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Media Development Fraction Pop Up Book Augmented Reality Based Fraction Material To Improve Numeracy Skills

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ABSTRACT

Numeracy skills must be owned by students to be able to face the challenges in the 21st century. Improving numeracy skills in students can be done in learning activities at school by using learning media that are in accordance with the development of the times, one of which is by using the Fraction Pop Up Book media based on Augmented Reality. This study was conducted with the aim of determining the level of validity, feasibility and attractiveness of the Augmented Reality-based Fraction Pop-Up Book media and also to determine the increase in students' numeracy skills after learning using the developed media. This study is included in research & development (R&D) research using the Borg and Gall development model using 7 stages. This study was conducted at SDN Tlogo 02 Blitar in class 3 with a total of 33 students. This study was developed using several instruments, namely: interviews, questionnaires, tests and documentation. The results of this study show that researchers get a score of 100% from material experts, 93.75% from media experts and 87.5% from language experts. This shows that the media developed by researchers is valid media and can be used without requiring revision. The media is also a very interesting media with a percentage score of 94.61%. Students' numeracy skills also increased in the moderate category.

1. Introduction

Numeracy skills or numeracy is the ability to understand and use numbers in various contexts. Numeracy skills is the ability to solve problems practically by using numbers as reported by Winata et al., (2021). Numeracy skills this becomes an advanced ability when students have been given mathematics learning in the classroom as reported by Resti et al., (2020). Numeracy skills this involves an understanding of basic mathematical concepts, the ability to perform calculations,

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read graphs, and also solve problems involving numbers. Other studies also show that skills focuses on processing data and numbers to evaluate statements about problems and situations that require mental evaluation in real life. Aela et al., (2023).

Nowadays, learning media is the best solution in the world of education. Based on technological foundations, the purpose of developing learning media is to develop various learning resources for students according to student characteristics according to Rachmawati et al., (2020). Media Learning is an important tool to make learning easier for students to understand. According to Fatih & Alfi (2021), learning media is included in the means of delivering messages in the form of information and knowledge to students. Seeing this situation, the world of education has created many innovations in learning media. Learning media has many types that are developed through various sources, one of which is the Fraction Pop-Up Book media based on Augmented Reality. Fraction Pop-Up Book media based on Augmented Reality.

Based on reality in the field, researchers found problems at UPT SDN Tlogo 02 Kanigoro. Researchers conducted research at UPT SDN Tlogo 02 on Wednesday, November 27, 2023 which was carried out using observation techniques on class 3 teachers of UPT SDN Tlogo 02 Kanigoro because there were 15 students out of 33 students who could not understand and calculate fractions. So many students still do not know the various types of fractions and also how to calculate them.

In addition, the 3rd grade teachers of UPT SDN Tlogo 02 also do not use enough learning media so that learning seems monotonous and less interesting for students. During the learning process, teachers are fixated on using LKS, textbooks, and learning videos so that 3rd grade students who are the lower class are less interested in following the learning process. The lack of teacher innovation in developing learning media is also one of the causes of this problem. Based on the explanation of the problems seen in 3rd grade of UPT SDN Tlogo 02, it has a major impact on students' abilities and understanding of fraction material.

The lack of use of learning media can result in many students who are less interested in following the learning delivered by the teacher. The impact of the lack of use of learning media resulted in 15 students out of 33 students in grade 3 of UPT SDN Tlogo 02 who were unable to recognize, understand, and calculate fractions. This is also a problem for teachers because the declining numeracy skills of students result in decreasing student grades, especially in Fraction material. By writing, someone can express a certain goal or intention to other people clearly so that readers can understand the meaning (Inayah,2024).

Based on the findings at UPT SDN Tlogo 02 Kanigoro, one of the researcher's efforts to help improve students' numeracy skills is to realize new innovations in the form of Augmented Reality-based Fraction Pop-Up Book learning media. The real form of this Augmented Reality-based Fraction Pop-Up Book is made attractive so that students are able to easily grasp fractional material so that they

can overcome the urgency of students' numeracy skills. Setiyani Rum, (2020) explains that pop-up book media is a type of 3D media that can create interesting effects because the images and materials contained in the pop-up book are displayed every time the page is opened. This is in line with research conducted by Sanvi et al., (2022) he also conducted this study aimed to analyze numeracy skills reviewed based on initial mathematical abilities. In Vocational High Schools in the field of tourism expertise, chemistry subjects are not studied directly as subjects, but are integrated into applied science subjects (Afinda, 2023).

