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The Influence of Fraction Puzzle Media on the Mathematical Concept Understanding Ability of Elementary School Students

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Abstract: This research aims to determine the effect of fraction puzzle media on students' ability to understand mathematical concepts. This research was conducted at SDN Petir 04 in class III, the second semester of the 2023/2024 academic year. The research method used is quasi-experimental with a nonequivalent control group design. The research samples in this study were class III-B students as the experimental class and class III-C students as the control class, which were obtained using cluster random sampling techniques. The test given is an essay with seven questions. The statistical analysis using the Independent Sample T-test showed a significance value of 0.000 < 0.05, leading to the rejection of H_0 and acceptance of H_1. This confirms that students in the experimental class, who were taught using fraction puzzle media, demonstrated better conceptual understanding than those in the control class, who received conventional instruction. The fraction puzzle media enhances learning by providing a hands-on, interactive experience that helps students visualize and manipulate fraction concepts more effectively. This approach facilitates deeper comprehension, reduces misconceptions, and improves problem-solving skills related to fractions. Therefore, integrating fraction puzzle media into mathematics instruction can effectively enhance students' conceptual understanding and engagement in learning fractions.
Keywords: Media, Puzzle, Ability to Understand Mathematical Concepts, Fraction

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A. Introduction

Education is an important condition for the development and progress of a nation. Without this, a country will not progress and be on par with other nations in the world. UNESCO has established four main pillars of education to face the 21st century, namely (1) Learning to know, which is learning not only oriented to learning outcomes, but must be oriented to the learning process, (2) Learning to do, namely learning to master competencies, (3) Learning to be, which is to form human beings who become themselves, and (4) Learning to live together, namely learning to work together (UNESCO, 2006). Therefore, in facing future challenges, it is necessary to have graduates who are skilled in all fields, especially in mathematics learning.

Mathematics is a science that trains understanding and strategies to think systematically, logically, critically, analytically, and creatively (OECD, 2023). The importance of mastering mathematics can be seen in the Regulation of the Minister of National Education Number 22 of 2016 which states that mathematics subjects must be given to all levels of education, from elementary school to university (Permendikbud, 2016). Mathematics learning at school is carried out so that students can understand mathematical concepts, explain the relationships between concepts, and apply concepts or algorithms appropriately in solving a problem (Suryaningsih & Yarmi, 2023)

Thus, mathematics lessons are a necessity and a means of developing human resources to have the ability to understand a concept and the intelligence to think logically, critically, creatively, as well as take the initiative to the growth and development of the times in each phase of their live (Arif & Upu, 2021). So that every human being is required to be able to fulfill himself as early as possible through various efforts, such as how a student has been trained to develop the ability to understand concepts and solve problems through mathematics subjects at the elementary school level (Orton, 2004). Well-designed problem-solving, including the selection of the right techniques and strategies, is expected to provide opportunities for the growth of various skills and bring out abilities that may not have been visible to students before (NCTM, 2009).

Ability is an action that a person can take according to the level of knowledge and reasoning that can be obtained from a variety of experiences (Ted Sundstrom, 2022). In fact, abilities have existed in every individual since birth, so it only takes ways and strategies to develop the diversity of these abilities according to their level (Johar et al., 2022). In addition, a person's success in life is influenced by the comprehension ability they have (Kholid et al., 2021). So that a student is said to have the ability to understand if the student is able to construct the meaning of messages that arise in learning such as oral communication, writing, and graphics.

The ability to understand concepts has an important role for elementary school students to master, because students are not only asked to just know and know concepts, but are able to reexpress concepts in a simpler and understandable way. By understanding the concepts, students can develop their abilities and successfully overcome various problems well in each subject matter, especially mathematics (Brophy, 1998).

