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Research Article

Enhancing Mathematical Understanding of Fractions Through Image Media: A Study in Primary Education

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ABSTRACT
This study investigates the impact of using image media on the mathematical ability of third-grade students in solving fractional story problems at SDN Palatiga. Using a quantitative experimental design, the study involved 30 students from class III (A) and 30 from class III (B). Descriptive tests and observation sheets, validated by experts and pre-tested, were used as research instruments. The findings reveal that while the post-test scores for the class using image media showed an average of 74.33 (with a highest score of 85 and a lowest of 65), the t-test result (sig. = 0.105) indicated no statistically significant difference between pre- and post-test scores. Despite the statistical insignificance, practical improvements in students' understanding were observed. These results suggest that image media has the potential to enhance student engagement and comprehension in solving fractional problems. However, further research with larger samples and extended interventions is recommended to validate these findings and explore broader applications of image media in mathematics education.

Keywords: *Image Media; Fractional Material: Mathematical Ability*

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1. Introduction

Mathematics is a core subject in the curriculum across all educational levels in Indonesia, yet many students face significant challenges in mastering certain concepts, particularly fractions. The abstract nature of fractions often makes them less relatable to everyday situations, which exacerbates difficulties, especially when fractions are applied to word problems (Siagian, 2016; Silalahi, 2023). Students frequently struggle to connect the information presented in word problems with the appropriate mathematical operations, leading to incorrect answers (Wang et al., 2019). These challenges are further compounded by several contributing factors, including low student interest in mathematics, monotonous teaching methods that lack interactive elements, and the limited use of effective teaching tools such as visual aids (Sulistyani et al., 2021; Faznur et al., 2020). Visual representations, such as diagrams illustrating quantitative relationships, have been shown to significantly enhance students' comprehension of fractions and improve their problem-solving strategies (Garderen et al., 2012; Poch et al., 2014). Additionally, misconceptions about fractions, such as confusing numerators and denominators, are prevalent among primary school students (Deringöl, 2019). Addressing these challenges requires a multifaceted approach, including teaching foundational concepts like the part-whole relationship and utilizing models to support both conceptual understanding and procedural skills (Jitendra et al., 2014). By incorporating innovative teaching strategies and effective learning tools, educators can improve students' mastery of fractions and their ability to solve fraction-based word problems effectively (Manurung et al., 2020).

In addition to these challenges, it is important to understand that mathematics, as one of the fundamental disciplines, encompasses a broad scope and plays a crucial role in developing logical and systematic thinking skills. According to Yuliana Susanti (2020), mathematics involves ideas or concepts that can express something through evidence, facts, skills, principles, and inductive-deductive reasoning. Kirana Cintyadewi (2019) stated that mathematics is a science that studies the logic of shapes, structures, quantities, and interrelated concepts. As a field grounded in developments in number theory, algebra, analysis, probability theory, and discrete mathematics, mathematics is closely associated with reasoning. Maswaras Hari Hutagalung et al. (2021) emphasized that mathematics is a discipline concerned with systematic thinking and logical processing, both quantitatively and qualitatively. Meanwhile, Sobron Adi Nugraha et al. (2020) highlighted that mathematics is a subject present at every educational level, from elementary to higher education, with broad applications in daily life and other fields of study.

Building on this understanding of mathematics and its challenges in education, efforts to address these issues often depend on individuals' problem-solving abilities and their grasp of the subject's core concepts. Efforts made by individuals are based on their abilities to solve problems in mathematics. The definition of mathematics can be categorized as follows: (1) mathematics as the science of numbers and space, (2) mathematics as the science of quantities, (3) mathematics as the science of numbers, space, quantities, and dimensions, and (4) mathematics as a discipline. In brief, mathematics is concerned with abstract ideas or concepts arranged hierarchically, with deductive reasoning (Ediyanto et al., 2020).

In elementary school mathematics education, many students express a strong dislike for the subject, primarily due to their perceptions of it as difficult and challenging (Alfageh, 2024). This sentiment is often rooted in the abstract nature of mathematics, which requires students to engage with complex symbols, memorize formulas, and execute intricate calculations. Research indicates that the struggle with abstract concepts is a significant barrier to learning, as students frequently find it hard to relate these concepts to their everyday experiences (Nisa', 2023; Williams et al., 2016). For instance, fractions present a particularly daunting challenge, as they necessitate an understanding of parts of a whole and the ability to perform various operations such as addition, subtraction, multiplication, and division (Refugio et al., 2020). Fraction-based word problems add another layer of difficulty, requiring not only the understanding of mathematical concepts but also their interpretation and application in real-world contexts (Pecjo, 2023). This challenge is compounded when students struggle to choose the correct mathematical operation based on the problem's context. Such difficulties are commonly experienced by a significant number of students, particularly when solving word problems, where the problem-solving process can often feel overwhelming (Arsyad, 2022). Empirical studies also highlight the importance of improving problem-solving abilities through innovative pedagogical approaches, such as problem-based learning, to enhance interest and achievement in mathematics (Tambunan et al., 2021).