This is in line with the research objective, which is to improve students' numeracy skills. In improving students' numeracy skills, media is needed that is easy for students to understand and interesting. Fraction Pop Up Book media is a 3D book that is beautifully and attractively designed and contains fractional material. Pop up book is an innovation in the form of a book that is able to display the potential and contents of the book through a 3-dimensional design that appears through a combination of folds, rolls, or rotations according to Umam et al, (2019). Fraction Pop Up Book media contains a book cover, Basic Competencies and Learning Objectives, a description of fractional material including fractional forms and how to calculate fractions, Augmented Reality Barcode, and Bibliography. According to Fatih (2023) through interesting and effective learning media, it is hoped that it can improve students' understanding which can affect students' learning outcomes. Science and technology in the development of the modern era today have entered all aspects of life, including education according to Alfi et al., (2022).

According to Sumardani et al.,(2019) Augmented reality is an application that connects the concrete world with a two or three-dimensional virtual world and simultaneously projects it into a concrete environment. Augmented Reality is a technology that can project virtual 3D images into our surroundings. According to Saputri et al, (2018) learning media using Augmented Reality is expected to be used as a learning resource for students. The combination of teaching materials and AR makes students more motivated to learn because they take an active role in the learning process with the ability to observe and visualize objects in their entirety according to research that has been conducted by Alfi et al., (2024).

This Fraction Pop Up Book media can improve students' numeracy skills. Numeracy skills are students' abilities in performing mathematical operations such as addition, subtraction, multiplication, and division. Not only that, numeracy skills are also students' abilities in understanding and solving problems. These numeracy skills are very much needed by students in their daily lives. In their daily lives, students will definitely not be separated from their ability to count, for example when students are buying something, they will definitely need numeracy skills.

The researcher took this research based on previous research with the title "Development of Pop Up Book Science Learning Media on Animal Life Recycling Material for Class IV MI/SD" compiled by Prasetyo & Yuliawati, (2021) which shows that the use of pop up book media is useful in expanding

students' knowledge about animal recycling materials in grade IV. This can be proven by the increase in students' knowledge of the material on animal life recycling which is delivered using the Pop Up Book media.

The next step is that the researcher also raised the research results of the Journal's Alexander & Mayarni, (2022) with the title "Development of Augmented Reality Media on the Material of Introduction to Planets and Celestial Bodies in Elementary School Science Learning which shows very good results as evidenced by the results of the evaluation of the suitability of the media of 88% assessed by media experts, 98% scored by material experts, and 95% assessed by education experts, indicating that augmented reality media helps understand the material of introduction to planets and celestial bodies.

Based on background of the discussion, in order to reduce the problems found, researchers at UPT SDN Tlogo 02 carried out innovation by conducting research and development (RnD) entitled "Development of Fraction Pop Up Book Media Based on Augmented Reality to Improve Students' Numeracy Skills in Fraction Material (Grade 3 Students of UPT SDN Tlogo 02 Blitar)" with the aim of improving the numeracy skills of grade 3 students at UPT SDN Tlogo 02 Blitar through this media and can also add variety and innovation to learning media for teachers so that learning feels more meaningful.

2. Methodology

This research uses the type of research and development (R&D) which is useful for producing certain products and testing their effectiveness. The development model used is the Borg and Gall model consisting of 10 steps. However, in this study the researcher only carried out up to stage 7 due to the limited time given. This is in line with research conducted by Mohamad Fatih, (2021) that the development model using Borg and Gall (modified Sugiyono) was carried out up to stage 7 of 10 stages. The stages of this research method can be seen in Figure 1 below.



Figure 1. Borg and Gall Stage Flow

The subjects of this study were 33 students of grade 3 of UPT SDN Tlogo 02. UPT SDN Tlogo 02 is located at Jl. Raya Tlogo-Serut No. 255 RT.01/04, Tlogo

Village, Kanigoro District, Blitar Regency. The teacher in grade 3 of UPT SDN Tlogo 02 is Mrs. Suci Puji Astutik, S.Pd who will guide and provide information about grade 3 students at SDN Tlogo 02.

