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Development of Fraction Teaching Aids to Improve Conceptual Understanding of Grade IV Elementary School Students (SD/MI)

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ABSTRACT :

Mathematics is one of the subjects that students need help understanding. This can be seen from the many students who have difficulty understanding various mathematical material concepts. The ability to understand concepts is the ability of students to understand and correctly understand the material being studied. Students will find it easier to master the material if the learning process carried out is in accordance with the characteristics and needs of the students. This is in line with the need to help students understand various concepts of equivalent fractions at SDN Balearjosari 1 Malang. This occurs because of the lack of mathematics learning aids, so students cannot understand the idea of the material being studied concretely. Based on these problems, researchers developed a teaching aid to make it easier for students to understand the concept of equivalent fractions at the elementary school level. This study uses the Research and Development research method with the Borg and Gall development model, adapting 6 stages: 1. Research and data collection, 2. Planning, 3. Initial product development, 4. Initial field testing, 5. Initial product revision, 6. Main field testing. The level of alat peraga validity obtained from several experts is 94 from material experts, 92 from alat peraga experts, and 96 from learning experts, with the three validation results showing alat peraga validation with very valid criteria. The effectiveness of fractional teaching aids in improving students' concept understanding abilities was obtained with a score of 0.72 or 72.18%, a high category using the N-gain test. By using fractional teaching aids, students' conceptual understanding at SDN Balearjosari 1 Malang increased in the high category.

Key words: *Teaching aids, Fraction Material, Understanding Concepts*

INTRODUCTION

Mathematics is a discipline that studies numbers, calculations, symbols, and patterns.¹ Mathematics is one of the subjects that students need help understanding.² This can be seen from the many students who have difficulty understanding various concepts of material in mathematics subjects.³ Mathematics education at the elementary school level aims to provide students with the skills to calculate and solve

¹ Alberth Supriyanto Manurung et al., "Implementasi Berpikir Kritis Dalam Upaya Mengembangkan Kemampuan Berpikir Kreatif Mahasiswa," *Jurnal Papeda: Jurnal Publikasi Pendidikan Dasar* 5, no. 2 (2023): 120–32, <https://doi.org/10.36232/jurnalpendidikandasar.v5i2.3965>.

² Zakiah Linda and Ika Lestari, *Berpikir Kritis Dalam Konteks Pembelajaran, Erzutama Karya Abadi*, 2019.

³ Een Unaenah et al., "Teori Brunner Pada Konsep Bangun Datar Sekolah Dasar," *Jurnal Pendidikan Dan Ilmu Sosial* 2, no. 2 (2020): 327–49, <https://ejournal.stitpn.ac.id/index.php/nusantara>.

problems in everyday life.⁴ To solve difficulties in everyday life, students must have an understanding of basic mathematical concepts. Suppose students have a mature understanding of mathematical concepts. In that case, they can solve problems through mathematical calculations using creative, careful, and systematic thinking skills to find solutions using the right mathematical calculations.⁵ Students' ability to perform mathematical calculations must also be based on mastery of the studied material. Mastery will be easier if the learning process is guided by the students' characteristics and needs.⁶ Learning mathematics for elementary school students enables them to solve problems by thinking more critically.⁷ Mathematics also involves problem-solving and intelligent decision-making based on available data and facts.⁸ Learning mathematics can help students gain systematic and analytical thinking skills. They also benefit from memory and focus exercises that help them solve mathematical puzzles. However, mathematics is often considered a challenging topic.

The difficulty in understanding various mathematical concepts for elementary school students is in line with the results of an interview conducted with Mrs. Wahyu Vakhuriroh S.Pd as the homeroom teacher for class IV of SDN Balarjosari 1 Malang. According to Mrs. Wahyu Vakhuriroh, many fourth-grade students need help in learning mathematics, one of which is in the material on fractions of equal value.⁹ This happens because of the lack of mathematical learning aids used, so students tend to get bored with the material being studied, especially the equivalent fraction material. In the learning process, teachers can provide several teaching aids to help students understand the material.¹⁰ Teaching aids are one type of tool used to assist the learning process. Teaching aids are very important to support activities carried out by teachers.¹¹ For students to meet the set learning objectives, learning aids stimulate their ideas,

⁴ Inge Ayudia et al., *Pengembangan Kurikulum PT. MIFANDI MANDIRI DIGITAL*, 2023.