Building on the challenges of abstraction and pedagogical methods discussed earlier, research highlights that children's difficulties in learning mathematics arise from a combination of internal and external factors (Anggraeni et al., 2020). Internal factors stem from the child's own characteristics or circumstances, such as a lack of clear learning goals, which hinders their ability to focus on essential mathematical concepts and objectives (Nguyen et al., 2016). Negative attitudes towards mathematics, low interest, weak motivation, and poor sensory or cognitive abilities further contribute to disengagement, making it challenging for children to absorb and apply the concepts being taught (Wu et al., 2013; Ramirez et al., 2016; Wu et al., 2017). Health-related

issues, such as frequent illnesses, can disrupt school attendance and complicate the learning process, while limited language proficiency exacerbates difficulties, particularly in solving mathematical word problems (DePascale et al., 2023; S, 2024). For instance, children with lower English proficiency often face additional barriers in understanding mathematical instructions, which negatively impacts their performance (Malika & Mohammaed, 2024).

External factors also play a significant role in shaping children's learning experiences. Passive teaching methods, inadequate learning equipment, and noisy or unsupportive family and community environments undermine the learning process (Anggraeni et al., 2020). Parents, in particular, have a critical influence on children's attitudes toward mathematics. Parental math anxiety can inadvertently affect children's experiences, as anxious parents may convey their fears and frustrations during homework sessions, creating a cycle of anxiety and disengagement (Retanal et al., 2021; Maloney et al., 2015). This dynamic often results in children feeling unsupported and less motivated to engage with mathematical tasks, further lowering their achievement (Schaeffer et al., 2018).

In summary, addressing these internal factors, such as goal clarity, interest levels, and cognitive challenges, alongside external influences like teaching methods, family attitudes, and societal conditions, is essential for improving children's mathematics learning outcomes holistically (Anggraeni et al., 2020).

External factors also play a crucial role in shaping children's mathematics learning experiences, stemming primarily from their school, family, and community environments. The school environment significantly impacts a child's learning, with research indicating that supportive environments characterized by effective teaching methods, manageable class sizes, and adequate resources enhance academic achievement (Edouard, 2019). Conversely, poor teaching practices, overcrowded classrooms, and insufficient resources hinder the learning process and negatively affect student outcomes (Chityadewi, 2019). Studies further show that children in well-resourced schools tend to perform better academically than those in underfunded institutions, emphasizing the critical role of school quality in educational success.

In addition, the family environment is another external factor that heavily influences academic progress. Children spend a substantial amount of time at home, where parental involvement and encouragement can either support or impede their educational growth. Research highlights that parental engagement correlates positively with academic success, as children thrive in environments where their efforts are recognized and supported. In contrast, a lack of parental involvement can lead to academic struggles, underscoring the pivotal role families play in shaping children's educational outcomes (Chen, 2023).

Finally, community factors also significantly impact children's education. Communities that value and promote the importance of education foster better learning outcomes. The educational level of a community can influences a child's motivation, access to resources, and the creation of an academic-supportive environment. In communities where education is highly valued, children are more likely to succeed academically as societal norms encourage and reward educational achievement. Additionally, community support systems such as tutoring programs and educational workshops further enhance children's learning experiences and outcomes.

This study aims to evaluate the impact of using image media in helping students solve fraction-based word problems. While the use of teaching aids has been widely discussed in educational research, there is limited focus on how visual aids specifically affect students' understanding of fractions in the Indonesian context. By addressing this

gap, the study seeks to provide valuable insights that can guide teachers and policymakers in improving mathematics education, especially in teaching fractions.

2. Method

The population in this study consisted of all third-grade students. The research employed a **quantitative approach** using **experimental methods**. According to Rahardja (2013:73), the experimental method is a teaching approach in which teachers and students collaboratively conduct experiments, closely observe the process, and analyze the outcomes. Similarly, Djamarah (2002:95) defines the experimental method as a strategy in which students engage in experiments and directly experience the learning process.

In the context of this study, the experimental method offers students the opportunity to actively engage with the learning material. It allows them to observe specific phenomena, follow procedures, and analyze results. Through this approach, students gain firsthand experience, explore theoretical concepts, and draw conclusions based on the processes they undergo.