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Based on the results of the research that has been carried out, it is found that there are several problems related to the understanding of mathematical concepts. Students have difficulty mastering mathematical concepts to solve problems (Suryaningsih & Astuti, 2021). This is due to the lack of mastery of the basic concepts related to the material. In addition, many teachers only deliver material without providing students with an understanding of concepts, so they are only able to solve mathematical problems without understanding the solution (Endramawati, 2021). From the point of view of mathematical materials, fractions are part of mathematics. Fractions are one of the difficult medical topics to teach (Suryaningsih et al., 2025). Many teachers in the classroom teach fractions only using symbols and operations without explaining the concept of fractions through media that can be applied in students' daily activities (Diputra et al., 2023). This makes learning in the classroom uninteresting and tends to be boring (Fauzi & Suryadi, 2020). This is in line with research Salim Nahdi & Gilar Jatisunda (2020), which found that mathematics learning in schools is still procedural without emphasizing conceptual understanding that can improve students' critical thinking skills. Conceptual errors in fractional material occur when students are unable to distinguish between numerators and denominators, do not understand the concept of equal fractions, and do not master basic terms such as KPK (Suardi et al., 2022). This is due to learning that emphasizes too much procedure without providing a deep conceptual understanding and the lack of use of contextual concrete media.

Based on the results of the study of these previous studies, there is a gap for this research to contribute further. One of them is the lack of a concept-based approach in fraction learning. Students' understanding of mathematical concepts, especially in fractional materials, is still low because learning focuses more on problem-solving procedures compared to in-depth understanding of concepts. In addition, the lack of use of interactive media in fractional learning is also a factor that hinders students' understanding (Fauzi & Suryadi, 2020). Fraction learning in the classroom still relies on textbooks as the main source without being supported by interesting and interactive learning media, so students have difficulty understanding the concept of fractions, especially in distinguishing numerators and denominators and associating fractions with more concrete visual representations (Firma & Dian, 2021). On the other hand, students find it easier to understand fractional material when given manipulative-based learning media compared to only conventional approaches (Setianingrum et al., 2023).

Furthermore, the limitations in the implementation of interesting learning media are also a problem that has not been overcome much in previous research. Although there are studies that highlight the use of concrete media in learning, there have not been many studies that empirically discuss the influence of fractional puzzles on students' understanding of mathematical concepts with rigorous experimental designs. Research by Novita and Putri (2020) Furthermore, the limitations in the implementation of interesting learning media are also a problem that has not been overcome much in previous research. Although there are studies that highlight the use of concrete media in learning, there have

not been many studies that empirically discuss the influence of fractional puzzles on students' understanding of mathematical concepts with rigorous experimental designs.

In line with the above, facts in the field based on the results of an interview that has been conducted with one of the grade III homeroom teachers at SDN Petir 04, show that the learning process applied by teachers only relies on available books, and there are still students with below-average intelligence levels, so they have difficulty understanding a concept, especially in learning mathematics on fractional materials. In addition, the low ability of students to understand mathematical concepts is caused by some students who have not mastered the concept of fractions well, including difficulty distinguishing between numerators and denominators, as well as lack of utilization of learning media carried out by teachers. Therefore, students' ability to understand mathematical concepts is still relatively low. This means that the learning process that has been happening has not achieved the expected success.

Therefore, this study fills the gap in the previous study by using fractional puzzle media as a tool that can improve students' understanding of mathematical concepts through direct experience and manipulative activities. In addition, this study will test the effectiveness of this media in a quasi-experimental manner with a Nonequivalent Control Group Design, so that it can provide stronger empirical evidence than previous descriptive studies. Thus, this research is expected to provide practical implications for teachers in choosing more interactive and concept-based learning strategies, especially in fractional learning in elementary schools, as well as filling the gap in previous research by presenting a more effective manipulative media-based approach.

B. Method

This research refers to a quantitative research approach. Quantitative research is a research method that is inductive, objective, and scientific. In this method, the data obtained is in the form of numbers, such as scores, grades or questions that are assessed, and then analyzed through statistics. Quantitative research generally aims to test the validity of a theory, with an approach that starts from theory, data collection, analysis, then discussed and conclusions (Sugiyono, 2016).

Meanwhile, this research method uses a quasi-experimental design (Quasi Experimental Design). Sugiyono, (2015) defines that experimental research is research that is used to find the effect of certain treatments on others under controlled conditions. This design has a control group, but it cannot fully control the external variables that affect the implementation of the experiment (Sugiyono, 2014).

The research design used in this study is Nonequivalent Control Group Design. Nonequivalent Control Group Design is a research design that compares pretest and postest values between the experimental group and the control group, where the selection of members of the two groups is not carried out through randomization (Hardani, 2020). The data collection in the research aims to obtain reliable materials, facts, and information

(Arikunto, 2010). The data collection in this study uses interview, test, and documentation techniques.