⁵ Aulia Khairunnisa, Dadang Juandi, and Sumanang Muhtar Gozali, "Systematic Literature Review: Kemampuan Pemahaman Matematis Siswa Dalam Menyelesaikan Masalah Matematika," *Jurnal Cendekia : Jurnal Pendidikan Matematika* 6, no. 2 (2022): 1846–56, <https://doi.org/10.31004/cendekia.v6i2.1405>.

⁶ Samsul Susilawati, "Pengembangan Media Pembelajaran Digital Berbasis Website Berintegritas Nilai-Nilai Islam" 9 (2023): 66–79.

⁷ Anisa Indofah, Vitriana and Cahyo Hasanudin, "Anggapan Siswa Tentang Pelajaran Matematika Yang Sulit Dan Menakutkan," *Prosiding Seminar Nasional Daring*, no. 2020 (2023): 1110–13.

⁸ Siti Rofiatul Azizah, Vera Dewi Susanti, and Didin Heri Irawan, "Peningkatan Pemahaman Konsep Pecahan Melalui Penggunaan Alat Peraga Puzzle Pecahan Siswa Kelas 3," *FIBONACCI: Jurnal Pendidikan Matematika Dan Matematika* 9, no. 2 (2023): 157, <https://doi.org/10.24853/fbc.9.2.157-166>.

⁹ Wahyu Vakhuriroh, "Wawancara" (Malang, 2024).

¹⁰ Dian Andesta Bujuri, "Analisis Perkembangan Kognitif Anak Usia Dasar Dan Implikasinya Dalam Kegiatan Belajar Mengajar," *LITERASI (Jurnal Ilmu Pendidikan)* 9, no. 1 (2018): 37, [https://doi.org/10.21927/literasi.2018.9\(1\).37-50](https://doi.org/10.21927/literasi.2018.9(1).37-50).

¹¹ Yamomaha Telaumbanua, "Efektivitas Penggunaan Alat Peraga Pada Pembelajaran Matematika Pada Sekolah Dasar Pokok Bahasan Pecahan," *Kaos GL Dergisi* 8, no. 75 (2020): 147–54, <https://doi.org/10.1016/j.jnc.2020.125798> <https://doi.org/10.1016/j.smr.2020.02.002> <http://www.ncbi.nlm.nih.gov/pubmed/810049> <http://doi.wiley.com/10.1002/anie.197505391> <http://www.sciencedirect.com/science/article/pii/B9780857090409500205>

feelings, and motivation to understand the material being studied.¹² One of the most effective ways to support students and teachers during the learning process is through learning activities with teaching aids.¹³

Based on this, it can be said that teaching aids in the learning process function as aids that help teachers create an interesting and dynamic mathematics learning process for their students.¹⁴ Based on this, teachers can create interesting learning materials that help students understand the concept more thoroughly. By using fractional teaching aids, it can help students understand the concept of fractional material better¹⁵. From this description, the researcher developed a teaching aid to make it easier for students to understand the material of equivalent fractions. The research and development in question is entitled "Development of Fraction Teaching Aids (APACAN) to Improve the Conceptual Understanding Ability of Grade IV Students at SDN Balarjosari 1 Malang. This fraction teaching aid is made of board cardboard, designed to resemble the shapes of surrounding objects encountered in students' daily lives. This fraction teaching aid can be removed and reattached according to the pattern of the Object's shape. This teaching aid is also integrated with technology, which aims to provide students with a learning experience by studying the material and solving problems given through digital interalat peragaries. This technology is used so that students can better master and utilize modern technology appropriately.

