Development Of Fraction Puzzle Teka-Teki Media to Improve Mathematical Problem-Solving Abilitiy Students' in Elementary School

Dwi Endah Lestari[1], Wahyudi[2]

[1]*PGSD FKIP, Universitas Kristen Satya Wacana, Indonesia.*

[2]*PGSD FKIP, Universitas Kristen Satya Wacana, Indonesia.*

E-mail:endahtan@gmail.com, yudhi@uksw.edu

Abstract

Penelitian ini mengkaji pengembangan media *Puzzle* Teka-Teki Pecahan yang bertujuan untuk meningkatkan kemampuan pemecahan masalah matematika siswa SD kelas 2. Media ini dirancang dengan pendekatan interaktif guna mengatasi permasalahan dalam pembelajaran matematika bagi siswa yang memiliki kemampuan pemecahan masalah matematis yang masih rendah. Dalam penelitian ini menggunakan jenis penelitian *Research and Development* dengan model pengembangan ADDIE (*Analysis, Design, Development, Implementation dan Evaluating*). Subjek penelitian adalah Sekolah Dasar Negeri Tingkir Lor 02 Salatiga, untuk sampel penelitian yaitu siswa kelas 2 SD. Hasil dari penelitian ini yaitu validasi oleh ahli materi, ahli media, dan ahli pembelajaran menunjukkan tingkat validitas yang "sangat tinggi", masing-masing mencapai 91,6%, 93,3%, dan 75%. Kepraktisan media mendapatkan presentase 88% dengan kategori "sangat tinggi" dari respon siswa dan 92,5% dengan kategori "sangat tinggi" dari respon guru. Penerapan "Puzzle Teka-Teki Pecahan" dalam pembelajaran efektif, seperti yang dibuktikan oleh peningkatan nilai pos tes siswa kelas 2. Analisis statistik menunjukkan hasil yang signifikan (Sig. [2-tailed] = 0,000 < 0,05), menunjukkan peningkatan kemampuan pemecahan masalah matematika setelah penggunaan media yang dikembangkan. Berdasarkan temuan ini, dapat disimpulkan bahwa "Puzzle Teka-Teki Pecahan" adalah media yang layak digunakan dalam pembelajaran matematika dan efektif dalam meningkatkan kemampuan pemecahan masalah matematika siswa kelas 2 sekolah dasar.

Kata Kunci: Pengembangan, Puzzle Teka-Teki Pecahan, Pemecahan Masalah, Matematika

Abstract

This research examines the development of a media entitled "Fraction Puzzle Teka-Teki" with the aim of improving the mathematical problem-solving abilities of 2nd grade elementary school students. This media is designed with an interactive approach to address issues in mathematics education for students with low problem-solving abilities. This research uses Research and Development research with the ADDIE (Analysis, Design, Development, Implementation and Evaluating) development model. The research subjects were the Tingkir Lor 02 Salatiga State Elementary School, the research samples were 2nd grade elementary school students. Validation results from subject matter experts, media experts, and learning experts indicate "very high" levels of validity, with scores reaching 91.6%, 93.3%, and 75%

respectively. Media practicality received a percentage of 88% in the "very high" category from student responses and 92.5% in the "very high" category from teacher responses. The implementation of the "Fraction Puzzle Teka-Teki" in education is effective, as evidenced by the improvement in post-test scores for second-grade students. Statistical analysis shows significant results (Sig. [2-tailed] = 0.000 < 0.05), indicating an enhancement in mathematical problem-solving abilities following the use of the developed media. Based on these findings, it can be concluded that "Fraction Puzzle Teka-Teki" is a suitable tool for mathematics education and is effective in enhancing the mathematical problem-solving abilities of students. indicating an enhancement in mathematical problem-solving abilities following the use of the developed media. Based on these findings, it can be concluded that "Fraction Puzzle Teka-Teki" is a suitable for use in mathematics education and is effective in improving the mathematical problem-solving abilities of 2nd grade elementary school student.