Through the design of this study, the two groups were given tests in the form of a pre-test at the beginning of learning and a post-test at the end of learning, as well as treatment in accordance with the independent variables between the two tests. In this study, the researcher provided a treatment in the form of the use of fractional puzzle media (independent variable) to find out whether there was an effect on students' ability to understand mathematical concepts in the mathematics learning of fractional material in the form of addition and subtraction with the same denominator. The concept of this research can be presented simply in the table below.

The steps taken before carrying out the learning process in the two classes, the researcher first tests the ability to understand mathematical concepts using the instruments that have been designed.

Table 1. Research Design

Group	Pre-test	Treatment	Post-test
Eksperimen	O	X_1	O
Kontrol	O	X_2	O

Information:

X1 : Treatment using fractional puzzle media

X2 : Treatment by not using fractional puzzle media

O : Test of mathematical concept comprehension skills given to both groups before and after learning

Data collection instruments are tools used by researchers in collecting data through a test designed to measure a person's achievement after learning something (Muleong, 2012). The research instrument used is a test that refers to an indicator of the ability to understand mathematical concepts in the form of description questions. The test is given to the same two groups, namely in the form of pretest and posttest questions. The indicators of the ability to understand mathematical concepts used are the ability to restate the concepts that have been learned, the ability to give examples of the concepts studied, the ability to present concepts in the form of mathematical representations.

Table 2. Indicators of Concept Comprehension Ability Mathematical (Kilpatrick et al., 2001)

Indicator	Sub Indicators
Ability to restate concepts that have been learned	Students have the ability to re-express what they understand.
Ability to provide examples of concepts learned	Students have the ability to give an example of what they understand.
Ability to present concepts in the form of mathematical representations	Students have the ability to express ideas or ideas in the form of symbols and fractional symbols.

The researcher will test students' ability to understand mathematical concepts, then compare the results of the test of mathematical concept comprehension skills between students who are taught using fractional puzzle media and students who are taught using Powerpoint. If there is a significant difference between the experimental class and the control class, the treatment given has a significant effect.

Before the research instrument was used, an initial trial was carried out on 30 students who had studied fractional material to measure validity and reliability. Of the 10 questions that were tested, as many as 7 questions were declared valid based on the results of the correlation coefficient, with 6 questions at a high level and 1 question at a sufficient level, and the reliability value of the instrument reached 0.809 based on the SPSS 25 analysis, which was included in the very high category (Creswell, 2015; Field, 2012). Data analysis was followed by a prerequisite test in the form of a normality test using Shapiro-Wilk and a homogeneity test using variance analysis with SPSS, as the basis for the feasibility of using the hypothesis test (Hair et al., 2010; Shapiro & Wilk, 1965). The t-test used in this study is the Independent Samples T-Test to compare experimental and control groups, with decision-making based on F-calculated values and F-tables to assess the significance of the research results and the effect of the treatment given.

C. Results and Discussion

Results

Before the research is carried out, a preliminary test (pretest) is carried out to find out the initial ability of students before being given treatment, both in the experimental class and the control class. After the pre-test, the teacher applies the media in the learning process. The teacher starts by explaining the material and giving fraction problems, then students are asked to arrange colored puzzle pieces that represent the numerator and denominator on the media board. Students actively compile and solve fractional problems by matching puzzle pieces according to instructions. Upon completion, students are asked to present their work results in front of the class as part of the evaluation and reinforcement of the conceptThe data of the pretest results will be presented in the form of a bar chart in Figure 1.

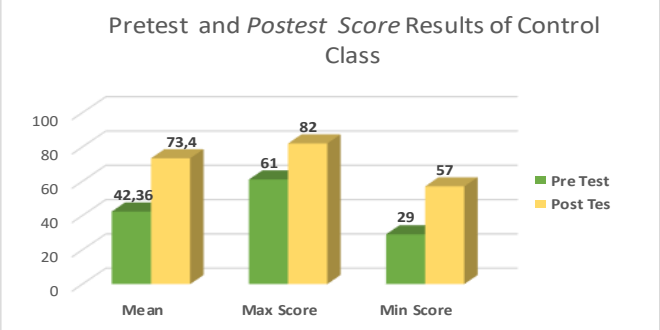

Figure 1. Bar Diagram of Pretest and Postest Score Results of Control Class

Based on Figure 1, the results of the pretest in the control class show that the average score of students is 42.36, with the highest score of 61 and the lowest score of 29. After following the learning process without special treatment, the posttest results showed an increase in scores. The average score increased to 73.4, the highest score reached 82, and the lowest score rose to 57. From these results, it can be concluded that even though no special treatment is given, there is an increase in learning outcomes in the control class. However, to assess the effectiveness of learning more comprehensively, it is necessary to compare the results of experimental classes that received certain treatments. The results of the pretest posttest conducted in the experimental class are presented in the form of a bar chart in Figure 2.

