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Development of GeoGebra-Based Fraction Gap Learning Media to Improve Understanding of the Fraction Concept of Grade V Elementary School

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Abstract: Students need mathematics to solve everyday problems with fundamental technological developments. Technology-based media greatly supports success in mathematics learning, especially for elementary school students. This study aims to develop GeoGebra-based Fractional Gap learning media that is feasible in improving the understanding of the concept of fractions of grade V elementary school students. The implementation of this research uses the Research and Development (R&D) method with the ADDIE development model (Analysis, Design, Development, Implementation, and Evaluation). Data collection techniques include interviews, observation, expert validation, and pretest-posttest tests. The study was conducted on V-A and V-C class students at SD IT Al-Falaah Sambi, totalling 40 students. The results of the media feasibility test amounted to 4.59, including the " Very Good " criteria; the material feasibility test amounted to 4.18, including the "Very Good" standards; and the feasibility test from practitioner validation amounted to 5, including the "Very Good" criteria. Product effectiveness tests were conducted using pretest-posttest test questions in experimental and control classes. The hypothesis test results obtained a probability of significance of 0.022 < 0.05, meaning that students' understanding of the concept of fractions increased. From the study results, it was concluded that GeoGebra-based Fractional Gap learning media is feasible and practical to be applied to improve the understanding of the concept of fractions of grade V elementary school students.

INTRODUCTION

Mathematics is a discipline of subject knowledge based on technological developments so that it

can be learned by elementary school students to form logical, critical, creative, synthesis, and analytical thinking skills (Setiawan et al., 2020). Students need mathematics subjects to solve problems in everyday life; therefore, the learning process must be based on the student's level of development and characteristics. During the mathematics learning process, an educator should be able to optimize his ability to improve students' ability to understand mathematical material concepts (Mulyani et al., 2018)

But in fact, students' understanding of mastering the concept of fraction calculation operation material in mathematics learning is still low, especially in elementary schools. The fraction calculation operations are subtraction, addition, division, and multiplication (Indra et al., 2019). Rahmawati & Wahyudin, (2018) found that the common understanding of students is due to difficulty calculating fraction concepts, such as difficulty solving fraction story problems, difficulty in calculating addition and subtraction of fractions, difficulty in simplifying fractions, and difficulty in recognizing the concepts of multiplication and division of fractions.

In fact, fractional material is an achievement of knowledge that elementary school students must understand because fractions are often encountered daily in real life. This is in line with Subarinah (Mulyani et al., 2018), saying that fraction-counting operations are essential for learners to understand because many aspects of operations are related to daily life. The initial concept of learning fractional material needs to be taught well so that it can be stored in students' memory for a long time (Wahyu et al., 2020).

Regarding the problem of students' difficulties in understanding the concept of fractions, the educator's solution in teaching is to apply to teach media to support the learning process of fractional material mathematics. The learning media can be tangible (concrete) or technology-based (Sardin et al., 2022).

Concrete learning media has the advantage that it can provide direct and actual experience. However, concrete media also has disadvantages, such as it cannot be used repeatedly and the treatment is complicated (Daryanto, 2016). To overcome these weaknesses,

using technology-based media can be a solution. In addition, technology-based learning media makes it easy for students to understand teaching materials and can be accessed anytime by students and educators (Hasrah, 2019), especially now that the skill of using technology is a skill that must be mastered by educators and students (Redhana, 2019).

The use of technology-based media greatly supports success in learning mathematics. Positive aspects of the role of technology-based learning media in mathematics learning include independent learning tools, learning aids, and learning resources. In addition, using technology-based media in mathematics teaching and learning activities can solve problems studied in the material and improve students' mathematical communication skills (Purnomo, 2021).

Media development in technology-based fractional learning is minimal because educators' ability to develop technology-based media requires good technology-related skills. Even though not all educators can develop media, therefore, it is essential to create technology-based learning media that can be used in the classroom and practised independently at home or easily accessed anywhere. One of the technologies that can be developed is GeoGebra software.