The data collection techniques used were interview techniques, questionnaires, tests (pre-test and post-test) and documentation. Research instruments are tools used to collect data or measure the object of a research variable according to Yusup, (2018). Interview instruments were used by researchers to conduct initial observations at schools that were the objects of this research. Furthermore, questionnaire instruments were used to validate products to media experts, material experts and also language experts. In addition, questionnaire instruments were also used by researchers to assess the feasibility of the media and also to assess the level of attractiveness of the media that had been developed by researchers. Then to assess the increase in students' numeracy skills, researchers used test instruments in the form of pretests and posttests.

The data analysis technique used by researchers in this study used 2 methods, namely qualitative analysis and quantitative analysis. Qualitative analysis was obtained directly from the informants while quantitative analysis was obtained by analyzing the validation questionnaire, feasibility questionnaire analysis, attractiveness questionnaire analysis, and analysis of students' numeracy skills improvement obtained from the results of the students' pretest and posttest. The quantitative data obtained by researchers to see the increase in students' numeracy skills was calculated using the N-Gain formula. The following are the results of the N-Gain formula to see the score of students' numeracy skills improvement:

$$\text{N-Gain} = \frac{\text{Spost} - \text{Spre}}{\text{Smaks} - \text{Spre}}$$

Information:

Spontaneously = Posttest score

Spread = Pretest score

Smaks = Maximum Score

3. Results and Discussion

The following are the results and discussion of research that has been developed using the Borg and Gall model which has been modified according to the researcher's needs.

Results

The development model used by the researcher is the Borg and Gall model and has been modified with 7 steps as follows:

- a) Potential and Problems
-

According to the results of the researcher's interview with the third grade teacher, Mrs. Suci Puji Astutik, S.Pd, on November 27, 2023, information was obtained that students' numeracy skills had decreased due to limited supporting learning media. The researcher also found that the lack of students' numeracy skills was due to the lack of students' understanding of the material presented by the teacher. In accordance with the results of the interview conducted at UPT SDN Tlogo 02 above, the alternative solution offered by the researcher to support the learning process and improve students' numeracy skills is to develop Fraction Pop Up Book media based on Augmented Reality.

b) Data collection

In product development Fraction Pop-up Book Fractions Based on Augmented Reality, researchers utilize various reference sources such as magazines, books, and the internet that focus on fraction material. The main goal is to improve students' numeracy skills at UPT SDN Tlogo 02 Blitar. By utilizing various reference sources, the product development process becomes easier and more structured for researchers.

c) Product design

Based on product design, it is divided into 2 stages, namely:

a. Material Selection

In media product development Fraction Pop-Up Fractions Based on Augmented Reality, researchers select materials through various sources such as books, magazines, and the internet related to fraction material. This is also a consideration for school teachers and media experts to adjust learning. In addition, Core Competencies (KI) and Basic Competencies (KD) are also provided to support learning. By utilizing these sources, researchers can more easily create innovative products that are in accordance with learning needs.

b. Initial Design Planning

In this stage there are several stages, namely the initial analysis carried out by the researcher, namely by determining the needs of students to support learning media to be in accordance with the discovery of problems obtained during the interview and observation process. The selection of materials, namely the definition of fractions, equivalent fractions, simplifying fractions, and addition and subtraction of the same denominators that are in accordance with the abilities and problems found at UPT SDN Tlogo 02 Blitar Regency. In addition, the selection of this material is also in accordance with KI and KD on Fraction material. This initial planning stage can be seen in Figure 2.