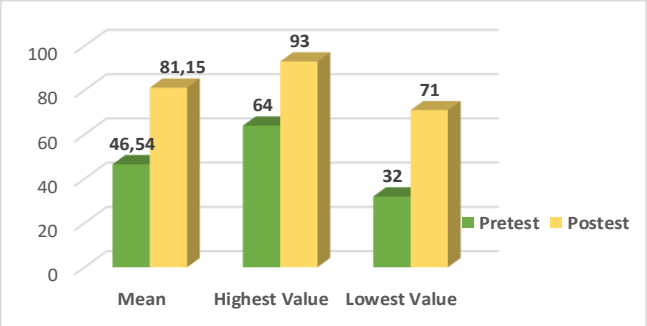

Figure 2. Bar Diagram of Pretest and Posttest Results of Experimental Class

Based on Figure 2, the results of the pretest in the experimental class show that the average score of students is 46.54, with the highest score of 64 and the lowest score of 32. After being given treatment in the learning process, the posttest results showed a significant improvement. The average score increased to 81.15, the highest score reached 93, and the lowest score rose to 71. From these results, it can be concluded that the treatment given in the experimental class has a positive impact on improving student learning outcomes. Compared to the control class, the experimental class showed a greater increase in posttest scores. This shows the effectiveness of the treatment in improving students' understanding and academic achievement.

Based on the results of the posttest of the experimental class, it can be seen that most of the students have been able to restate the concepts that have been learned quite well. However, there are still some students who have difficulty in reexpressing concepts in a systematic and structured manner. In terms of the ability to provide examples of the concepts learned, the majority of students have been able to present examples that are in accordance with the concepts that have been taught. Nonetheless, some students still need further guidance in connecting concepts with more complex and applicable examples. Meanwhile, in the ability to present concepts in the form of mathematical representations, most students have been able to express their ideas or ideas in the form of fractional symbols and symbols. However, some students still experience obstacles in the accuracy of using mathematical symbols, so further practice is needed to improve their understanding and accuracy in representing concepts symbolically. Overall, these results show that students' understanding of concepts has improved well, although additional learning efforts are still needed to overcome the difficulties faced by a small percentage of students.

The hypothesis results with an independent sample t-test with a significance level (α) of 0.05 were obtained with a sig. (2-tailed) for post-test of 0.000. Through decision making, the hypothesis test on the score of the post-test sig value above is < 0.05 which means that H0 is rejected and H1 is accepted. Thus, it can be concluded that there is an influence of fractional puzzle media on students' ability to understand mathematical concepts. The results of the effect size test to see how much the influence of fractional puzzle media on students' ability to understand mathematical concepts, the results of the influence test with Cohen are as follows:

$$d = \frac{81{,}15 \quad - \quad 73{,}40}{6{,}90}$$

$$= \frac{7{,}75}{6{,}90} = 1{,}12$$

Based on the calculation above, it shows that the effect size test value of 1.12 was obtained. If you look at the existing classification table, the value of 1.12 is included in the large category. This can be proven that the media of fractional puzzles has a great influence on the ability to understand mathematical concepts of grade III students of SDN Petir 04.

Discussion

The use of learning media can facilitate communication between teachers and students. In addition, the use of learning media makes it easier for teachers to explain abstract material. On the contrary, the use of learning media can help students understand the concept of the material in a visual and concrete way. Therefore, effective learning tools are needed to be applied to students. In each lesson, teachers of course use different media so that students do not get bored easily.

One of the media that can be used by teachers in learning is fractional puzzles. Puzzles are one of the alternatives that can be used as a medium to convey fractional material to students. The use of this media not only attracts students' attention, but also helps improve students' reasoning skills.

