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The Effect of Joyful Learning on Mathematics Learning Outcomes in Multiplication and Division of Fractions in Class VI SD Negeri 33 Pontianak Utara

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Abstract: Mathematics is recognised as an essential subject in the Indonesian curriculum; however, many students still perceive it as frightening, particularly in topics involving multiplication and division of fractions. This study examined the effect of Joyful Learning on mathematics learning outcomes of Grade VI students at SDN 33 Pontianak Utara. The research employed a pre-experimental One Group Pretest–Posttest design with a sample of 28 purposively selected students who demonstrated low formative assessment scores on fraction operations. Data were collected through tests, documentation, and classroom observation, and analysed using descriptive statistics, normality testing, paired sample t-test, and effect size. The pretest showed an average score of 60.21, with only 21.4% of students meeting the KKTP. After the Joyful Learning intervention implemented through applause-based reinforcement, energizers, and game-based problem-solving the posttest mean increased to 76.64, with 67.9% of students achieving the KKTP. The paired sample t-test indicated a statistically significant improvement ($|t| = 10.603$; $p < 0.001$). To avoid misinterpretation of statistical results, the significance conclusion was based on the absolute comparison $|t_{count}| > t_{table}$ (1.70329). Moreover, effect size analysis yielded a Cohen's d value of 2.00, indicating a very large practical impact of the intervention. These findings suggest that Joyful Learning substantially enhances students' comprehension of fraction multiplication and division, both statistically and practically. Nonetheless, given the limitations of the One Group Pretest–Posttest design, future research should adopt a quasi-experimental design with a control group to yield stronger causal inferences.

***Keywords**:* Deep Learning, Joyful Learning, Learning Output, Mathematics

A. Introduction

As a compulsory subject in the curriculum structure stated in the Indonesian Minister of Education Regulation No. 13 of 2025, mathematics is recognised as an essential discipline. Mathematics is not only taught as a tool for numerical calculation, but also as a means of applying concepts to solve everyday problems. Its presence is inseparable from various aspects of life (Azizah et al., 2019; Juardi & Komariah, 2023). One of the competencies that students in Phase C must master is multiplication and division of fractions, which is included in Learning Outcome Number 046 of 2025. At the end of Phase C, students are

expected to be able to compare fractions, perform arithmetic operations on fractions, and solve multiplication and division problems involving fractions and natural numbers.

However, mathematics is still perceived as a frightening subject by many students, creating a psychological barrier that affects their performance. When students feel intimidated, they tend to be passive, overwhelmed, and unable to fully absorb the lesson. Therefore, effective and meaningful learning approaches are needed to change these negative perceptions. One of the approaches emphasised in the latest curriculum framework is Deep Learning, which focuses on developing students' competencies through meaningful, authentic, and connected learning experiences (Natsir, 2025). Deep Learning encourages students to think critically, engage actively, and apply concepts in real contexts (Chosya & Takiddin, 2025). To ensure these deep and meaningful learning processes occur, the curriculum places Joyful Learning as one of its fundamental supporting elements. Joyful Learning provides the positive emotional climate necessary for students to engage in deep exploration, creativity, and collaborative problem-solving. A comfortable, enjoyable, and non-threatening atmosphere becomes a prerequisite for students to develop the global competencies targeted in Deep Learning.

In this conceptual relationship, Deep Learning provides the framework for meaningful learning**,** while Joyful Learning ensures that students are emotionally ready, motivated, and continuously engaged**.** Joyful Learning encourages students to participate actively through varied instructional strategies such as games, songs, videos, and creative classroom arrangements (Istiqomah & Prihatnani, 2019; Hurriyati et al., 2022). When students enjoy the learning process, they are more prepared to follow the deeper-level thinking processes required in Deep Learning.

Interviews with five students in Grade VI-B of SDN 33 Pontianak Utara show that all of them perceive mathematics as a scary subject that causes confusion and mental burden. Fractions, especially division, were considered difficult to understand. Observations in the classroom revealed that learning was dominated by lectures and drills, which caused many students to be passive. Some students struggled to understand multiplication of mixed numbers and the concept of fraction division. Moreover, errors frequently occurred even in basic arithmetic operations such as multiplication and division of whole numbers.

Formative assessments also indicated low mastery of fraction multiplication and division, with an average score of 60.57. This situation is concerning, especially considering that the teacher had implemented a multiplication and division star programme**,** designed to train students to memorise multiplication and division facts. Although this programme motivated students to memorise quickly to obtain rewards, it did not help them achieve conceptual understanding. Students tended to memorise mechanically and forget shortly after, leading to poor performance in actual problem-solving tasks. This indicates that the programme relied heavily on rote memorisation without supporting deeper comprehension.

Therefore, given the students' persistent difficulties in basic arithmetic and the ineffectiveness of the star programme, Joyful Learning emerges as a contextual and relevant solution. Its emphasis on enjoyable, meaningful, and interactive learning activities is aligned with the Deep Learning framework and has the potential to help

students overcome their fear of mathematics and improve their understanding of fraction operations. Based on these issues, this study aimed to examine the effect of Joyful Learning on the mathematics learning outcomes of Grade VI students at SD Negeri 33 Pontianak Utara, specifically in the material of multiplication and division of fractions.