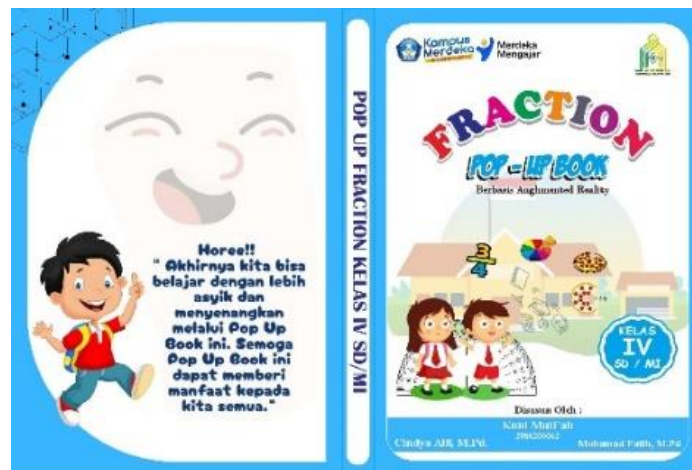


Figure 2. Initial Design Planning

d) Expert Validation

Expert validation is a process carried out by researchers to evaluate products that are made to be valuable and suitable for use by students. The goal is to ensure that the product meets standards and is used effectively in learning. Through the expert validation process, researchers can receive input and suggestions for product improvements before being implemented to students. This is an important step to ensure the quality of products used in learning activities. This product uses 5 stages of validation including:

a. Subject Matter Expert

1) Instrument Test

Material expert instrument test, tested by Mrs. Cindya Alfi, M.Pd, Lecturer at Nahdlatul Ulama University, Blitar on February 29, 2024. The following graph shows the results of the expert material instrument validation test which can be seen in Figure 3.

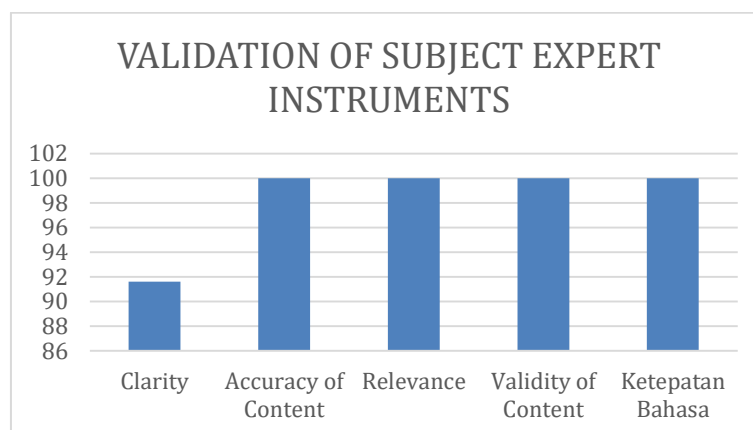


Figure 3. Validation Test of Material Expert Instrument

The assessment results showed a percentage of 97.5%, categorized as "Very Valid", so this value shows that the learning media can be applied.

2) Material expert validation test

Validation of the material on the Augmented Reality-based Fraction Pop Up Book product was carried out by Mr. Fathul Niam, M.Pd as a Lecturer at Nahdlatul Ulama University, Blitar on May 25, 2024. The following graphic image shows the results of the validation by material experts, which can be seen in Figure 4.

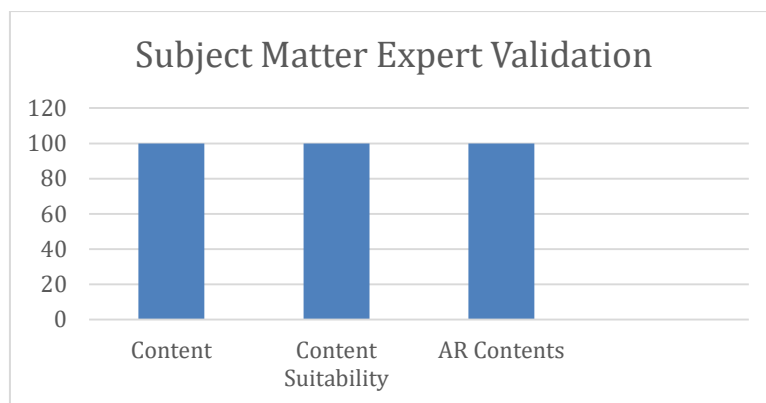


Figure 4. Validation by Material Experts

The assessment results show a percentage of 100%, categorized as "Very Valid", so this value shows that the learning media can be applied.

b. Media expert

1) Media expert instrument test

Mrs. Cindya Alfi, M.Pd, a lecturer at Nahdlatul Ulama University tested the media expert instrument in Blitar on February 29, 2024. The following graphic image of the results of the media expert instrument test can be seen in Figure 5.