GeoGebra software is a learning application that can be used dynamically to assist the process of mathematics teaching and learning activities (Ekawati, 2016; Nur, 2017; Pratiwi, 2020). stated that GeoGebra is an application that makes it easier for students to understand mathematical material better. This GeoGebra software can motivate students to learn mathematics in the classroom and at home.

GeoGebra-based addition and subtraction media (fractional gap) is a virtual visual aid assisted by internet access that contains material on the concept of subtraction and addition of fractions. Developing this media aims to improve the understanding of the concept of fractions of grade V learners. The development of GeoGebra-based learning media has been created before, such as research conducted by (Anggraeni et al., 2019); it was concluded that the development of GeoGebra-based teaching media that

has been carried out is said to be feasible to be used in increasing students' understanding of mathematics learning concepts.

To develop GeoGebra-based Fractional Gap learning media, researchers will use SD IT Al-Falaah Sambi as a basis to explore the needs of students and educators in mathematics learning. This elementary school is also used to answer difficulties in learning addition and subtraction of different denominator materials. Thus, the problem of students understanding the concept of addition and subtraction of varying denominator fractions can be appropriately resolved.

METHOD

The method in this study is Research and Development (R&D). According to Sugiyono, this research method is implemented to produce a product and test its effectiveness of the product (Indra et al., 2019; Sugiyono, 2012). The effect produced in this research and development is a GeoGebra-based Fraction Gap learning media. The study uses the ADDIE development model, which consists of five stages, including the stages of analysis, design, development, implementation, and evaluation.

The description of the stages of the ADDIE development model can be observed in the following table, among others, namely:

Table 1 Analysis Phase

Purpose	To analyze the needs of students related to mathematics learning activities in class V SD IT Al-Falaah Sambi. Such as the media used and the ability of students to understand the concept of fractions.
Instruments	Observation and interview.
Data Source	Mathematics teacher and fifth-grade students.
Information	The analysis results in guided researchers to develop GeoGebra-based Fraction Gap learning media.

Table 2 Design Phase

Purpose	Create a media design to be developed.
Instruments	-
Data Source	-
Information	This Media is designed as a book comprising the main media menu titles, including a description of the Fractional Gap Media, Introduction to Media, Introduction, Material, Media, and Practice Questions. In addition to designing media designs, research instrument designs are also carried out at this stage.

Table 3 Development Phase

Purpose	Realizing the design of the media design before being tested on students is by

	asking for validation from validators.
Instruments	Expert validation assessment questionnaire sheet.
Data Source	Media experts, material experts, and practitioner experts.
Information	At this stage, there are two stages: initial product creation and validation from experts. Researchers revise GeoGebra-based Fractional Gap learning media based on improvement suggestions, product responses, and assessments provided by validators. Thus, a repaired initial product was produced. The development of Fractional Gap media is said to be successful if the validation from experts gets a proper assessment.

Table 4 Implementation Phase

Purpose	Applying media to test the feasibility and effectiveness of GeoGebra-based Fractional Gap media.
Instruments	Pretest-posttest question test.
Data Source	19 students of class V-A
Information	Researchers shared pretest-posttest questions before and after learning with GeoGebra-based Fractional Gap media.

Table 5 Evaluation Phase

Purpose	To evaluate GeoGebra-based Fractional Gap learning media in increasing understanding of fraction concepts in grade V students.
Instruments	-
Data Source	V-A and V-C class learners numbered 40.
Information	Conducted by analyzing the results of the pretest-posttest Test of grade V students to determine the effectiveness of the teaching media that has been developed.

This research uses qualitative and quantitative data analysis techniques. Qualitative data were obtained from observations of the learning process and interviews with mathematics teachers related to mathematics learning grade V SD IT Al-Falaah Sambi. In addition, it is also obtained from the responses and suggestions of validator experts. Meanwhile, quantitative data is obtained from the average validation score of material experts, media, and practitioners. In addition, it is also obtained from the effects of students' pretest-posttest test scores before and after the learning process by implementing GeoGebra-based Fractional Gap media. The data analyzed, qualitative and quantitative, are used as guidelines in revising the developed media and to determine the level of media feasibility in increasing the understanding of the concept of fractions of grade V students.