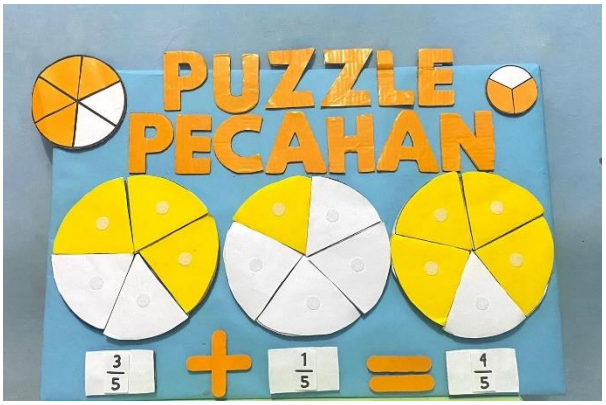

Figure 1. Fractional puzzle media product design

The results of this study show that the use of fractional puzzle-based learning media has a significant impact on students' understanding of mathematical concepts, especially in fractional materials. In terms of theoretical implications, these findings support Piaget's theory of constructivism, which emphasizes that concrete experiential learning can help students build better conceptual understanding (Zhan et al., 2022). In addition, the results of this study are also in line with the educational game-based learning model, which has been developed in various studies on the effectiveness of learning media in improving students' mathematical thinking skills.

Practically, this study indicates that the use of fractional puzzle media is more effective than PowerPoint media in improving student understanding. This is evidenced by the average posttest score of students in the experimental class (81.15) which is higher than that of the control class (73.4), as well as an effect size value of 1.12 which is included in the large category. Thus, teachers are advised to integrate educational game-based media in mathematics learning to increase students' active participation. In addition, the hypothesis test showed a significant difference between the experimental class and the control class ($p < 0.05$), which means that the use of fractional puzzle media made a real contribution in improving students' conceptual understanding. However, in its application, the use of this media also has challenges, such as adjusting the duration of learning so that students have enough time to solve puzzles and the need for teachers to understand manipulative media so that learning can take place optimally.

This study provides an insightful examination of the use of fractional puzzle media as a tool for improving students' conceptual understanding of mathematical fractions. In analyzing the effectiveness of the learning media, several key areas emerge that demonstrate both the strengths and limitations of this method in comparison with traditional teaching methods like PowerPoint presentations.

The theoretical foundation of this study is deeply rooted in Piaget's constructivism theory, which emphasizes the importance of concrete experiences in building a deep understanding of abstract concepts. The use of puzzles as manipulative learning tools aligns with Piaget's view that active, hands-on experiences allow learners to internalize abstract concepts through concrete representations. By engaging students in tactile and visual interactions with fractions, this study reinforces Piaget's argument that conceptual development is maximized when learners can physically manipulate objects to gain insight into mathematical concepts (Piaget, 1976).

Additionally, the study supports Kilpatrick et al., (2001) framework for understanding mathematical concepts, particularly in terms of conceptual understanding, procedural fluency, and problem-solving ability. The results of this study show that puzzle-based media fosters the three essential indicators of mathematical understanding: restating concepts, providing examples, and presenting concepts symbolically. This implies that the puzzle media not only helps students understand mathematical fractions but also aids them in developing essential skills that will serve them in higher-level mathematical tasks.

In terms of practical implementation, the study emphasizes that fractional puzzle media has proven to be more effective than traditional PowerPoint presentations in enhancing students' understanding. The experiment shows that students in the experimental group, who engaged with puzzles, outperformed those in the control group in both post-test scores and the development of conceptual understanding, with a notable effect size (1.12). This indicates that the puzzle media offers a more engaging and effective way to reinforce learning by actively involving students in their learning process rather than relying solely on passive learning techniques like PowerPoint presentations.

Furthermore, the study highlights how puzzles serve as a motivational tool that not only attracts students' attention but also promotes cognitive engagement. Puzzles provide students with an interactive experience that fosters problem-solving skills, perseverance, and reasoning abilities. This hands-on approach to learning also complements the educational game-based learning model, which has gained recognition in various studies for its capacity to improve students' mathematical thinking skills (Hachmann, 2022; Valentza, 2024).

The use of an experimental design with a control group and pre- and post-test assessments lends rigor to the study's conclusions. The hypothesis testing showed significant differences between the experimental and control groups ($p < 0.05$), suggesting that the use of fractional puzzle media contributed to meaningful improvements in students' understanding of fractional concepts. The clear statistical evidence supports the idea that manipulative tools like puzzles can effectively enhance mathematical learning, as opposed to relying on more traditional, less interactive forms of media.