Introduction

Education in 21st century learning emphasizes the importance of problem-solving abilities in facing future challenges. This ability is one of the 4C characteristics in 21st century learning, namely the ability to communicate, collaborate, critical thinking, solve problems, and be creative and innovative (Ratna Sari et al., 2018:78). Problem solving abilities are very relevant, especially in the learning context in elementary schools. Mathematics is one of the subjects that is closely related to everyday life and requires problem solving abilities. However, TIMSS and PISA data show that students' mathematical abilities in Indonesia are still low, especially in problem solving (Lestari et al., 2021). Therefore, it is important to improve students' mathematical problem-solving abilities, especially at the elementary school level. The current elementary school curriculum demands the importance of problem-solving skills in mathematics learning (Ardhiyah & Radia, 2020). Results from Ministry of Education and Culture data also show that students' problem-solving abilities, especially in mathematics, are still low (Kemendikbud, 2022).

At the stage of cognitive development, children at elementary school age will experience difficulties in solving abstract problems. According to Khurriyati et al., (2022) fraction material is one of the mathematics learning materials that students find difficult, because students cannot understand the problems well so they can be applied to mathematical symbols and solving fraction problems. The lack of tools or media for learning fractions also makes it difficult for students to understand the abstract concept of fractions and apply problem solving.

Based on the results of a preliminary study through interviews with teachers in grade 2 at Tingkir Lor Elementary School, teachers still use simple learning media such as paper and plasticine. During the lesson, the teacher had never developed learning media. Apart from that, data was also obtained that grade 2 students still had difficulty learning mathematics, especially learning about simple fractions. Students are still unable to complete story questions. Therefore, it is necessary to develop learning media that can help students improve their mathematical problem-solving abilities, especially in simple fractions material for grade 2 elementary school.

A method that can be used as a solution is to use learning media in the form of puzzles. Puzzle is a game in the form of a puzzle containing board pieces with pictures or words that must be arranged first to form a complete pattern (Tsani & Indrawati, 2019). By using this media, students can actively think, analyze problems, and find solutions. This media is

also able to increase students' interest in learning mathematics.

This research aims to develop fraction puzzle media that can improve elementary school students' mathematical problem-solving abilities. This media consists of puzzle pieces with illustrations of story problems about simple fractions, puzzle boards, fraction puzzle pieces, problem solving-based LKPD, and guidebooks. Students will be asked to solve word problems in fraction puzzle pieces, analyze the problem, and plan a solution to the problem. Through the medium of fraction puzzles developed in this research, it is hoped that it can make it easier and help students to overcome difficulties in understanding fractions and improve their mathematical problem-solving abilities. In previous research, (Gorev et al., 2018). This media can also train students to think creatively, take initiative, and be responsible for choosing problem solving methods. The use of fraction puzzle media is an innovative and positive step in improving the quality of mathematics learning in elementary schools. It is hoped that mathematics learning, especially in fraction material, can be more interactive, effective, interesting and help students understand the material. Based on this, to meet students' needs because the role of learning media is considered important, the researchers developed Fraction Puzzle Teka-Teki media using simple fraction material to improve elementary school students' problem-solving abilities.

Method

The type of research carried out in this research is research and development (R&D), which includes a research approach aimed at developing or producing a new product, method or innovation as well as testing the effectiveness or feasibility of the product or innovation. This development researcher used the five steps of the ADDIE model development model. In detail it can be explained as follows:

In the analysis stage, interviews were conducted with teachers and students to find out the learning process, difficulties experienced by students when learning, student learning styles, student abilities, teachers' teaching methods, and the media used. The research subjects were teachers and grade 2 students at Tingkir Lor 02 Salatiga State Elementary School.

The design (planning) stage is carried out to determine the theme of learning media in the form of print media in the form of puzzles, insert books and other reference sources to support research, identify competencies, learning objectives and assessments, and finally prepare a learning plan.

The development stage aims to test the level of product validity through testing media experts, material experts and learning experts by providing validation instrument sheets. Experts will provide assessments, criticism and suggestions for improvements which will then be revised by researchers before the product is tested. Data analysis of the feasibility of product development results is written using a percentage score, the greater the percentage, the higher the product feasibility.

The implementation stage was carried out by field trials with teachers and 8 students to determine the level of practicality of the media by providing teacher and student response questionnaires. After that, a media trial was carried out in one class to determine the effectiveness of the media through the results of assessing problem-solving abilities from the pre-test and post-test.

The final stage is evaluation. In this stage, pre-test and post-test data processing of mathematical problem-solving abilities was carried out using IMB SPSS Statistics 25, which was then tested using the Paired Samples T Test.