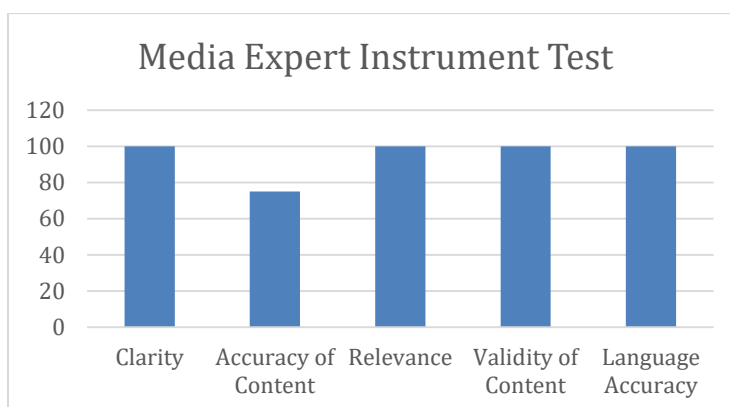


Figure 5. Media expert instrument validation test

The assessment results showed a percentage of 97.5%, categorized as "Very Valid", so this value shows that the learning media can be applied.

2) Media expert validation test

Validation of the Augmented Reality-based Fraction Pop Up Book media was carried out by Mr. Fernadiksa Rasta, M.Pd as a Lecturer at Nahdlatul Ulama University, Blitar on May 28, 2024. The following graphic image of the media expert validation results can be seen in Figure 6.

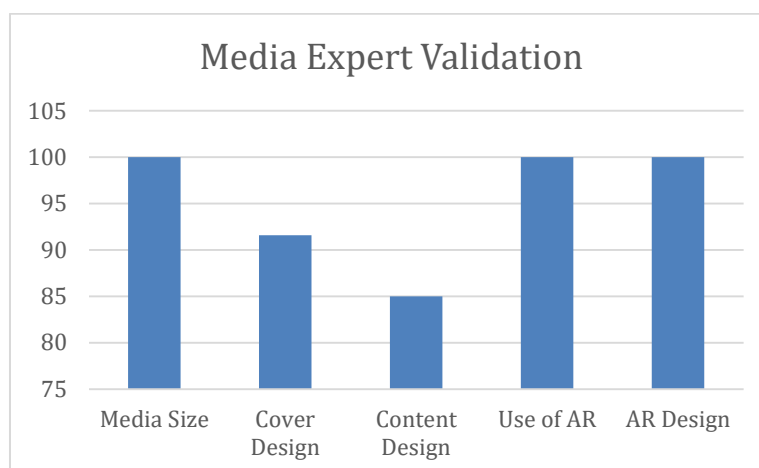


Figure 6. Media expert validation

The assessment results showed a percentage of 93.75%, in the category "Very Good"Valid", then this value shows that the learning media can be applied.

c. Linguist

1) Language expert instrument test

February 29, 2024. The Language Expert Instrument was tested by a Lecturer at Nahdlatul Ulama University, Blitar, Mr. Mohamad Fatih, M.Pd. The following graphic image of the results of the language expert instrument test can be seen in Figure 7.

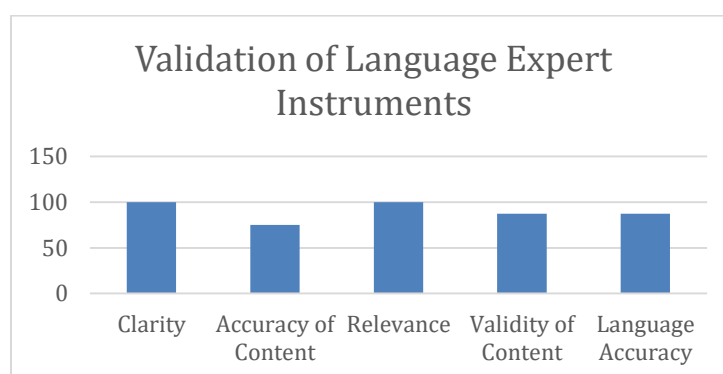


Figure 7. Validation Test of Language Expert Instrument

The assessment results showed a percentage of 92.5%, categorized as "Very Valid", so this value shows that the learning media can be applied.