Quantitative data analysis from questionnaires and tests using quantitative descriptive statistical methods then converted based on product feasibility classification. The

following steps for converting qualitative and quantitative data on a scale of five refer to (Widoyoko, 2010).

1. Recapitulate the results of research data by changing the results of qualitative assessments into a quantitative Likert scale with the following conditions.

Table 6 Scoring Guidelines

Qualitative Data	Score
Very Good	1
Good	2
Good Enough	3
Not Good	4
Very Less Good	5

2. Perform the calculation of the average score of the instrument with the following formula.

$$\bar{X} = \frac{\Sigma x}{n}$$

Information:

$\bar{X}$ = Average score of the instrument

Σx = Number of scoring scores

n = Number of statements

3. Qualitatively interpret the data on the average score of each aspect with a five-scale conversion formula according to the following table.

Table 7 Data Conversion

Mark	Criteria	Calculation Score
5	Very Good	X > 4,08
4	Good	3,36 < X ≤ 4,08
3	Good Enough	2,64 < X ≤ 3,36
2	Not Good	1,92 < X ≤ 2,64
1	Very Less Good	X ≤ 1,92

Data assessment is generated from media experts, materials, and practitioners, according to Table 7. If the GeoGebra-based Fractional Gap learning media has been declared feasible by media experts, materials, and practitioners, it can be tested on students through limited trials. Media is viable if the assessment score obtained is at least included in the criteria of good and excellent (score > 3.36).

RESULT & DISCUSSION

Result

The results of developing GeoGebra-based Fraction Gap learning media regarding the concept of addition and subtraction of fractions. The following are the stages of research results:

1. Analysis

At this stage, several analyses are carried out related to the needs of students. Based on the results of interviews and observations conducted at SD IT Al-Falaah Sambi with mathematics teachers, it is known that the facilities in the school are inadequate. The media used in the mathematics learning process still uses makeshift press as monotonous non-ICT media, such as props,

package books and pictures in manuals, and blackboards. Such a mathematics learning process makes students less interested and tends to be passive in teaching and learning activities because they only listen to explanations from the teacher. One obstacle is the limited time available in creating and preparing learning media, so teachers only rely on textbooks and whiteboards as media for delivering material to students. In addition, researchers also saw that during mathematics learning activities, students were less focused when the teacher gave addition and subtraction material. Students here also have difficulty understanding the concept of addition and subtraction of fractions due to limited media that is modest and less interesting. The solution to these problems can be done by providing Learning media that are interesting, creative, innovative, easily accessible, and technology-based according to the characteristics and needs of students.

2. Design

GeoGebra-based Fractional Gap learning media began to be designed based on the results of the analysis that had been carried out. This media design is created as a book with several menu displays. Design stage activities include:

a. Open the GeoGebra website via Google Chrome and log in through the account that has been created.
b. Create a flow of teaching and learning activities: setting Basic Competencies (KD), Competency Achievement Indicators, learning objectives, material preparation, and question exercises.
c. Forming and explaining the main menu of media, namely the description of Fraction Gap Media, Introduction, Introduction (including KD, Competency Achievement Indicators, and learning objectives), Addition and Subtraction Fraction Material, Fraction Gap Media, and Question Practice.
d. After that, form a submenu of the Addition and Subtraction of Fractions, namely the material on the concept of fractions, the addition of fractions, reduction of fractions, and solving problems

related to addition and subtraction of fractions. In addition, it also forms a submenu of the Question Practice menu, namely questions and discussion of questions.

e. After the media design has been completed, the Fractional Gap learning media is saved. Then it is automatically saved on the GeoGebra account web.

GeoGebra-based Fractional Gap Learning media design can be seen in the following picture.