Methods

The research and development method is used in this research. Researchers use the R&D research type to conduct research and create, produce, and test items that are being developed.¹⁶ The development model used in this study uses the Borg and Gall model stages by adapting 6 stages.¹⁷ The Borg and Gall model is used because it is a commonly used research development model and has proven to be efficient in developing high-quality products.¹⁸ The Borg and Gall model has 10 stages. This study adapts 6 of them based on the needs analysis results in the field, which, with the 6 stages, have answered the research objectives. This study used 25 fourth-grade students of SDN Balarjosari 1 Malang as subjects. Data collection techniques include

¹² Ari Indriani, "Penggunaan Blok Pecahan Pada Materi Pecahan Sekolah Dasar," *JIPMat* 3, no. 1 (2018): 11–16, <https://doi.org/10.26877/jipmat.v3i1.2418>.

¹³ Azizah, Susanti, and Irawan, "Peningkatan Pemahaman Konsep Pecahan Melalui Penggunaan Alat Peraga Puzzle Pecahan Siswa Kelas 3."

¹⁴ Mohammad Faizal Amir, *Buku Ajar Matematika Dasar*, 2016.

¹⁵ Rizki Nurhana Friantini et al., "Penguatan Konsep Matematika Dasar Pada Anak Usia Sekolah Dasar," *Jurnal Abdimas Bina Bangsa* 1, no. 2 (2020): 276–85, <https://doi.org/10.46306/jabb.v1i2.55>.

¹⁶ Sugiyono, *Metode Penelitian Kuantitatif, Kualitatif, Dan R&D*, ed. MT Dr.Ir. Sutopo. S.pd, 2nd ed. (Yogyakarta: ALFABETA, 2018).

¹⁷ Dede Dwiansyah Putra et al., "Kupas Tuntas Penelitian Pengembangan Model Borg & Gall," *Wahana Dedikasi : Jurnal PkM Ilmu Kependidikan* 3, no. 1 (2020): 46, <https://doi.org/10.31851/dedikasi.v3i1.5340>.

¹⁸ Moh. Iqbal Assyauqi, "Model Pengembangan Borg and Gall," *Institut Agama Islam Negeriegeri*, no. December (2020): 2–8, <https://www.taufiq.net/2019/09/model-penelitian-pengembangan-borg-and.html>.

observation, interviews, surveys, and documentation. Data analysis techniques use the N-gain test to measure the increase in learning outcomes before and after using fractional teaching aids.

Table 1. Research Stages

No	Stages	Description
1.	Research and Information Collection	<ul style="list-style-type: none"> a. Initial Analysis (Observation) b. Student Analysis c. Teacher Interview d. Task Analysis e. Learning Objectives Analysis f. Learning Alat peraga Analysis
2.	Planning	<ul style="list-style-type: none"> a. Planning Product Design b. Prototype/ Storyboard c. Initial Draft
3.	Developing Preliminary Form of Product	<ul style="list-style-type: none"> a. Designing alat peraga b. Creating alat peraga c. Allocating costs
4.	Preliminary Field Testing	<ul style="list-style-type: none"> a. Questionnaire Validation b. Expert Validation (Material Expert, Alat peraga Expert, and Learning Expert) c. Validation Result
5.	Revising Main Product	<ul style="list-style-type: none"> a. Analysis of Expert Validation b. Revising Product
6.	Main Field Testing	<ul style="list-style-type: none"> a. Final Product b. Trial in Class at SDN Balarjosari 1 Malang

Result

Research and Information Collection

The research was conducted by interviewing fourth-grade teachers to obtain information about the problems faced by students during the learning process. This step was taken to identify the issues and concerns that often occur in the classroom. The researcher conducted a literature review and discussed with experts who could help the researcher produce more information needed in the research process. The development of a product in the form of fractional teaching aids will be adjusted to the problems found at SDN Balarjosari 1 Malang. After collecting data and asking several questions to explore information, the following results were found: a.) Teachers still use teaching materials on the equivalent fraction material using modules and LKS. b.) The alat peraga teachers use in the learning process through objects around the class to explain the equivalent fraction material. c.) Teachers use only lecture and discussion methods in the learning process; d.) The teacher supports the researcher in developing equivalent fraction teaching aids to increase student learning motivation and help the learning process understand the equivalent fraction material better. Based on these problems, the researcher analyzed the existing learning achievements (CP) as a form of guidance to develop a learning alat peraga product.

