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Development of puzzle learning media for equivalent fractions for fourth-grade elementary school

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ABSTRACT

The background of this research is the lack of use of mathematics learning media in elementary schools. Therefore, this study aims to develop a puzzle learning media for equivalent fractions that is valid and practical. This study used research and development (R&D) methods with the ADDIE model which consists of 5 stages: analyze, design, development, implementation, and evaluation. The puzzle developed were validated by media and materials experts. The subjects of this study were four fourth-grade elementary school students. The results showed that the validity of the media was 91.15% with a very valid category, and the validity of the material was 79.69% with a valid category. Practicality test with 4 fourth-grade students obtained a percentage of 91.68% with a very practical category. Therefore, the puzzle learning media for equivalent fractions is appropriate to be used as a medium for learning mathematics in fourth grade of elementary school.

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INTRODUCTION

Mathematics is one of the fields of study that play a significant part in education. Mathematics is a tool for developing a way of thinking because mathematics is essential in life and in dealing with the advancement of science and technology (Hsieh et al., 2012), hence mathematics should be taught to kids from kindergarten to college.

Mathematics is the most difficult topic for elementary school kids to grasp, and fractions are one of the materials regarded challenging (Oktasari et al., 2022). Fractions are a fundamental material in the study of mathematics and research related to the environment (Zabeta et al., 2015). Students' difficulties in solving fractions problems are caused by a lack of students' interest in learning mathematics, particularly fractions, as well as low learning motivation and insufficient student abilities in learning mathematics (Haniq, 2019). This occurs because the teacher is less adept in correctly imparting the concept of fractions.

According to the findings of Putra's (2016) study, only 44.53% of prospective primary school teachers were successful in presenting fraction multiplication operations and 24.22% were successful in presenting fraction division operations. Teachers, in fact, require this expertise in order to teach students fraction operations (Putra, 2016). Meanwhile, teachers tend to teach fractions to pupils in an abstract manner, without linking it to real life or employing learning media to help students understand the topics being studied.

Mathematics learning in primary schools necessitates the use of learning media, which can be utilized as a method to deliver subject matter (Nurzayyana et al., 2021). According to Azhar (2011), the media can help to simplify the complexity of the material delivered to students. The learner is the recipient of the message, while media is a tool utilized to transmit message content (Anitah, 2009). The usage of learning media is essential for conveying the subject since visualization allows the material to be seen more clearly and interestingly. Puzzle media is one type of media that can be converted into engaging mathematics learning media.

Puzzle is a type of game in which fragments of images are arranged to produce a coherent whole (Jamil, 2012). Puzzle games are a type of game that tests students' creativity and memory more profoundly owing to the creation of incentive to always strive to answer issues, but they are still enjoyable because they may be replayed. The usage of puzzle games in mathematics education can provide pupils with meaningful learning. This is because kids are in an enjoyable learning environment rather than a boring one. This meaningfulness can help students understand teaching materials, resulting in improved learning outcomes.

Based on the description that has been stated, the authors are interested in researching the development of puzzle media as learning media in mathematics subjects. More specifically, researchers are interested in developing learning puzzle media on equivalent fraction material for grade 4 students as if it were a valid and practical basis.

METHOD

The research method used in this study is the research and development (R&D) (Sugiyono, 2019) method with the ADDIE model. The ADDIE model (analise, design, develop, implement, and evaluate) that is applied in the world of education is made with the aim that learning can be student-centered, innovative, and provide genuine experiences to students (Branch, 2009).

Analyze stage is the initial stage which consists of student and material analysis. Student analysis is very important at the beginning of planning. Student analysis is carried out by observing the characteristics of students so that the products developed are following student interests. Material analysis is carried out by identifying the main materials to be used, collecting materials, and selecting relevant materials, and rearranging them systematically.

After getting the problems from the analysis stage, the next stage is the design stage. This design stage aims to design the presentation of a puzzle media of fractions that will be used. The product designed in this research is a media in the form of a puzzle and each puzzle has 16 puzzle pieces, and each piece has numbers and pictures. The process of designing the card by determining the size of the card using Corel Draw x7, after the size is adjusted then the process of entering numbers and images that match the fraction material. This product is designed as an interesting and fun medium for learning mathematics.

This development stage aims to produce a fraction puzzle media product that has been revised based on input from media experts and material experts. Expert validation serves to validate the equivalent fraction puzzle media before the trial is carried out. The validation results are used to revise the product, so that it can be seen whether the fraction media is feasible or not. The results of this validation are used as improvement material for the perfection of the puzzle media product of equivalent fractions that was developed.

The implementation stage is the step in which the developed media design is put into action in real-world conditions (Cahyadi, 2019). Following on from the creation stage, the media is now being tested on students in the implementation stage. More pupils participated in small group trials than in one-on-one trials. The researchers analyzed two fourth grade students in a one-on-one trial. The small group trial was carried out on four fourth grade students from Pekanbaru.