The data analysis technique used to calculate product validation from media, material and learning experts is using percentage and categorical descriptive analysis techniques. This aims to determine the feasibility results of the media being developed. The formula used is:

$$AP = \frac{Skor\ Aktual}{Skor\ Ideal}\ x\ 100\%$$

The percentage formula used is, the actual score is the score obtained by the expert divided by the ideal score or the maximum score resulting from the product of the number of items and the maximum score for each item.

The presnetase results are then interpreted into five product suitability categories, which can be seen in Table 1.

Table.1 Categories of Data Analysis Results

Percentage Interval	Category
81 – 100 %	Very high
61– 80 %	Tall
41 – 60 %	Enough
21 – 40 %	Low
0 – 20 %	Very low

Based on these percentage categories, the media validation test results can be said to be suitable for testing if the minimum average percentage figures reach the high category ($\geq 61\%$) (Gumilang et al., 2019). The practicality of the media was carried out through analysis of the results of response questionnaires during limited trials of fractional puzzle media. Meanwhile, the effectiveness of the media is carried out by analyzing pretest and posttest results using fraction puzzle media using the problem-based learning (PBL) model in one class with a one group prettes-posttest design. From the results of the pretest and posttest completion using problem solving ability criteria, then compared with the Paired Samples T Test.

Results and Discussion

The development of Fraction Puzzle Teka-Teki media is a positive step in improving the quality of mathematics learning in elementary schools. This media can help students develop their mathematical problem-solving skills and prepare them to face mathematical challenges involving fractions in the future. Research carried out at SD Negeri Tingkir Lor 02, found that teachers had not developed or used much learning media. Even if it is used, its use is still limited and is not closely related to the learning model or method used. Apart from that, students' abilities in problem solving, especially in word problems in mathematics lessons, are still low. Therefore, the first step that needs to be taken is to develop learning media as an innovation in the learning process, with the hope of improving students' ability to solve problems by trying to answer and finding ideas for how to solve the problem. The second process involves planning the concept of developing learning media in the form of Fraction Puzzles. This media is designed according to the subject matter and grade level to be used. The fraction puzzle media will be made in the form of a printed mission game that allows students to play it directly. The following is a display of the results of the development of fraction puzzle media products: This media is designed according to the subject matter and grade level to be used. The fraction puzzle media will be made in the form of a printed mission game that allows students to play it directly. The following is a display of the results of the development of fraction puzzle media products: This media is designed according to the subject matter and grade level to be used. The fraction puzzle media will be made in the form of a printed mission game that allows students to play it directly. The following is a display of the results of the development of fraction puzzle media products:
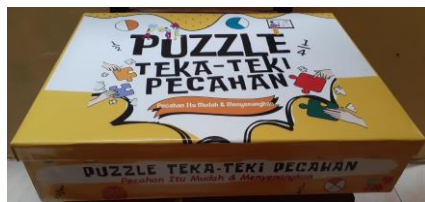
Figure 1.
Fraction Puzzle Media Packaging

Figure 2. Fraction Puzzle

Figure 3.
Fraction Pizza

Figure 4.
Broad Fraction

Figure 5. Guide book

Figure 6. LKPD based on problem solving

After the media product has been printed, the researcher carries out the validation stage. This stage involves media validation by media expert lecturers, material validation by material expert lecturers, and learning design validation by learning experts. During the validation stage, researchers included the learning media that had been developed together with the validation instrument sheet. The following is a discussion of the expert validation results:

1. **Material Expert Validation**

Table 2. Material Expert Validation Results

No.	Aspect	Score
1	Material Contents	32
2.	Solution to problem	23
	Amount	**55**
	Percentage	**91.6%**

Based on calculations, the presentation results reflect a total score of 55, which is equivalent to 91.6%. The results of this data analysis fall into the "Very High" category, with a range between 81% to 100%, with no revision or correction required. Therefore, it can be concluded that the Fraction Puzzle development media is worthy of being tested without requiring revision.