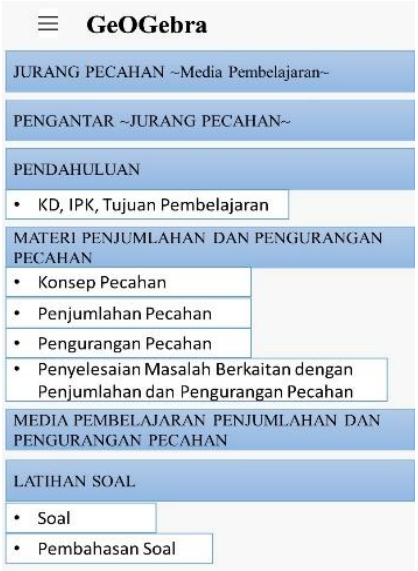

Figure 1 Design Fractional Gap Learning Media

3. Development

At this stage, produce products from designs that have been made before. The results of the display design of the GeoGebra-based Fractional Gap learning media that have been developed are presented in the following figure.

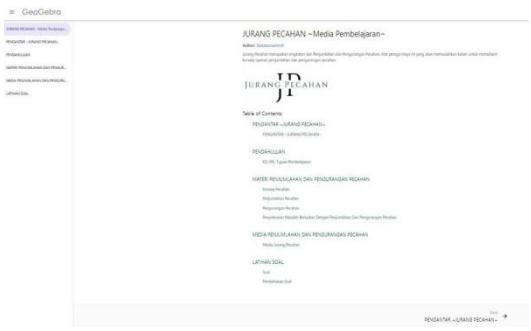

Figure 2 Menu Display Description of Fractional Gap ~ Learning Media~

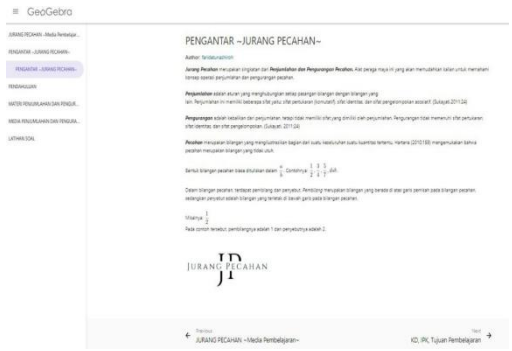

Figure 3 Introduction Menu Display ~Fractional Gap~

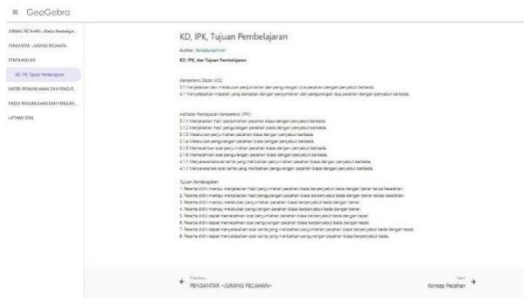

Figure 4 Introduction Menu Display KD, Competency Achievement Indicators, and Learning Objectives