At this stage, the researchers completed the last modification of the equivalent fraction puzzle media, which was created using feedback from the response questionnaire. This is done to ensure that the corresponding fraction puzzle media generated is actually appropriate and may be widely used in classrooms. Only formative evaluation was used in this study to validate the product development and make adjustments based on the input or ideas provided. Categories for the quality of equivalent fraction puzzle media are based on table 1.

Table 1. Categories of the validity and feasibility of equivalent fraction puzzle media

Criteria	Kategori
81 - 100	Very Valid/Very High
61 – 80	Valid/High
41 – 60	Less Valid/Fair
0 – 40	Not Valid/ Poor

RESULTS AND DISCUSSION

a. Analysis

The analysis stage is useful for determining and defining the needs in the learning process and collecting various information related to the product to be developed. This stage is divided into two steps, namely:

Analisis of Student Characteristics

Student analysis is very important at the beginning of planning. Analysis of students is done by observing the characteristics of students so that the products to be developed are in accordance with the interests of students. Analysis of the characteristics of students is carried out to determine the skills of learning styles, and attitudes of students to be ready to carry out the learning process. Elementary school students enjoy active and creative learning. Therefore, the media of equivalent fraction puzzle is expected to increase students' interest in learning mathematics. This analysis was carried out by observing the fourth-grade students at an integrated Islamic school in Pekanbaru when the researchers conducted an internship. Students have difficulty understanding the materials given because learning mathematics is carried out using the lecture method and is guided by examples that are only

found in textbooks. From the results of this analysis, researchers are interested in making and developing puzzle media in mathematics learning with equivalent fractions.

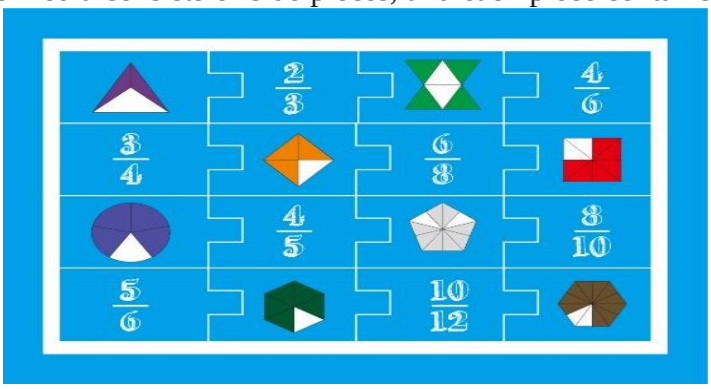
Analysis of Science Learning Material

Material analysis is performed by identifying the primary material to be used or selected, gathering material, selecting relevant material, and systematically rearranging it. The first lesson's material is about fractions. The learning material chosen is tailored to the ongoing learning. In the first semester of fourth grade, students learn about recognizing fractions and equivalent fractions. The numbers and visuals on the comparable fraction puzzle medium are designed to be easily understood by pupils based on what they have learnt.

b. Design

This design stage aims to design the presentation of a domino card media that will be used. The steps taken are to prepare the source of the book and identify the material from the fourth-grade elementary math book focused on the material of fractions worth

The puzzle media consists of side pieces, and each piece contains several fractions,



and the other piece contains a picture of a fraction. The number of shard puzzles is 16 puzzle pieces (Figure 1).

Figure 1. Puzzle of equivalent fractions

The media image of the equivalent fraction puzzle is designed with several stages. The initial stage is to determine the size of the puzzle into 16 puzzle pieces and then color the background. Then the placement of pictures and fraction numbers following the arrangement that has been determined. The final stage is printing the puzzle media using vinyl paper and pasting it on a paper board (thick) so that the durable media can be reused.

c. Development

Following the completion of the design stage, the product validation stage is carried out. The validation of the media puzzle was carried out by two validators: one media expert and one material expert. Fraction puzzle media is redesigned by increasing the size of cards, graphics, materials, and so on. The validators provide an assessment of the puzzle media of equivalent fractions using the instrument after making adjustments.

Table 2 presents the results of the media expert's or validator's assessment of the product from the aspect of the display developed. The results from table 2 show that the average score of the validator's assessment is 91.15% with a very valid category.

Tabel 2. The Results of Media Expert Validation

No	Indicator	Score	Category
2.	Appearance	87.50%	Very Valid
2.	Presentation	93.75%	Very Valid
3.	Content	83.33%	Very Valid
4.	Usage	100%	Very Valid
Average		**91.15%**	**Very Valid**

Table 3 presents the results of the material expert's or validator's assessment of the product from the aspect of the display developed. The results from table 3 show that the average score of the validator's assessment is 79.69% with a valid category.