However, the study is not without its limitations. One of the main concerns is the limited scope of the sample third-grade elementary school students. While the results indicate positive outcomes for younger students, it remains uncertain whether these findings can be generalized to older students or more advanced mathematical concepts. Therefore, a more comprehensive study including various grade levels and mathematical topics is necessary to evaluate the broader applicability of puzzle-based learning media.

Despite the promising results, there are practical challenges that need to be addressed for the successful implementation of puzzle-based learning. For instance, adjusting the learning duration to allow students enough time to solve puzzles and ensuring that teachers are adequately trained in using manipulative media are key considerations. The success of puzzle-based learning depends not only on the media itself but also on how effectively teachers can integrate these tools into their lesson plans and how they manage the classroom dynamics to optimize learning opportunities.

Moreover, while the study demonstrated the effectiveness of puzzles in enhancing conceptual understanding, it is essential to explore how these tools can be adapted for use with more complex mathematical concepts in higher grades. As students progress in their mathematical journey, the nature of the concepts becomes more abstract, and it remains to be seen whether puzzle-based learning can effectively support these more advanced topics.

This study makes a valuable contribution to the field of mathematics education by demonstrating the efficacy of manipulative learning media in improving conceptual understanding of fractions. However, further research is needed to explore the potential of fractional puzzle media in different educational contexts. Future studies could involve larger and more diverse student populations, including students from various cultural and linguistic backgrounds, to test the generalizability of the findings. Additionally, the integration of other cognitive variables, such as mathematical problem-solving and critical thinking, could provide a more comprehensive understanding of the media's impact. Lastly, the effectiveness of puzzle-based learning could be further explored through longitudinal studies to evaluate whether the gains in conceptual understanding are sustained over time and how puzzle-based learning affects students' long-term mathematical proficiency.

D. Conclusion

Based on the results of the research, it can be concluded that the use of fractional puzzle media has a significant effect on the ability to understand mathematical concepts of third grade students of SDN Petir 04. This is evidenced by a higher average posttest score of the experimental class (81.15) than the control class (73.4), as well as the results of the t-test with a significance value of 0.000 (<0.05) and a size effect of 1.12 which indicates a large influence category. This media has been proven to improve students' ability to restate concepts, provide examples, and present fractional concepts in the form of mathematical representations.

Scientifically, this research contributes to the development of effective manipulative learning media to improve students' conceptual understanding, especially in fractional materials. A visual and concrete approach through puzzles helps students understand concepts more deeply, reduce misconceptions, and improve problem-solving skills. These findings can be the basis for the development of interactive learning strategies to improve the quality of mathematics learning at the primary education level.

References

Arikunto, S. (2010). Research methods. Jakarta: Rineka Cipta, 173.

Brophy, D. R. (1998). Understanding, measuring, and enhancing individual creative problem-solving efforts. Creativity Research Journal, 11(2), 123–150. https://doi.org/10.1207/s15326934crj1102_4

Diputra, K. S., Suryadi, D., Herman, T., & Jupri, A. (2023). Analysis of the Elementary School Students' Learning Obstacles: A Case Study on the Concept of Fractions. Al Ibtida: Jurnal Pendidikan Guru MI, 10(1), 13. https://doi.org/10.24235/al.ibtida.snj.v10i1.13078

Endramawati, T. A. (2021). Efforts to Improve Students' Ability to Understand Concepts and Confidence Through the Guided Discovery Learning Model. Didaktika: Journal of Educational Thought, 27(2).

Fauzi, I., & Suryadi, D. (2020). Learning Obstacle the Addition and Subtraction of Fraction in Grade 5 Elementary Schools. In Jurnal Kajian Pendidikan Islam (Vol. 12, Issue 1).

Firma, I., & Dian, N. (2021). Mathematics Realistic Education (RME) Model on Fractional Materials in Elementary Schools. Journal of Basicedu, 5(4), 1888–1899.

Hardani. (2020). Metode Penelitian Kualitatif & Kuantitatif. Pustaka Ilmu Group.

