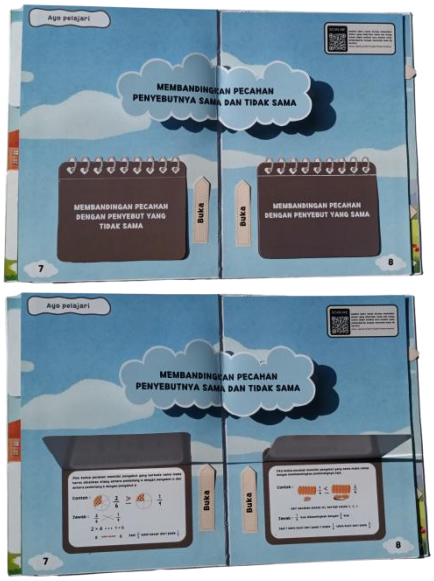
1. Product Specifications

At this stage instarting to design pop-up products in Canva and choosing colors, images, and also the placement of the order of pop-up media products and presenting them in class, suggestions and input from classmates and lecturers, then researchers design media content by entering the material that has been determined in the design that has been designed in the Canva application.

Table 6. Product Specifications

 Cover: the cover that is made can draw the material comparing fractions available in the book. The design that we use is made to attract	 Foreword: on the foreword page the author expresses his gratitude, the author's hopes, the pop-up design, and thanks.

students' attention with a combination of bright colors according to the age of the students so that students are interested and enthusiastic about studying their pop-up book. Back cover: on the back cover there is an explanation of the title, theory, material, and also the advantages of pop-up books.	Table of contents: the table of contents contains topic titles which make it easier to find the page.
 Cp & tp: this page contains the achievements and learning objectives that students need to achieve based on the independent curriculum. Instructions for use: instructions for use serve to make it easier for children to use the pop-up book.	 Pages 1 - 2: on this page there is an activity "let's observe" which at this stage uses the enactive stage in Brunner's theory, where in this activity students are invited to think using concrete objects that appear on the page
 Pages 3 and 4: on this page, students are still at the same activity and stage, where they are still learning by looking at the objects that appear on the page and the illustration of a person taking the food. On this page, there are also several questions that students can open and pull	 Page 5 - 6: on this page or in the activity "let's understand" students are at the iconic stage where students learn to use images to visualize and determine their fractions, on this page there are also definitions, symbols, and several simple questions that can be pulled and opened by students.

according to the instructions on this page to find the answers.	
 Page 7 - 8: on this page or in the "let's learn" activity, students are already at the symbolic stage where on this page there are examples of questions comparing fractions with the same denominators that can be opened to find out how to do it, and there is also a barcode scan to increase students' understanding.	 Pages 9 - 10: on this page, the activities and stages are the same as on the previous page, but on this page there are examples of story problems and how to solve them.
 Page 11: on this page there is a "let's practice" activity where students are given 2 story problems that can be opened to find the problem according to the instructions. Page 12: On this page, students work on 5 questions in the form of pictures, and 5 questions in the form of stories that they can	 Bibliography: this page contains articles that we used as references in creating pop-up books. Author profile: this page contains the identity of the author of the pop-up book.

draw on to find the questions, and on this page there is also a barcode for the evaluation practice questions on the liveworksheet.	

2. Product Validation

a. Validate the product with experts

The product validation stage aims to evaluate the extent to which the developed pop-up book meets the eligibility standards before being applied to the next stage. The pop-up book assessment process is carried out using a questionnaire that includes 10 statements in each expert field, where each statement is assessed on a scale of 1-5, with an assessment of 1 (not good), 2 (less good), 3 (enough), 4 (good), and 5 (very good), The existence of a predetermined Likert scale makes it easier for validators to assess pop-up products. The assessment results from the validator will be averaged using a formula and the criteria for the percentage of eligibility of the pop-up book media will be determined based on the average.

Table 7. Pop-up book media feasibility percentage criteria

Mark	Category
81% -100%	Very Worth It
61% – 80%	Worthy
41% – 60%	Quite Decent
21% – 40%	Less Worthy
1% – 20%	Not feasible

a) Material Expert Validation Results

The validation results from material experts show the extent to which pop-up books meet the established standards of content and information delivery.