2. **Media expert validation**

Table 3. Media Expert Validation Results

No.	Aspect	Score
1	Appearance	34
2.	Instructional Quality	9
3.	Quality	13
	Media Technical	

Amount	56
Percentage	93.3%

Based on the figures, the data analysis results show a total score of 56 with a percentage of 93.3% which can be classified in the "Very High" category, with a score range between 81% to 100%, without any revision or correction required. Therefore, it can be concluded that the Fraction Puzzle development media is suitable for testing without the need for revision. A media expert also commented on the Fraction Puzzle media, saying that this media was designed in the form of an interesting puzzle and was suitable for use in research.

3. Validation of learning design experts

Table 4. Learning Expert Validation Results

No.	Aspect	Score
1	Learning	30
	Amount	30
	Percentage	75%

Based on the calculation of presentation numbers, the total score is 30, which results in a presentation number of 75%. The results of this data analysis are in the "High" category, with a score ranging from 61% to 80%, but need to be revised with notes on suggestions for improvement. The first improvement note is regarding the preparation of learning objectives, which need to adhere to the correct ABCD formulation and describe activities according to PBL syntax. The second improvement note refers to phase 1 of the activity, which needs to have a key issue that will resolve all the expected competencies. Finally, an improvement note is that assessment questions must be adjusted to basic competency indicators and provide measurable opportunities to measure problem solving abilities in accordance with PBL.

Researchers have carried out revisions to the products developed in accordance with suggestions given by experts. Next, the product was tested limited to teachers and 8 grade 2 students at SD Negeri Tingkir Lor 02. The results of this trial were used to determine the level of practicality of the fraction puzzle media. After analyzing the results of filling out the response questionnaire, the class 2 teacher at SD Negeri Tingkir Lor obtained a percentage of 92.5% and the results of the student response questionnaire obtained a percentage of 88%. This proves that fraction puzzle media as a learning medium has a very high level of practicality with a score ranging from 81% to 100%.

Furthermore, the results of students' problem-solving abilities can be seen from the results of pre-test and post-test completion, which can be seen in table 5.

Table 5.
Completeness of pretest and posttest results

Ketuntasan	Pretes		Postes	
	Jumlah	Presentase	Jumlah	Presentase
Tuntas	7	25%	25	89%
Tidak Tuntas	21	75%	3	11%

Based on the pretest and posttest completion table above, it is stated that only 7 students completed the pretest with a score of ≥ 70 or 25%, while there were 21 students who did not complete it or 75%. Meanwhile, completion of the posttest with a score of ≥ 70 increased to 25 students or 89%, while there were still 3 students who did not complete it or 11%. So, it can be concluded that students' mathematical problem-solving abilities after using fraction puzzle media show a significant increase.

Table 6.
Descriptive Statistics Pretest and Posttest

	N	Minimum	Maximum	Mean	Std. Deviation
Pre	28	35.00	85.00	65.3214	12.66975
Post	28	48.00	100.00	84.2143	11.59616
Valid N	28				

Based on table 6, this summary of descriptive statistics provides an overview of the distribution of pretest and posttest data as well as several important statistics that describe the characteristics of the two groups of data with the average value of the Pretest having an average value of 65.3214 and the Posttest having an average value of 84.2143. This indicates that after the treatment or intervention was given, there was a significant increase in the posttest results compared to the pretest results. In addition, the lower standard deviation value in the posttest indicates that the posttest data is more concentrated around the average value compared to the pretest data. Std. Mean Error measures how accurate the estimate of the sample mean is to the population mean. Std value. The lower mean error in the posttest indicates that the posttest mean estimate is more accurate compared to the pretest. Overall, this table provides important information about the distribution of the data, the comparison between the pretest and posttest, and how consistent or concentrated the data is around the mean value. The increase in the average score from pretest to posttest shows the effectiveness of the intervention carried out in this study.

Table. 7 Paired Samples Test

			Paired Differences						
					95% Confidence Interval of the Difference				Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	T	Df	
Pair 1	PRETEST – POSTTEST	-18.89286	15.67574	2.96244	-24.97127	-12.81444	-6,377	27	,000

Based on the tabel.7 Paired Samples Test, it shows the results of the comparative analysis between the pretest and posttest scores after applying the development media, namely the Fraction Puzzle Teka-Teki, using the basis for decision making and looking at the results of the t test table shows a significance value (2-tailed) of 0.000, which means < 0.05. Therefore, it can be concluded that H0 (null hypothesis) is rejected, and this shows that there is a significant influence from the development of Fraction Puzzle media on increasing the mathematical problem-solving abilities of grade 2 elementary school students. There is a substantial difference between the pretest learning results before using Fraction Puzzle Teka-Teki media and the posttest learning results after using this media during the learning process. Therefore, concluded that the Fraction Puzzle Teka-Teki Media that has been developed has proven to be effective in improving the mathematical problem-solving abilities of 2nd grade elementary school students.