2) Language expert validation test

Language validation of this development product was carried out by Mrs. Latifatul Jannah, M.Pd as a Lecturer at Nahdlatul Ulama University, Blitar on May 22, 2024. The following graphic image of the language expert validation can be seen in the Figure 8.

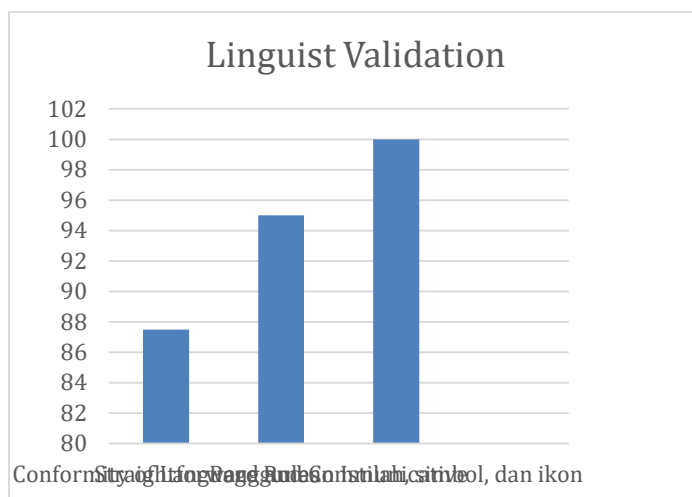


Figure 8. Linguist Validation

The assessment results showed a percentage of 87.5%, categorized as "Very Valid", so this value shows that the learning media can be applied.

d. Media eligibility

1) Media feasibility instrument test

The media feasibility instrument was tested by Mr. Mohamad Fatih, M.Pd as a Lecturer at Nahdlatul Ulama University, Blitar on February 29, 2024. The following graphic image shows the results of the media feasibility instrument test, which can be seen in Figure 9.

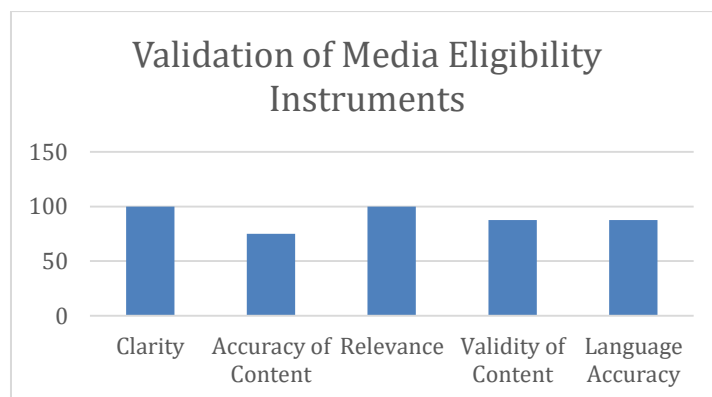


Figure 9. Media suitability validation test

The assessment results showed a percentage of 92.5%, categorized as "Very Valid", so this value shows that the learning media can be applied.

2) Media feasibility validation test

Validation of the media feasibility of this development product was carried out by Mrs. Suci Puji Astutik, S.Pd as a Class 3 Teacher at UPT SDN Tlogo 02 Blitar on May 29, 2024. The following image shows the results of the media suitability test which can be seen in Figure 10.

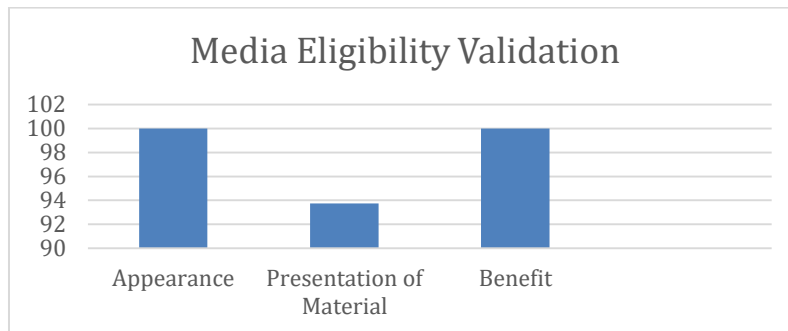




Figure 10. Validation of media suitability

The assessment results showed a percentage of 97.5%, categorized as "Very Eligible", so this value shows that the learning media can be applied.

e) Design Revision

The design revision was carried out after the media validation process carried out by several experts including material experts, media experts, and language experts with the aim of assessing the weaknesses and deficiencies in the Augmented Reality-based Fraction Pop Up Book. The results of the Augmented Reality-based Fraction Pop Up Book media revision will later make the Augmented Reality-based Fraction Pop Up Book more feasible to be tested on students. The final results of the revised design according to the experts' suggestions are shown in Table 1.