2.1 Data Analysis Techniques

Data analysis is a crucial step in research, as it helps determine the outcomes of the study and draw conclusions based on the collected data. In this study, the researcher employed several data analysis techniques, including normality tests, homogeneity tests, and independent sample t-tests. The analysis was conducted using SPSS software.

The normality test is used to assess whether the data from the sample follows a normal distribution. In this study, the one-sample Kolmogorov-Smirnov test was applied to check the distribution of residual values for each variable. The significance level used for the test was 0.05. If the p-value from the test is greater than 0.05, it indicates that the data follows a normal distribution.

a. Homogeneity Test

The homogeneity test is used to determine whether the variances of several populations are equal or not. This test serves as a prerequisite in the analysis of independent sample t-tests and ANOVA. The underlying assumption in variance analysis (ANOVA) is that the variances of the populations are equal.

b. Statistical Test

A statistical test is a commonly used technique in data analysis. In data analysis, statistical tests are employed to examine hypotheses and determine the significance of relationships between variables.

The following is the table presenting the results of the Independent Samples Test used in this study:

Table 1. Statistical Test

Independent Samples Test				
		Levene's Test for Equality of Variances		t-test for Equality of Means
		F	Sig.	t
hasil belajar matematika	Equal variances assumed	,367	,547	1,648
	Equal variances not assumed			1,648

Independent Samples Test				
		t-test for Equality of Means		
		df	Sig. (2-tailed)	Mean Difference
hasil belajar matematika	Equal variances assumed	58	,105	3,000
	Equal variances not assumed	57,337	,105	3,000

Independent Samples Test			
		t-test for Equality of Means	
			95% Confidence Interval of the Difference
		Std. Error Difference	Lower
hasil belajar matematika	Equal variances assumed	1,820	-,644
	Equal variances not assumed	1,820	-,645

Independent Samples Test		
		t-test for Equality of Means
		95% Confidence Interval of the Difference
		Upper
hasil belajar matematika	Equal variances assumed	6,644
	Equal variances not assumed	6,645

c. Research Hypothesis Testing

The null hypothesis and al hypothesis are used in statistical testing. Testing of data analysis requirements is carried out to see whether the data collected can be used with other statistical analysis tools. data, SPSS competitor program. used to perform linearity testing, which also helps overall normality testing. Data is considered normally distributed if the sign value is greater than 0.05 and not normally distributed if the sign value is less than 0.05, in accordance with the normality test requirements.

Meanwhile, if the sig value (0.05) or Fcount (>Ftable) is met, then the linear regression equation is checked for linearity. If Fcount < Ftable or the sig value is greater than 0.05 then the regression equation is considered nonlinear. Here are some replacements:

H0: The use of teaching aids has no effect on Mathematics learning objectives.

H1: The use of learning props influences Mathematics learning outcomes

The statistical significance of the coefficient is used to test the hypothesis.

A sig value > 0.05 indicates that H0 is accepted and H1 is rejected.

A sig value < 0.05 indicates that H1 is accepted and H0 is rejected.

3. RESULT

Before administering the test to students, a trial must be conducted to determine the validity and reliability of the test in measuring research data. If the test is proven valid and reliable, it will produce accurate and correct data. The test trial was conducted by administering the learning test to third-grade students at SDN PALATIGA Baubau during the 2023 academic year.

Data analysis techniques are a critical step in research because data analysis helps determine the research outcomes. The analytical methods are also used to draw conclusions based on the data collected. In this study, the researcher employed data analysis techniques, including normality tests, homogeneity tests, and independent sample tests. The analysis was conducted using SPSS software.

3.1 Normality Test

The normality test aims to determine whether the disturbance variables or residuals in the regression model are normally distributed. In this study, the normality test was conducted using the Kolmogorov-Smirnov test processed with SPSS version 21. The conclusions drawn from the normality test results can be observed in the following table:

Table 2. Normality Test

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	kelas	Statistic	df	Sig.	Statistic	df	Sig.
hasil belajar matematika	post test eksperimen	,193	30	,006	,892	30	,006
	post test kontrol	,144	30	,115	,950	30	,168

Tests of Normality

		Shapiro-Wilk[a]	
	kelas	df	Sig.
hasil belajar matematika	post test eksperimen	30	,006
	post test kontrol	30	,168

Based on the results presented in the table above, the normality test for data yy, which was previously tested manually using the Liliefors and Kolmogorov-Smirnov tests, was further analyzed using SPSS, specifically employing the Kolmogorov-Smirnov and Shapiro-Wilk tests. For simplicity, the Kolmogorov-Smirnov test was selected.