Conclusion

From the research results described in the study entitled "Development of Fraction Puzzle Teka-Teki Media to Improve Mathematical Problem-Solving Abilitiy Students' in Elementary School," it can be concluded that the Fraction Puzzle Teka-Teki media, which is designed interactively, can overcome the problems faced by teacher's class 2 in improving students' mathematical problem-solving abilities which tend to be low. This media, in the form of print, has successfully passed a series of validations which resulted in a high level of validity, as approved by material experts at 91.6%, media experts at 93.3%, and learning design experts at 75%. The media developed is also practical to use, this is based on the results of a questionnaire given to 8 students with results of 88% and the results of the questionnaire given to teachers were 92,5%. Apart from that, Fraction Puzzles have also been proven to be effective in improving students' mathematical problem-solving abilities, as seen from the significant increase in post-test scores (Sig. [2-tailed] = 0.000 < 0.05). Thus, the results of the development of Fraction Puzzle Teka-Teki media in this research conclude that this

media is suitable for use in the learning process and is effective in improving students' mathematical problem-solving abilities at elementary school level.

References

[1] Ardhiyah, M. A., & Radia, E. H. (2020). Pengembangan Media Berbasis Adobe Flash Materi Pecahan Matematika Untuk Meningkatkan Hasil Belajar. *Jurnal Penelitian Dan Pengembangan Pendidikan*, *4*(3), 479. Https://Doi.Org/10.23887/Jppp.V4i3.28258

[2] Gorev, P. M., Telegina, N. V., Karavanova, L. Z., & Feshina, S. S. (2018). Puzzles As A Didactic Tool For Development Of Mathematical Abilities Of Junior Schoolchildren In Basic And Additional Mathematical Education. *Eurasia Journal Of Mathematics, Science And Technology Education*, *14*(10). Https://Doi.Org/10.29333/Ejmste/93675

[3] Gumilang, M. R., Wahyudi, W., & Indarini, E. (2019). Pengembangan Media Komik Dengan Model Problem Posing Untuk Meningkatkan Kemampuan Pemecahan Masalah Matematika. *Journal Of Medives : Journal Of Mathematics Education Ikip Veteran Semarang*, *3*(2), 185. Https://Doi.Org/10.31331/Medivesveteran.V3i2.860

[4] Khurriyati, A. L., Ermawati, D., & Riswari, L. A. (2022). Peningkatan Kemampuan Pemecahan Masalah Matematis Siswa Kelas Iii Melalui Media Pacapi (Papan Pecahan Pizza). *Jiip - Jurnal Ilmiah Ilmu Pendidikan*, *5*(4), 1028–1034. Https://Doi.Org/10.54371/Jiip.V4i5.497

[5] Lestari, Y., Rahmad, M., & Zulfarina, Z. (2021). Needs Analysis Of Problem Solving Based Learning Video Development To Train Students' Concept Understanding. *Jurnal Pendidikan Sains (Jps)*, *9*(1), 81. Https://Doi.Org/10.26714/Jps.9.1.2021.81-90

[6] Ratna Sari, Y., Thoha Jaya, M. B., & Fitria Anggraini, G. (2018). *Penggunaan Media Puzzle Terhadap Peningkatan Kemampuan Pemecahan Masalah Anak Usia 5-6 Tahun*.

[7] Tsani, N. Z., & Indrawati, D. (2019). *Pengembangan Media Zebotika (Puzzle Book Matematika) Berbasis Pendidikan Matematika Realistik Indonesia (Pmri) Pada Materi Mengenal Pecahan Bagi Siswa Kelas II Sekolah Dasar*.

Author Profile

The first author is Dwi Endah Lestari, is a final semester student from Satya Wacana Christian University Salatiga, who is taking the PGSD S1 Study Program. The second author is Dr. Wahyudi, S.Pd., M.Pd., MCE. As a PGSD lecturer at Satya Wacana Christian University Salatiga.