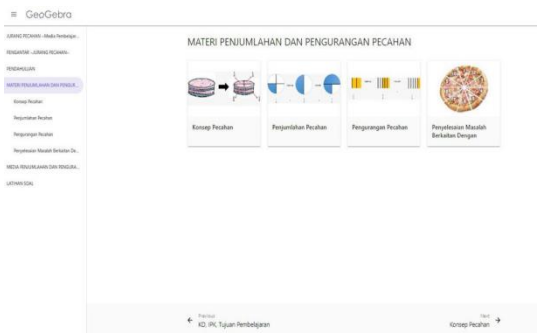

Figure 5 Summation Material Menu Display and Fraction Subtraction

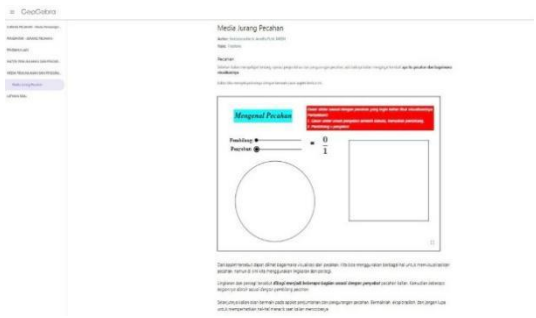

Figure 6 Learning Media Display Fractional Gap

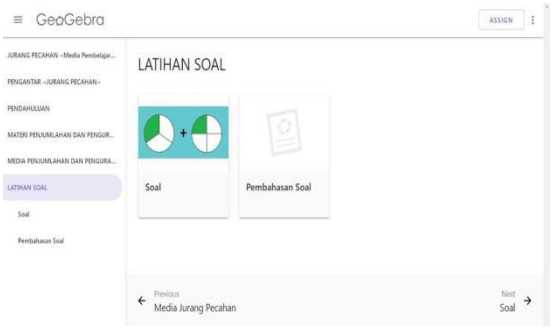

Figure 7 Question Practice Menu Display

The results of the validation of the Fractional Gap media that have been developed are used as qualitative and quantitative data. These data are then analyzed and described as a guideline in revising GeoGebra-based Fractional Gap learning media. Here are the results of the validation test.

Table 8 Media Expert Assessment Results

Aspect	Scores Obtained	Average Score	Category
Efficiency	17	4,25	Very Proper
Product Display	74	4,62	Very Proper
Technical Quality, Product Effectiveness and Utilization	42	4,66	Very Proper
Average		4,59	Very Worthy

The validation results from the expert validator, Muhammad Abduh, M.Pd, received an average instrument score of 4.59. When converted into qualitative data, the media criteria are "Very Good." This is evidenced by the achievement score of 29 statements on the questionnaire filled out by validators getting a score of 133 out of 145. So the GeoGebra-based Fractional Gap learning media deserves to be tested by class students by paying attention to responses and suggestions for improvement from media experts.

Suggestions and responses obtained from media experts include adding audio elements to make it even better. Thus, learning media is declared suitable for use with little revision. Regarding the advice given by media experts, researchers have not been able to follow up because the GeoGebra Software website cannot add audio elements.

Table 9 Material Expert Assessment Results

Aspect	Scores Obtained	Average Score	Category
Fill	33	4,125	Very Proper
Display	13	4,34	Very Proper
Average		4,18	Very Worthy

The validation results from the material expert validator, Meggy Novitasari, M.Pd, received an average instrument score of 4.18. When converted into qualitative data, the media criteria are said to be "Very Good". This is evidenced by the achievement score of 11 statements on the questionnaire filled out by validators, scoring 46 out of 55. So the GeoGebra-based Fractional Gap media deserves to be tested on grade V students by paying attention to responses and suggestions for improvement from material experts.

Suggestions and responses from material experts, namely Competency Achievement Indicators and objectives, made HOTS, evaluation questions made HOTS, and the development of teaching materials can be made more interesting with colourful pictures. Thus, learning media is declared suitable for use with little revision.

Table 10 Practitioner Expert Assessment Results

Aspect	Scores Obtained	Average Score	Category
Fill	40	5	Very Proper
Efficiency	15	5	Very Proper
Appearance	35	5	Very Proper
Effectiveness of Media Use	35	5	Very Proper
Average		5	Very Worthy

The validation results from the practitioner expert validator, Aris Susilowati, S.Pd, received an average instrument score of 5. When converted into qualitative data, the media criteria are "Very Good." This is evidenced by the achievement score of 15 statements on the questionnaire filled out by validators getting a 75 out of 75. So the Geogabra-based Fractional Gap learning media deserves to be tested on students by paying attention to responses and suggestions from practitioners experts.

From expert practitioners, there are no suggestions or responses. So based on the assessment, the Fractional Gap media is declared suitable for use in learning without revision.

4. Implementation

This stage is implementing GeoGebra-based Fractional Gap media that has been developed. The application of GeoGebra-based Fractional Gap media to students is carried out after obtaining a proper

assessment from validation experts (validators). Learning media was tested on 19 V-A SD IT Al-Falaah students. In applying teaching media, pretest-posttest tests are also carried out before and after using media to students to determine whether GeoGebra-based Fractional Gap media is effective in helping students in the teaching and learning process or not. The following are the pretest-posttest results of students from 2 classes, namely V-A and V-C classes, totalling 40 students.