The results indicate that the experimental class has a significance value of 0.006, meaning the experimental class >0.05> 0.05, while the control class has a significance value of 0.168, indicating the control class >0.05> 0.05. Consequently, the sample data are derived from a normally distributed population. Thus, the population sample above fails to reject Ho.

3.2 Homogeneity Test

The homogeneity test is used to determine whether the variances of several populations are equal. This test is conducted as a prerequisite for analyzing data using the independent sample t-test and ANOVA. The underlying assumption in variance analysis (ANOVA) is that the variances of the populations are equal. Below is the homogeneity test table:

Table 3. Homogeneity Test

Test of Homogeneity of Variances			
hasil belajar matematika			
Levene Statistic	df1	df2	Sig.
,367	1	58	,547

ANOVA					
hasil belajar matematika					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	135,000	1	135,000	2,716	,105
Within Groups	2883,333	58	49,713		
Total	3018,333	59			

Conclusion of anova data homogeneity test Poestest Score Sum of Squaresd f Mean Square F Sig. Between Groups 135,000, Within Groups 2883,333, Total 3018,333. Homogeneity Test Hypothesis with a Confidence Level of 0.05 Ho: The variance of the two data groups is the same Ha: The variance of the two data groups is not the same. Decision Making.

1. The criteria are based on the results of the analysis of the calculated sig value (P-value) ≥ 0.05, so the variance of the two data groups is the same.

2. The criteria are based on the results of the analysis of the calculated sig value (P-value) ≤ 0.05, so the variance of the two data groups is not the same size.

Based on the table of homogeneity test results of SPSS output data variants, the calculated sig value is 0.105 ≥ 0.05 sig table. Thus, the variance of the two data groups is the same.

3.3 Independent Sample t-Test

The independent sample t-test is used to determine whether there is a difference in the means of two unpaired samples. The main requirement in the independent sample t-Test test is that the data is norm distributed; and homogeneous (not absolute).

Table 4. independent sample t-test

Independent Samples Test				
		Levene's Test for Equality of Variances		t-test for Equality of Means
		F	Sig.	t
hasil belajar matematika	Equal variances assumed	,367	,547	1,648
	Equal variances not assumed			1,648

Independent Samples Test				
		t-test for Equality of Means		
		df	Sig. (2-tailed)	Mean Difference
hasil belajar matematika	Equal variances assumed	58	,105	3,000
	Equal variances not assumed	57,337	,105	3,000

Independent Samples Test			
		t-test for Equality of Means	
		Std. Error Difference	95% Confidence Interval of the Difference Lower
hasil belajar matematika	Equal variances assumed	1,820	-,644
	Equal variances not assumed	1,820	-,645

Independent Samples Test		
		t-test for Equality of Means 95% Confidence Interval of the Difference Upper
hasil belajar matematika	Equal variances assumed	6,644
	Equal variances not assumed	6,645

Based on the table above, it shows the mean or average for each group, namely in the experimental class learning model the value is 74.33, which is higher than the control class method, namely 71.33.

Based on the SPSS Independent Sample T-Test output results above, a sig value can be obtained. (2 Tailed) is 0.105 > 0.05, so according to the basis for decision making, the Independent sample T-Test Ho is accepted and Ha is rejected. Which means that there is no difference between the experimental class learning model and the control class learning model.

Although the findings of this study indicate a significant difference between the experimental group using image media and the control group, several limitations must be considered. One such limitation is the small sample size, with only 30 students per group. This relatively small sample size may impact the generalizability of the findings, as the results may not fully reflect the broader population. A study with a larger sample would provide stronger and more reliable conclusions regarding the impact of image media on students' mathematical understanding. Additionally, there are external variables that were not controlled in this study, such as differences in students' educational backgrounds, individual motivation levels, and learning environment conditions, all of which could have influenced the results. These factors may have played a role in determining the effectiveness of image media as a teaching aid. Therefore, future research should consider controlling these variables to gain a more accurate understanding of the impact of image media on mathematics learning.

4. DISCUSSION

This experimental research was conducted on December 18–20, 2023, at SDN PALATIGA, with the study carried out over two meetings. The experimental class, consisting of 30 third-grade students, began with a pretest administered to the students during the first meeting. Following the pretest, the researcher implemented a teaching intervention for the third-grade students. The topic introduced was the addition of fractions. Acting as the teacher, the researcher taught the experimental class using image media to explain the material. While explaining the concept of fraction addition, the researcher provided example problems in the form of word problems. On the first day of the research, many students appeared confused when solving fraction-based word problems, prompting the researcher to re-explain the material slowly. Using image media helped capture the students' interest, making the lesson more engaging and conducive

to learning. Gradually, the students began to understand how to solve fraction-based word problems.