Table 8. Results of Material Expert Validation

Validators	Score	Percentage
Validator 1	45 of 50	90%
Validator 2	40 of 50	80%
Total scores obtained	85 out of 100	85%
Maximum score	100 of 100	100%
Validation of the material showed a result of 85%, with both validators stating that this pop-up book was very suitable for use, although it needed to be revised according to the validator.		

b) Linguist Validation Results

The validation results by linguists assess the extent to which the pop-up book meets the required grammatical and language appropriateness standards.

Table 9. Results of Language Expert Validation

Validators	Score	Percentage
Validator 1	39 of 50	78%
Validator 2	41 of 50	82%
Total scores obtained	80 out of 100	80%
Maximum score	100 of 100	100%
Language Validation showed a result of 80%, with both validators stating that this pop-up book is suitable for use, although it needs to be revised according to the validator.		

c) Media Expert Validation Results

The validation results by media experts evaluate the extent to which the pop-up book meets the expected design standards and effectiveness of media presentation.

Table 10. Media Expert Validation Results

Validators	Score	Percentage
Validator 1	40 of 50	80%
Validator 2	44 of 50	88%
Total scores obtained	84 of 100	84%
Maximum score	100 of 100	100%
Media Validation showed a result of 84%, with both validators stating that this pop-up book is very suitable for use, although it needs to be revised according to the validator.		

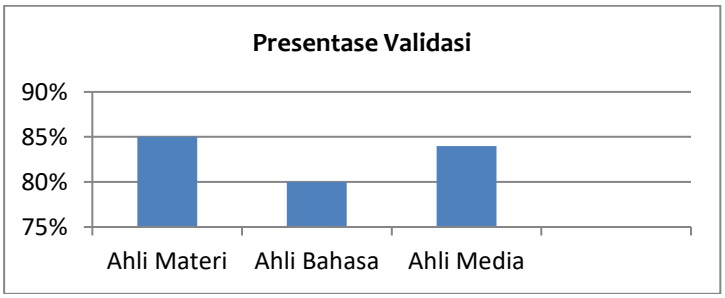


Figure 1. Validation Percentage

Table 8. Results of Material Expert Validation

No.	Validators	Total Score (%)
1.	Subject Matter Expert 1	90%
2.	Subject Matter Expert 2	80%
3.	Linguist 1	78%
4.	Linguist 2	82%
5.	Media expert 1	80%
6.	Media expert 2	88%
	Amount	498
	Average	83%

Based on the validation results, the value of the material expert is 85%, the language expert 80%, and the media expert 84%. With an average value of 83% from the material expert, this pop-up book can be declared very feasible to use according to the feasibility percentage table.

b. Student responses to pop-up book media

Data analysis of student responses also uses a Likert scale of 1-5. The way to determine whether or not students' responses to mathematics learning are good is by using a formula.

Table 8. Student Response Percentage Criteria

No	Mark	Category
1.	81 -100%	Very good
2.	61 – 80%	Good
3.	41 – 60%	Enough
4.	21 – 40%	Not good
5.	1 – 20%	Not good

Table 9. Categories of Student Responses to Pop-Up Book Media

No	Many students	Mark	Presentation
1	1 Student	8	80%
2	4 Students	9	90%
3	10 Students	10	100%
Amount	144	Average	96%

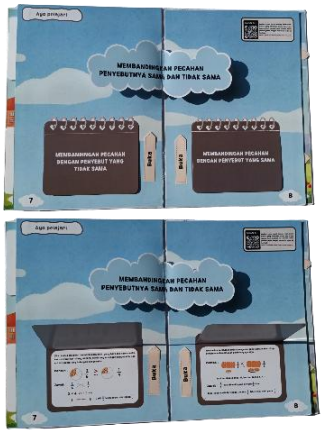
Based on data from student response results, it has a percentage of 96%, so the above percentage is said to be very good and the response given by students is stated to be positive on the Pop-up book media containing material on comparing fractions in mathematics subjects. According to the results of the student questionnaire, the Pop-up book is considered interesting because the book makes it easier to understand the material on comparing fractions and increases their enthusiasm for reading.