Table 11 Data After Treatment With and Without Media

Frequencies

		N
Data after treatment with media - Data after treatment without media	Negative Differences[a]	2
	Positive Differences[b]	11
	Ties[c]	6
	Total	19

a. data after treatment with media < data after treatment without media
b. data after treatment with media > data after treatment without media
c. data after treatment with media = data after treatment without media

Table 12 Hypothesis Test

Test Statistics[a]

	Data after treatment with media - data after treatment without media
Exact Sig. (2-tailed)	.022[b]

a. Sign Test
b. Binomial distribution used.

Based on the results of the analysis above, it can be seen in the test statistics that the results of the hypothesis test obtained a probability of significance or p-value of 0.022 < 0.05, so that Ha is accepted means that there is an increase in understanding of the concept of addition and subtraction of fractions in grade V elementary school students using GeoGebra-based Fraction Gap learning media.

5. Evaluation

This is an evaluation stage of research on developing GeoGebra-based Fractional Gap learning media and student pretest-posttest results. If there are shortcomings, improvements are made so that the media that has been designed becomes better. This evaluation stage consists of formative and summative evaluation. Formative evaluation is carried out at the end of activities in each of the four stages of research to improve the media at each stage. Each step is assessed and revised to obtain media results that are suitable for use in mathematics learning. Summative evaluation is obtained from the effects of pretest-posttest tests on students regarding the concept of fractions. From the

pretest-posttest results, it can be concluded that the teaching and learning process using GeoGebra-based Fractional Gap media in the V-A class of SD IT Al-Falaah is effective. This is because students experience an increased understanding of addition and subtraction concepts of different denominator fractions.

Discussion

In this study, the GeoGebra-based Fraction Gap learning media that researchers have developed is feasible to improve the understanding of the concepts of grade V students on subtraction and addition of different denominator fractions. Thus, the GeoGebra-based Fractional Gap media is effectively applied in learning. This research is in line with the research and development carried out by (Aprilia & Zaini, 2020) that the GeoGebra-based media that has been developed is said to be feasible. Because it obtained very valid scores with 90% validity, 91.36% of student responses, and practical scores with 89.29% practicality of teacher responses. Thus, the resulting GeoGebra-based teaching media is practical and feasible in improving the learning outcomes of grade V elementary school students. In another research on development conducted by Nababan (2020), it can be concluded that the teaching media based on GeoGebra developed by researchers is said to be feasible. This is because it includes 3 criteria: valid, practical, and effective. Thus, this learning media can be implemented in teaching and learning activities to make it easier for students to understand the concept of the subject matter. In addition, previous research and development were also carried out by Sutopo & Ratu (2021), suggesting that the GeoGebra Classroom-based learning media that the researchers have developed is said to be feasible, effective, and practical to make it easier for students to learn and to understand the concepts of mathematical material.

CONCLUSION

Based on the results of research and development conducted, it was concluded that GeGebra-based Fractional Gap learning media is suitable to be used in the mathematics learning process for grade V elementary school students to improve understanding of the concept of subtraction and addition of fractions

with different denominators. Product feasibility is obtained by validating media, materials, and practitioners. The results of the media feasibility test are based on the calculation of the average media validation score of 4.59, which means that the media is on the "Very Good" criteria. The results of the material feasibility test are based on the calculation of the average material validation score of 4.18, which means that the media is in the "Very Good" criteria. The results of the material feasibility test are based on the calculation of the average practitioner validation score of 5, which means that the media is on the "Very Good" criteria. Increased understanding of the concept of fractions of students obtained from the results of the pretest-posttest obtained p-values of 0.022 < 0.05, then Ha is accepted, meaning that there is an increase in understanding of the concept of addition and subtraction of fractions in grade V students using GeoGebra-based Fraction Gap learning media. Thus, the GeoGebra-based Fraction Gap media development results are expected to help grade V elementary school students understand the concept of fractions and can help educators in the teaching process. However, applying GeoGebra-based Fractional Gap media in mathematics learning has weaknesses in accessing it, which requires a quota and internet network that is good enough to be accessible.

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