Table 1. Product Revisions

No.	Before Revision	After Revision
1.	 <p>Replace the appropriate fraction illustration</p>	 <p>The illustration image has been replaced with a suitable image.</p>

2.



Improve your word choice to make it easier for students to understand.



The choice of words has been improved to make it easier for students to understand.

f) Product Trial

The product trial was conducted through 2 trial stages, namely the small-scale trial stage and the large-scale trial stage to determine the level of success in developing the Fraction Pop Up Book media based on Augmented Reality. The test instrument test was conducted by the researcher before the test was given to students by testing the test to grade 4 students to determine its validity and reliability. Validity tests are used to measure the validity score of the instrument used to obtain data and reliability tests are used to measure the consistency of an instrument Fatih et. al, (2022)

The results of the validation test conducted by the researcher with the help of the SPSS 2.7 application showed that the questions given by the researcher were valid questions and obtained a score greater than 0.514 which is the rtable. The following are the results of the validity test of the students' numeracy skills improvement test which can be seen in table 2.

Table 2. Results of the Validity Test of The Students' Numeracy Skills Improvement Test

Question Number	rhitung	rtable	Results
1	0.631	0.514	Valid
2	0.907	0.514	Valid
3	0.578	0.514	Valid
4	0.612	0.514	Valid
5	0.631	0.514	Valid
6	0.907	0.514	Valid
7	0.907	0.514	Valid
8	0.631	0.514	Valid
9	0.907	0.514	Valid
10	0.907	0.514	Valid

Correlation is significant at the 0.05 level (2-tailed)
 Correlation is significant at the 0.01 level (2-tailed)

In addition, researchers also conducted reliability tests using the Cronbach Alpha formula with the help of the SPSS application. The following are the results of the tests carried out by the researchers which can be seen in Table 3.

Table 3. Reliability Test Results

Cronbach's Alpha	N of Items
.925	10

Based on the table above, it is known that the reliability value obtained by the researcher is above 0.60, so it can be said that the questions given by the researcher are reliable questions. The researcher conducted 2 trials. The first trial was conducted by the researcher on a small scale with 15 students in grade IV as subjects. and obtained a final percentage value of 92% which is included ininterval 85.01% - 100%, by obtaining a decision that it can be used without revision. The second trial was conducted by the researcher on a large scale with 33 students in grade 3 as subjects and obtained a final percentage value of 96.3% which is included in the interval 85.01% - 100% with the test provisions that were completed synchronized with the results of the researcher's calculations stating that it can be used without revision.

g) Product Revision

The small-scale product trial and large-scale product trial stages that researchers have carried out on May 29, 2024 and June 10, 2024, which were carried out at UPT SDN Tlogo 02, Blitar Regency, obtained a total assessment of "Very Interesting", so that the media development product Fraction Pop Up Book Based on Augmented Reality Fraction Material at UPT SDN Tlogo 02, Blitar Regency can be used as a learning medium with several criticisms and suggestions in the assessments given by several respondents.

Discussion

1. Validity of Fraction Pop Up Book Media Based on Augmented Reality

The validation test stage of the material expert was tested by Mr. Fathul Ni'am, M.Pd as a lecturer at Nahdlatul Ulama University, Blitar on May 25, 2024. The results of this media validation test obtained the final test results that had been synchronized with the calculation results if they were allowed to be used without revision. The final score obtained was based on the final score results from the aspects assessed and obtained very valid criteria without revision.