3. Pop-up book revision results

a. Media expert revision results

Table 9. Media Expert Comments and Revisions

Comment	Revision
Table of contents changed to add pop-up book usage guide slides	Added a page for instructions on using the pop-up book.
Before revision	After revision
	
Add pop-up media usage guide.	Added pop-up media usage guide and instructions on each slide.
Before revision	After revision
	
	

Comment	Revision
	
	
	

Comment	Revision
	

b. Results of revision by linguists

Table 10. Comments and Revisions from Linguists

Comment	Revision
Re-arrange the learning objectives to be achieved	Create learning objectives by re-adjusting to Bloom's Taxonomy theory (audience, behavior, condition, and degree)
Before revision	After revision
	
Put a period at the end of each sentence.	Add a period at the end of each sentence
Before revision	After revision
	

Implementation

The implementation that the researcher did by testing the pop-up product in class V of SDN Pegajahan 1, Cirebon City. The trial that the researcher did on elementary school students, namely in class V there were 15 students consisting of 8 male students and 7 female students. The researcher asked permission from the homeroom teacher of class V and the principal by submitting a research permit letter from the faculty, so that the research could be carried out smoothly. Before the researcher conducted the product trial,

the researcher first distributed the pre-test sheets to the students. This aims for the researcher to know the development of students before getting learning from the product that the researcher made and also after the implementation of the product that the researcher made.

The product implementation was carried out on August 6, 2024, at the beginning the researcher gave 3 pretest questions that the researcher took from the post-test questions which aimed to measure students' understanding after participating in learning related to the material comparing fractions, after that the researcher implemented learning which used pop-up book media that the researcher had previously made and also according to the stages of Brunner's theory of comparing fractions material and after the researcher conducted learning using learning media, namely pop-up book media, the researcher then distributed the post-test questions that the researcher had made to students to find out whether there was any development from students after implementing the pop-up product.

Evaluation

In the final stage or evaluation, the implementation of pop-up books was carried out on fifth grade students at SDN Pegajahan 1, Cirebon City. This evaluation was in the form of post-test questions that the researcher had given in the implementation stage of learning using pop-up products on fractional material, the post-test questions that the researcher gave were 6 questions and in accordance with the 3 stages of Brunner, the results of the pre-test and post-test of these students were then analyzed in order to evaluate student development and the effectiveness of the pop-up products that had been developed. That the research and development of pop-up books for the material on comparing fractions in class V of SDN Pegajahan 1, Cirebon City follows the ADDIE stages, which include analysis, design, development, implementation, and evaluation. Based on the pretest and posttest on fractions material for grade V, it can be seen from the KKM mathematics score of 65, then there are 8 children who passed the pre-test and post-test while there are 7 children who did not pass the pre-test and post-test, so the number of students' pre-tests is 950 and the number of students' post-tests is 1040, if the average results of the students' pre-tests are 63.33 and the students' post-tests are 69.33, the highest value in the pre-test data reaches 100 and the post-test reaches 90 while the lowest value in the pre-test data has a value of 0 and the post-test has a value of 30, for the average completion of the pre-test and post-test if presented reaches 53% while the average is not complete if presented reaches 47%. Therefore, it can be said that there are still more students who have completed the task compared to those who have not completed it, and the number of students' post-test scores is greater than their pre-test scores, therefore the

pop-up book media comparing the solutions that we made is suitable for use and there has been development in class V students of SDN Pegajahan 1, Cirebon City.

Conclusion

It can be seen based on data from language, material, and media experts that the feasibility of the pop-up book that the researcher has made regarding the subject of mathematics, the material of comparing fractions, which was checked by mathematics lecturers and homeroom teachers of grade V, starting from the validation of media experts reaching a score of 84% which can be categorized as very feasible, validation of material experts reaching a score of 85% which can be categorized as very feasible, and validation of language experts reaching a score of 80% which can be categorized as feasible. Based on the data that we have collected, it can be concluded that the pop-up product that we have developed can be used well in learning mathematics, the material of comparing fractions.