The analysis of existing learning outcomes (CP) to develop equivalent fraction material products is that students can recognize equivalent fractions to understand the meaning of fractions and determine equivalent fractions. Researchers analyze and adjust the learning alat peraga developed by analyzing learning outcomes (CP) of equivalent fraction material. Researchers develop products in the form of equivalent fraction teaching aids to help teachers explain the concept of equivalent fraction material.

Planning

At this stage, the researcher makes a plan for product development by designing alat peraga in the form of a fractional equivalent teaching aid. Planning the design and materials used is the goal of the product development process at this stage. They are starting. We will begin by designing the framework of the teaching aid and determining the materials, tools, and devices needed. After that, the size and shape of the fractional teaching aid are determined. After that, the product is adjusted to the learning objectives. Learning objectives are very important for later product trials to be carried out on students who have learning objectives.

Developing Preliminary Form of Product

After designing the equivalent fraction teaching aids, the researcher developed the initial product, namely the equivalent fraction teaching aids for the Mathematics subject of grade IV semester I. The results of the development of the equivalent fraction of teaching aid alat peraga are as follows:

This fraction teaching aid is made of thick cardboard with several components, namely:

- a. Answer space
- b. Fraction board
- c. Fraction series
- d. Fraction box
- e. Materials and instructions for using the teaching aids
- f. Question cards and answer cards
- g. Barcode

Preliminary Field Testing

At this stage, the researcher conducts a alat peraga validation process to assess the feasibility of the product to the experts who have been determined. The experts are material validators, alat peraga validators, and learning experts. The material expert validator will evaluate the connection between the alat peraga and the learning objectives and provide input or suggestions from the learning materials available in product development. Alat peraga expert validation will offer assessments and suggestions covering alat peraga design, alat peraga appeal, and alat peraga feasibility for product development. Meanwhile, learning experts will assess the effectiveness of the product development made with the ongoing learning process. The purpose of validation is to identify the shortcomings or weaknesses of professional validators. Researchers will get criticism, suggestions, or recommendations from developing the product. So, it is useful for overcoming deficiencies in the alat peraga. The results of the trials that have been carried out will help researchers to continue to the next stage. The following are the results of the product validation developed by researchers as follows:

Table 1. Validator assessment

No.	Validator	Nilai	Informasi
1	Material expert	94	Very Valid
2	Teachin aids design	92	Very Valid
3	Learning Expert	96	Very Valid

Based on the results of the presentation in Table 4.2, the validation of the material expert obtained a score of 94, the validation of the alat peraga expert obtained a score of 92, and the validation of the learning expert obtained a score of 96. So, the learning alat peraga of equivalent fractions showed results with very valid criteria and were worth using to help students understand the material of equivalent fractions. After the researcher designed the product, the researcher validated the fraction teaching aids to the expert validators; the researcher revised the product by considering suggestions and criticisms from the validators regarding product development so that later, the fraction teaching aids would be better.

Revising Main Product

After the validation of the alat peraga created by the researcher, the refinement process will be carried out at this stage by the direction and revision recommendations from the validator through the questionnaire that has been determined; thus, the revision of the product development can be made and by the results of the product revision.

Main Field Testing

At this stage, the fraction teaching aids that have been repaired and are ready to be used and tested, the researcher will conduct a trial on 25 students in grade IV of SDN Balarjosari 1 Malang. In using this fraction teaching aid, students are asked to form 4 groups, and they are then asked to arrange the fraction forms that have been provided. Before being asked to organize the fractions, students are given a brief explanation through examples of the material and directions regarding using the fraction teaching aid alat peraga. With this, the interest of students and the feasibility of the equivalent fraction teaching aids developed in grade IV of SDN Balarjosari 1 Malang can be seen and also known. This study was conducted to determine the pre-test and post-test results of the effectiveness of the equivalent fraction teaching aids.