Tabel 3. The Results of Material Expert Validation

No	Indicator	Score	Category
1.	Appearance	83.33%	Very Valid
2.	Presentation	87.50%	Very Valid
3.	Content	79.19%	Valid
4.	Usage	75%	Valid
Average		**79.69%**	**Valid**

d. Implementation

The equivalent fraction puzzle media is then tested on fourth-grade students. In the one-on-one trial of the puzzle media product, two students played and were guided by the first researcher. Students play individually, when playing it looks like the two students are excited to use puzzle media even though they have a little difficulty but trying to complete the puzzle arrangement. After they played, the first researcher interviewed the two students about the equivalent fraction puzzle media that had been played. From the results of the interview, student A was very happy and more active in playing even though in the puzzle media game there were obstacles to remembering the equivalent fraction material that had been studied at school. Student A has a very high curiosity, so he tries to be able to answer the obstacles that exist in the puzzle media. Student B also did not want to lose his curiosity. Student B also tries to answer the existing obstacles by recalling. Student B also did not want to lose to answer the obstacles in the puzzle media game. Student B also looks very happy and is more active in playing while learning.

In addition, the researchers ran a small study with four fourth-grade kids in Pekanbaru. The product is used following the rules and restrictions outlined in the user handbook. After the product had been played, the researcher handed a student response form to gather feedback on the product. The questionnaire revealed that pupils enjoyed the media

game of comparable fractions puzzle. Students are very passionate and active in memorizing the content that the teacher has taught them.

e. Evaluation

The formative method is used during the evaluation step. The evaluation stage assesses the quality of the developed product as well as the product development process itself. In the one-on-one evaluation, fourth graders were interviewed about the product being produced. Through these interviews, it was discovered that students enjoyed playing since they remembered learning through games. This device also has an appealing design, and the material that is loaded is easily understood. The rules of the game are clear to the students.

Response questionnaires were also given to four students. The comparable fraction puzzle media was discovered to be a new product for pupils through the questionnaire. Students are very animated and engaged when playing. Table 4 shows the results of the questionnaire on the practicality of the developed puzzle media.

Tabel 4. The Results of Material Expert Validation

No	Indicator	Score	Category
1.	Effectivity of Media	93.75%	Very High
2.	Student Learning Activity	90.65%	Very High
3.	Student Learning Motivation	90.63%	Very High
Average		**91.68%**	**Very high**

The average student response to the fraction puzzle media is 91.68% with a very high category (Table 4). Based on these results, the overall equivalent fraction puzzle media developed by the researchers received a very good response from students who used this product.

DISCUSSION

The development of equivalent fraction puzzle media in elementary schools is carried out according to the ADDIE model development procedure. The development of the puzzle media for equivalent fractions starts from the analysis stage which consists of student and material analysis. Student analysis is very important in the early stages of planning. Analysis of students is done by observing the characteristics of students so that the media to be developed is following the interests of students. Students in elementary schools are happy with games because they are beginning to develop mental and emotional intelligence in children so influential ways and patterns of play will have a positive effect on intelligence and emotional growth in children (Erfayliana, 2016).

Material analysis is performed by identifying the primary materials used or selected, gathering materials, selecting relevant materials, and carefully rearranging them. The product's material is equivalent fractions, which is the foundation for learning fractions in grade 4 elementary school. The researcher then begins to develop the media following the aims that have been established at the design stage.

To determine the feasibility of the product, it is necessary to validate the feasibility by 2 validators. After being validated, the researcher revised according to the validator's suggestion so that the equivalent fraction puzzle media could be tested on a limited basis to fourth-grade elementary school students. The validation results from the validator show that the product is in the very feasible category. The fraction puzzle media worth is then realized into a product that is ready to be implemented (Mulyatiningsih, 2014).

At the implementation stage, a one-on-one trial was carried out with 2 students with interviews and limited trials to 4 students. At this stage, the implementation of the product is carried out in real situations, namely in the classroom (Mulyatiningsih in Prasetyo, 2018), but due to the covid outbreak, the trial implementation is carried out in a limited manner with elementary school students. The test results show that students are very happy and excited when playing and learning equivalent fractions using puzzles. This can be seen from the reactions and responses of students because the media of equivalent fraction puzzles is the first they have experienced. The existence of a fraction puzzle media worth more attracts students to remember the lessons that have been learned and makes students very excited because students at the elementary school level have the characteristics of happy playing, happy to move, love to work in groups, and enjoy feeling or doing or demonstrating something directly (Putra et al., 2021).

The fraction puzzle media that the researcher developed is not like a puzzle that is commonly used. This puzzle media is certainly very different in terms of content and design. This fraction puzzle media, it contains ordinary fractions and pictures of fractions. The design is also different, this puzzle is more varied and colorful so that it attracts the attention of students. This is in line with the ability of color to create psychological impressions for students, these colors are not only observable, but color can also affect behavior, and play a role in aesthetic assessment (Mansyur, 2007).

CONCLUSSION

Based on the results of the research and discussion, it can be concluded that the equivalent fraction puzzle media developed is valid and practical. This is indicated by the results of the media and material validation, respectively, namely 91.15% in the very valid category and 79.69% in the valid category. The student's response to the fractional puzzle media as a whole got a percentage score of 91.68% in the Very high category. Thus, the developed equivalent fraction puzzle media can be applied in learning equivalent fractions in elementary school.

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