Pop-up book media developed as a media to encourage student learning outcomes and student development at SDN Pegajahan 1 Kota Cirebon which researchers conducted based on 5 ADDIE steps in the first ADDIE stage, namely the analysis stage, we conducted interviews with homeroom teachers of grade V before conducting observations on students which aimed to find out how previous learning and the characteristics of students in grade V, at the design stage the researcher designed the product & content of the material in the pop-up book, and formed a printed pop-up book, at the development stage, the researcher developed teaching materials from product validation assessed by 2 validators, namely the homeroom teacher of grade V and a mathematics lecturer, at the fourth stage of ADDIE, namely the implementation stage, we tested the pop-up book product to 15 students of grade V of SDN Pegajahan 1 Kota Cirebon, and the last stage was the evaluation stage where the researcher gave 3 pre-test questions that were distributed before the activity and 6 post-test questions that were distributed at the end of the activity after the pop-up book trial.

The response that the researcher got from students regarding the pop-up book that the researcher made was very appropriate. This is proven by the researcher giving 2 questionnaires to students regarding the assessment of the product and material that the researcher made in pop-up media, which reached a total score of 144 while the expected score was 150, then the percentage of student responses can be calculated based on the formula calculation is 96%, it can be said "very appropriate". The effectiveness of the pop-up book that the researcher has made can be seen from the data on the students' pre-test and post-test questions, where the median pre-test was 63.33 and the post-test was 69.33, the highest score on the pre-test was 100 and the lowest score was 0 while the highest score on the post-test was 90 and the lowest score was 40, the average student

completion on the pre-test and post-test reached 53% while the average student did not complete the pre-test and post-test was 47%. This is evidence that the majority of students have increased from before the media trial and after the trial of the pop-up mathematics book media on the material of comparing fractions. The pop-up books that researchers have created show positive results and are suitable for use. However, there are still things that need improvement to achieve optimal effectiveness. First, instructions for using pop-up media need to be clarified and arranged more carefully, so that their use becomes easier to understand. Second, the words used in pop-up books must be adjusted to the age of the students, so that the material is easier to understand and remember by the target audience.

Therefore, we hope that future researchers will pay more attention to these details in the design process. With deeper improvements in the instructions for use and language adjustments, it is hoped that pop-up media can be more effective and reduce the need for future revisions. The experience and feedback gained from this test will be invaluable in improving the quality and usability of pop-up media.

Conflict of Interest

The authors declare that no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely by the authors.

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Author Biography

Turini Erawati

Turini Erawati is a lecturer at Universitas Swadaya Gunung Jati (UGJ) in Cirebon, specializing in Primary Teacher Education. She has a strong interest in developing innovative learning media, particularly to enhance elementary students' numeracy and problem-solving skills. Turini completed her Master's degree in Education with a focus on curriculum and instructional technology. She is actively involved in research and community service, including the development of pop-up book media for teaching fractions. With a spirit of dedication and innovation, she continues to inspire the next generation of educators to be creative and responsive to 21st-century learners' needs.

Setiyani

Born in Indramayu, December 12th 1984 is a lecturer in the mathematics education department at the Universitas Swadaya Gunung Jati, Indonesia. The author completed his undergraduate program (S-1) at Ahmad Dahlan University in 2006. Then, completed a master's education program (S-2) at the University Semarang State in the 2012 mathematics education study program. Currently the author is completing her doctoral studies at Universitas Negeri Semarang. Her current research interest includes students' learning and development at various levels and areas of education.

Sri Sumarwati

Sri Sumarwati is a Ph.D. student in technical and vocational education, at the Faculty of Technical and Vocational Education from University Tun Hussein Onn Malaysia. She previously received her master degree from University Tun Hussein Onn Malaysia in technical and vocational education, in 2014 and a bachelor's degree in mathematics education from Universitas Ahmad Dahlan Indonesia. Her research interest includes technical and vocational education training (TVET), transferable skills, mathematics education, engineering education, and entrepreneurship program.

Fuad Nasir

Fuad Nasir is a lecturer in Mathematics Education at Universitas Swadaya Gunung Jati (UGJ), Cirebon. He specializes in mathematics instruction and is committed to improving students' mathematical reasoning and problem-solving abilities through contextual and innovative teaching methods. He earned his Master's degree in Mathematics Education and has been actively engaged in research, particularly in the development of effective teaching strategies for elementary and secondary education. Fuad is also involved in various teacher training and curriculum development programs aimed at enhancing mathematics learning outcomes. His passion lies in preparing future educators to teach mathematics with confidence, creativity, and a deep understanding of pedagogical content.