The media validation test for the Augmented Reality-based Fraction Pop Up Book product was carried out by Mr. Fernadiksa Rasta, M.Pd as a Lecturer at Nahdlatul Ulama University, Blitar on May 28, 2024. The results of this media validation test obtained a test determination that it could be used without revision by getting the final result of the criteria very valid without revision. Learning objectives can

be achieved if the media used can stimulate students' attention and interest as well as their thoughts and emotions according to research by Mohamad Fatih (2020).

At the stage of the validation test, the language expert product was carried out by Mrs. Latifatul Jannah, M.Pd as a Lecturer at Nahdlatul Ulama University, Blitar on May 22, 2024. The results of this language expert validation test obtained the final test results that had been synchronized according to the total calculation, namely that it could be used without revision with the criteria of being very valid without revision. This is in line with research conducted by (Fatih et.al, 2023) with the results of the validation of material and language experts of 88.3% so that it can be seen that the material and language in the comic media are very valid for use by grade IV elementary school students.

2. Feasibility of Fraction Pop Up Book Media Based on Augmented Reality

At the product feasibility validation test stage carried out by Mrs. Suci Puji Astutik, S.Pd as a Class III Teacher of UPT SDN Tlogo Blitar on May 29, 2024, the results of the test were obtained which were synchronized with the total calculation, namely that it can be used without revision with the criteria of being very feasible without revision. These results are reinforced by the results of research with the same variables but conducted by different authors. Previous research conducted by Ningsih (2020) found that the Pop Up Book media obtained an average percentage higher than 80% and was categorized as very suitable so that it could be used for learning.

3. The Attraction of Augmented Reality-Based Fraction Pop Up Book Media

At the stage of the validation test of the product's attractiveness, it was carried out by students of class III of UPT SDN Tlogo Blitar on June 10, 2024, getting the final test results that were synchronized by considering many things with the category "Very Interesting", meaning that this media can be applied as a learning tool in class III of Elementary School standards. Validation of the attractiveness of this media is carried out to see whether the media developed by the researcher is interesting and can help students understand the material through the media developed.

The visual features of Pop Up Books are able to arouse students' interest and understanding of the material being studied. This finding shows that the use of interactive and interesting learning media, such as Pop Up Books, can facilitate students' understanding more effectively. This is in accordance with the purpose of using learning media, which is to facilitate the delivery of information and help students absorb the material better. Their attention to learning proves the usefulness of Pop Up Book media when teaching narrative content. Another study conducted by Alfi Nur Jannah (2019) found that the Pop Up Book media showed a percentage of students' interest level of 96.3% and showed the category "very interesting."

4. Improving Students' Numeracy Skills

The product trial was carried out through 2 stages in the form of a small-scale trial and a large-scale trial of the Augmented Reality-based Fraction Pop Book product which was carried out on May 29 and June 10, 2024 in grades IV and III, where in the small-scale trial with 15 students, the test results were synchronized with the calculation results which stated that the students' numeracy skills improvement test was valid and reliable so that it could be tested on grade III students. Then in the large-scale trial with 33 students as subjects, the scores calculated using the N-Gain formula were obtained and the results were included in the moderate category.

The results of this study are in accordance with research conducted by Kristianingrum & Radia, (2022) They reported that students experienced increased understanding after using Pop Up Book media in learning. The average pre-test score of students was 71, while the average post-test score increased to 91.5. This shows a significant increase in students' abilities after learning using Pop Up Book media. This finding reinforces that the use of interactive learning media such as Pop Up Book can help students understand the material better and improve their learning outcomes. Therefore, it can be said that the use of Fraction Pop Up Book media based on Augmented Reality can help students understand learning materials, especially in mathematics.

4. Conclusion

Based on the data analysis that has been carried out, it can be seen that the fraction pop-up book media based on Augmented Reality is a media that is feasible and valid to be used in the learning process. Fraction pop-up book media based on Augmented Reality is also an interesting media for students so that they are more interested, easy to understand and motivated in following the learning activities that have been carried out. The use of fraction pop-up book media based on Augmented Reality in learning can improve the numeracy skills of grade 3 students of UPT SDN Tlogo 02, Blitar Regency. This is evidenced by the results of the pre-test and post-test which showed a significant increase in the numeracy skills of grade 3 students of SDN Tlogo 2, Blitar Regency. These results indicate that fraction pop-up book media based on Augmented Reality is a media that can be used as a means for students to understand the learning material given by the teacher.

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