Test the effectiveness of fraction teaching aids

Before students receive treatment from the implementation of fraction teaching aids, a pre-test is first conducted. Based on the pre-test results, students have difficulty understanding the material on equivalent fractions. The value obtained during the pre-test was 39.13, and after using the fraction teaching aids, the post-test results were 83.91. After receiving the pre-test and post-test scores, the researcher analyzed the scores obtained. The analysis used was the N-gain test. This test is used to determine

the effectiveness of the treatment given. The following is the formula used to calculate the N-gain score.¹⁹

$$N - Gain = \frac{\text{posttest score} - \text{pretest score}}{\text{total score} - \text{pretest score}}$$

The N-gain criteria are presented in the following table:

Tabel 4.6 N-Gain Criteria

N-gain Index	Criteria
$g < 0.3$	Low
$0.3 \leq g \leq 0.7$	Medium
$g > 0.7$	High

The N-gain score can be calculated with the help of Ms. Excel. The results of the calculation of N-gain score in this study are as follows:

Table 4.4 Results of N-gain score calculation

Nama	Pre test	Post test	Post-Pre	100-Pre	N-Gain Score	N-Gain Score (%)
SDN Balarjosari 1	39,13	83,91	44,78	60,86	0,72	72,18

Discussion

Fraction teaching aids

This research and development activity was carried out to produce a product in the form of a fractional equivalent teaching aid called "Apacan (fraction teaching aid)." This teaching aid is a tool to help teachers and students support mathematics learning activities on the material of fractions of equal value. This fraction teaching contributes to solving problems to support and motivate students to be enthusiastic about learning mathematics, especially on the material of fractions of equal value. This fraction teaching aid has been tested and is valid and worthy of testing in class IV at SDN Balarjosari Malang. This fraction teaching aid is a means to help the mathematics learning process so that students can absorb information and understand the material other than from modules or LKS. In line with this definition, the background of this fraction teaching aid is a solution for teachers to create a new atmosphere in the learning process that is fun in understanding the material of fractions of equal value. This study uses the RME mathematical approach or a mathematical environment relevant to real-world conditions, and students find it

¹⁹ Ni Luh Putu Ari Laksmi and Ni Wayan Suniasih, "Pengembangan Media Pembelajaran E-Comic Berbasis Problem Based Learning Materi Siklus Air Pada Muatan IPA," *Jurnal Imiah Pendidikan Dan Pembelajaran* 5, no. 1 (2021): 56–64.

easier to solve problems pertinent to everyday life based on their experiences.²⁰ The selection of real conventional teaching aids with their components will complement the chosen teaching aids because of the objects that students encounter in everyday life. In addition, it will help students achieve learning objectives from the equivalent fraction material. The equivalent fraction material is about understanding the concept of two or more fractions of the same value adjusted to the learning achievements set.²¹ This makes choosing equivalent fraction questions help students understand the concept of equivalent fractions.

Fraction teaching aid development process

The research and development activities of equivalent fraction teaching aids at SDN Balarjosari Malang were motivated by the facts of the problems found by the researcher. The problem in mathematics subjects in the equivalent fraction material is that students find it difficult to understand the material because teachers still use lecture and discussion methods without the help of teaching aids. This makes students less interested in the equivalent fraction material being studied²². Using modules and LKS alone is also why students easily get bored in the learning process.²³ With this teaching aid, researchers expect to help the learning process and understanding of equivalent fractions. So that effective and enjoyable learning can take place. This is also in line with previous research by Rachman et al. on the development of fraction teaching aids that can determine the effectiveness of teaching aids in the mathematics learning process.²⁴ Then, this study uses the Borg and Gall model research type by adapting 6 stages. The stages that will be carried out in this study are Research and data collection, Planning, Initial product development, Initial field testing, Initial product revision, and Main field testing.²⁵ Based on the results of developing fraction teaching aids and validation from expert validators. Fraction teaching aids are very feasible to be used in learning fractional equivalent material with very valid criteria.