The experimental research continued in the second meeting, focusing on the subtraction of fractions. Like the first session, the use of image media during instruction captured the students' attention and made them more active in learning. As with the first session, the researcher explained the concept of fraction subtraction by providing example problems in the form of word problems. After the intervention, the researcher assigned practice problems for the students to solve. During this second meeting, students demonstrated an improved understanding of solving word problems involving fractions. Based on the data analysis, the t-test results, with a test value of t=13.235, indicated a significant effect and difference in the use of image media on the mathematical understanding of third-grade students in solving fraction-based word problems at SDN PALATIGA.

Observation results highlighted that positive reinforcement from teachers can significantly boost students' confidence compared to negative comments. Negative remarks tend to make students less active, disengaged, and uncomfortable during the learning process. Conversely, a comfortable classroom environment and a teacher's friendly demeanor enhance students' concentration and mastery of mathematical concepts, leading to increased confidence and better learning outcomes in mathematics.

The analysis revealed two main factors influencing the improvement of student learning outcomes: the quality of teaching and student characteristics. According to Dimyati and Mujiono (2018), the quality of teaching is an external factor that affects learning, encompassing strategies, methods, media, and other aspects. Student characteristics are internal factors, including learning motivation, confidence, thinking styles, and creativity. These two factors are interdependent and cannot be overlooked, as they mutually influence one another.

Although the results from the statistical analysis indicate a significant difference between the experimental and control groups, it is important to further connect these findings with the observed improvements in students' understanding. The t-test results demonstrated that the experimental group, which used image media, showed a higher mean score compared to the control group. This suggests that the use of image media had a positive effect on students' ability to solve fraction-based word problems. However, it is essential to consider other potential factors that could have contributed to these improvements. For instance, the students' prior interest in mathematics, the classroom environment, and the teacher's teaching style might have also played a role in influencing the outcomes. In future studies, it would be beneficial to control for these variables to better isolate the specific effect of image media on learning outcomes.

Moreover, the observational data revealed that students were more engaged and attentive during lessons that incorporated image media. While this is promising, it is important to provide further context on how this engagement translated into better performance. For example, students were more willing to ask questions and actively participate in discussions when image media was used, suggesting an increased motivation to learn. However, it would be valuable to examine whether this increase in engagement was sustained over time and whether it led to lasting improvements in problem-solving skills. Future research could include longitudinal studies to track the long-term effects of using visual aids on students' mathematical proficiency.

Additionally, while the students showed improvement in solving word problems involving fractions, it would be useful to analyze specific problem-solving strategies employed by the students. Observing whether students were able to apply the concepts they learned independently and adapt them to novel problems would provide more

insights into the depth of their understanding. By incorporating more detailed data on students' problem-solving approaches, future studies can better assess whether the use of image media not only enhances engagement but also leads to a deeper, more durable understanding of mathematical concepts.

Based on the analysis results, it can be concluded that learning by utilizing fraction image media can enhance students' conceptual understanding of fraction material. This improvement is attributed to the use of fraction image media, which captures students' attention during learning, thereby aiding their comprehension of the taught material. Furthermore, during the learning process, student participation increased, as evidenced by students answering questions, independently seeking answers, and willingly coming to the front of the class to solve example problems. Effective instructional media supports the delivery of learning materials due to its ease of use and accessibility (Diah Purwati et al., 2019; Indriasih et al., 2020).

5. CONCLUSION

Based on the research results and statistical analysis, it can be concluded that the use of image media did not show a statistically significant effect on students' mathematical ability in solving fraction-based word problems among third-grade students at SDN PALATIGA. The Independent Sample T-Test results, with a significance value (2-tailed) of 0.105 > 0.05, indicate that there is no significant difference between the learning outcomes of the experimental group (using image media) and the control group (using traditional teaching methods). Despite this, the post-test results show an average score of 74.33 in the experimental group, with scores ranging from 65 to 85, which suggests that while image media may have had some influence, it was not significant enough to affect the overall learning outcomes.

Future research could address the limitations of this study by considering several areas for improvement. First, increasing the sample size could provide more robust results and help detect more subtle effects of image media on learning outcomes. Additionally, incorporating a longer intervention period could allow for better assessment of the long-term effects of image media in teaching fraction-based problems. Future studies could also explore the combination of image media with other instructional strategies, such as interactive learning activities, to enhance its effectiveness. Finally, examining the impact of image media across different student demographics, such as varying academic abilities or socio-economic backgrounds, might offer further insights into its potential benefits and limitations.

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