Johar, R., Khairunnisak, C., & Rohaizati, U. (2022). Students' Mathematical Representation Ability in Learning Algebraic Expression using Realistic Mathematics Education. Jurnal Didaktik Matematika, 4185, 151–169. https://doi.org/10.24815/jdm.v9i1.25434

Kholid, M. N., Imawati, A., Swastika, A., Maharani, S., & Pradana, L. N. (2021). How are Students' Conceptual Understanding for Solving Mathematical Problem? Journal of Physics: Conference Series, 1776(1). https://doi.org/10.1088/1742-6596/1776/1/012018

Kilpatrick, J., Swafford, J., & Findell, B. (2001). Adding it up: Helping children learn mathematics.

Lince, R. (2016). Creative Thinking Ability to Increase Student Mathematical of Junior High School by Applying Models Numbered Heads Together. Journal of Education and Practice, 7(6), 206–212. www.iiste.org

Mason, J. Burton, L. & Stacey, K. (2011). Thinking Mathematically (Second Extended Edition). Prentice Hall (Pearson).

Muleong, L. (2012). Qualitative Research Methods. Remaja Rosdakarya.

NCTM. (2009). Focus in high school mathematics: Reasoning and sense making. National Council of Teacher Mahtematics.

Niagara, A., Widyatiningtyas, R., & Rahmawati, D. (2022). The Use of Fractional Block Props to Improve the Ability to Understand the Concept of Fractions in Grade III Elementary School Students. (2), 2621–2637.

Nurani, M., Riyadi, R., & Subanti, S. (2021). The Profile of Understanding Mathematical Concepts is Reviewed from Self Efficacy. Axioms: Journal of Mathematics Education Study Program, 10(1), 284. https://doi.org/10.24127/ajpm.v10i1.3388

OECD. (2009). The PISA 2009 Assessment Framework: Key Competencies in Reading, Mathematics, and Science. 2009.

Orton, A. (2004). Learning Mathematics: Issues, Theory and Classroom Practice. Continuum.

Permendikbud. (2016). Attachment to the Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 20 of 2016 concerning Competency Standards for Graduates of Primary and Secondary Education.

Salim Nahdi, D., & Gilar Jatisunda, M. (2020). Conceptual Understanding and Procedural Knowledge: A Case Study on Learning Mathematics of Fractional Material in Elementary School. Journal of Physics: Conference Series, 1477(4). https://doi.org/10.1088/1742-6596/1477/4/042037

Setianingrum, A., Iriawan, S. B., & Mufliva, R. (2023). Diactic Design in Mathematics Learning of Grade IV Fractional Materials in Elementary Schools. 63 JPGSD (Issue 1).

Sugiyono. (2014). Educational Research Methods Quantitative, Qualitative, and R&D Approaches. Alphabeta.

Sugiyono. (2015). Educational Research Methods Quantitative, Qualitative, and R&D Approaches. Alphabeta.

Sugiyono. (2016). Quantitative, Qualitative and R&D Research Methods. PT Alphabet.

Suryaningsih, T. (2023). The Effect of The Use of Realia Media on Students' Ability to Understand Concepts and Learning Interests in Grade III Flat Building Materials at Sdn Bojong Sempu 01. Syarif Hidayatullah State Islamic University, Jakarta.

Suryaningsih, T., & Astuti, M. A. (2021). The Effect of the Open Ended Learning Model on the Mathematical Creative Thinking Ability of Grade IV Students on Fractional Materials. Elementar (Elementary of Tarbiyah): Journal of Elementary Education, 1(1), 95–104.

Suryaningsih, T., Marini, A., & Zakiah, L. (2024). Mathematics Problem Solving Through Make a Drawing Strategy for Elementary School Students with Mild Intellectual Disability. Auladuna: Jurnal Pendidikan Dasar Islam, 11(1), 31–41.

UNESCO. (2006). School and Teaching Practices for the Twenty-first Century Challenges: Lessons from the Asia-pacific Region (Regional Synthesis Report, Ed.). UNESCO.

Valentza, D. (2024). Proceedings of the Basic Scientific Conference on the Utilization of Math Puzzle Games Applications in Mathematics Learning. Proceedings of the Basic Scientific Conference, 1694–1700. http://prosiding.unipma.ac.id/index.php/Kid

Zhan, Z., He, W., Yi, X., & Ma, S. (2022). Effect of Unplugged Programming Teaching Aids on Children's Computational Thinking and Classroom Interaction: with Respect to Piaget's Four Stages Theory. 60(55), 1277–1300. https://doi.org/10.1177/07356331211057143