Fraction teaching aid validation process

The results of the product feasibility validity test by three expert validators, namely material experts, demonstration tool experts, and learning experts, are as follows: (1) Product feasibility test 56 by material experts, namely obtaining a score of 94 with the criteria of very valid and very feasible, (2) Product feasibility test by demonstration tool experts, namely obtaining a score of 92 with the criteria of very valid and very feasible, and (3) Product feasibility test by learning experts, namely obtaining a score of 96 with the criteria of very valid and very feasible.

²⁰ Anita Dewi Utami, Puput Suriyah, and Novi Mayasari, *Level Pemahaman Konsep Komposisi Fungsi Berdasar Taksonomi Solo*, 2020.

²¹ Jefri Febrianto et al., "Kemampuan Siswa Dalam Menyelesaikan Masalah Matematika Pada Materi Bilangan Bulat Dan Pecahan," *Prosiding Seminar Nasional Pendidikan Matematika, Universitas Mulawarman* 3 (2023): 204–10.

²² Muhammad Rusli Baharuddin, "Konsep Pecahan Dan Pendekatan Pembelajaran Matematika Realistik," *Jurnal Studi Guru Dan Pembelajaran* 3, no. 3 (2020): 486–92, <https://doi.org/10.30605/jsgp.3.3.2020.442>.

²³ Frischa Angelline Kurniawan, Aan Nurfahrudianto, and Dian Devita Yohanie, "Kemampuan Berpikir Kritis Matematis Ditinjau Dari Hasil Belajar Siswa," *Jurnal Ilmiah Pendidikan Citra Bakti* 10, no. 3 (2023): 636–49, <https://doi.org/10.38048/jipcb.v10i3.2077>.

²⁴ Andi Nurannisa Mutmainna, Asfar Taufan, Asfar, *Pemahaman Konsep Siswa Bernuansa Etnomatematika*, 2016.

²⁵ Sepna Gitnita, Zuhendri Kamus, and Gusnedi, "Analisis Validitas, Praktikalitas, Dan Efektivitas Pengembangan Bahan Ajar Terintegrasi Konten Kecerdasan Spiritual Pada Materi Fisika Tentang Vektor Dan Gerak Lurus," *Pillar of Physics Education* 11, no. 2 (2018): 153–60.

Effectiveness of fraction teaching aids

Conceptual Understanding Ability in this study was measured from the pretest and post-test questions. An N-gain test was conducted to determine how much the students' numeracy ability increased after using fractional teaching aids. The N-gain test results on the pretest and posttest results of students at SDN Balearjosari 1 Malang obtained a value of 0.72 or 72.18% with a high category. By using fractional teaching aids, the students' understanding of the concept of equivalent fractions at SDN Balearjosari 1 Malang increased in the high category.

Conclusion

Based on the results of the development of teaching aids and data presented, this development produces the following: a. The product development process was developed using the R&D research method with the Borg and Gall model, which was adapted into 6 stages as follows: (1) Research and data collection, (2) Planning, (3) Initial product development, (4) Initial field testing, (5) Initial product revision, and (6) Main field testing. The level of validity of teaching aids obtained from several experts was 94 from material experts, 92 from teaching aid experts, and 96 from learning experts, with the three validation results showing the validation of teaching aids with very valid criteria. The results of the developed products are worthy of being used as teaching aids to help students understand the concept of fraction material. In addition, the use of technology using barcodes can also improve their understanding of modern technology. This is a good introduction to mastering more complex technology in the future. The effectiveness of fraction teaching aids in enhancing students' concept understanding abilities was obtained with a score of 0.72 or 72.18%, a high category. By using fraction teaching aids, students' conceptual understanding at SDN Balearjosari 1 Malang increased to the high category.

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