B. Methods

This quantitative research employed a pre-experimental design using the One Group Pretest–Posttest model, in which the dependent variable was measured before and after the intervention (Junianti et al., 2025). The pretest was administered prior to the treatment, followed by the implementation of the Joyful Learning intervention, and ended with the administration of the post-test. Although this design allows researchers to observe changes that occur after treatment, it is important to acknowledge that the One Group Pretest–Posttest design is highly susceptible to external biases such as history, maturation, testing effects, and the Hawthorne effect. These threats may influence changes in student outcomes independently of the intervention administered.

The population in this study consisted of all 58 Grade VI students at SDN 33 Pontianak Utara. Purposive sampling was used to select participants, considering those who demonstrated low learning achievements in multiplication and fraction segmentation. Based on formative assessment results, 28 students were identified as the sample of the study. Data were collected through tests, documentation, and classroom observation. Tests were administered before the intervention (pre-test) and after the intervention (post-test). Once the data were collected, quantitative analysis was performed, including computation of the mean, median, standard deviation, variance, highest score, and lowest score, and the results were presented using a frequency distribution histogram.

Furthermore, a paired sample t-test was conducted to examine the hypothesis involving two related datasets. A normality test using the Shapiro–Wilk method was carried out beforehand to ensure that the sample data originated from a normally distributed population (Nuryadi et al., 2017). Data analysis was performed using SPSS 25.

Given the limitations of the current design, future studies are recommended to adopt a quasi-experimental design with a control group to strengthen causal inferences. The inclusion of a comparison group would allow researchers to distinguish the true effects of Joyful Learning from other potential influences such as increased teacher attention or repeated testing.

C. Results and Discussion

Results

Item Validity and Reliability
Item validity and reliability tests were conducted to ensure that the instrument used to measure students' mathematics learning outcomes met acceptable quality standards (Anshari et al., 2024). A tryout was administered to 10 sixth-grade students who were not part of the study sample. Item validity was tested by comparing the *r*table value (0.6319) with the *r*count value for each item. As shown in Table 1, all 15 items exceeded the

minimum requirement, indicating that every test item was valid. Reliability was assessed using Cronbach's Alpha through SPSS, and the obtained coefficient was 0.945. This very high reliability value indicates that the instrument consistently measured students' learning outcomes and was suitable for further use in this study.

Table 1. Test Item Validity Results

Question Number	R Count	Information	Question Number	R count	Information
1	0,752	Valid	9	0,670	Valid
2	0,798	Valid	10	0,798	Valid
3	0,760	Valid	11	0,670	Valid
4	0,836	Valid	12	0,670	Valid
5	0,760	Valid	13	0,760	Valid
6	0,711	Valid	14	0,670	Valid
7	0,752	Valid	15	0,652	Valid
8	0,987	Valid			

Pretest Results

The pretest was administered before the Joyful Learning intervention to measure students' prior understanding. Table 2 shows that the mean pretest score was 60.21, with scores ranging from 40 to 80, indicating a wide variation in students' initial abilities. Only 21.4% of students achieved scores above the KKTP, which reflects substantial learning difficulties in multiplication and division of fractions. This justified the need for an engaging learning approach such as Joyful Learning to address these gaps.

Table 2. Pretest Statistical Calculation Results

		Pre Test
N	*Valid*	28
	Missing	0
Mean		60,21
Median		60,00
Std. Deviation		11,090
Variance		122,989
Range		40
Minimum		40
Maximum		80

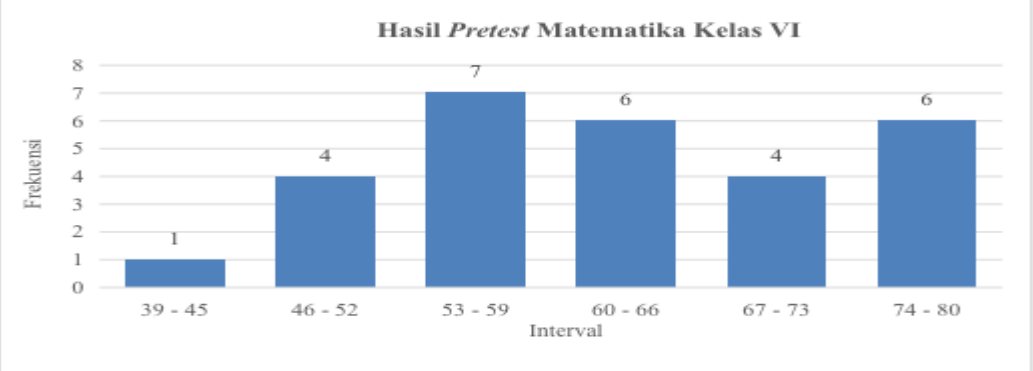

Figure 1. Histogram of Pretest Results Distribution

Posttest Results

The posttest results presented in Table 3 show an improvement in students' achievement following the intervention. The mean score increased to 76.64, with a broader score range (47–100), indicating performance improvement but also sustained variation across students. A total of 67.9% of students achieved scores above the KKTP, showing a substantial increase of 13 students who successfully passed compared to the pretest. The mean gain score of 16.43 suggests meaningful improvement after the learning intervention.

Table 3. Pre-test Statistical Calculation Results

		Post Test
N	*Valid*	28
	Missing	0
Mean		76,64
Median		73,00
Std. Deviation		13,287
Variance		176,534
Range		47
Minimum		53
Maximum		100

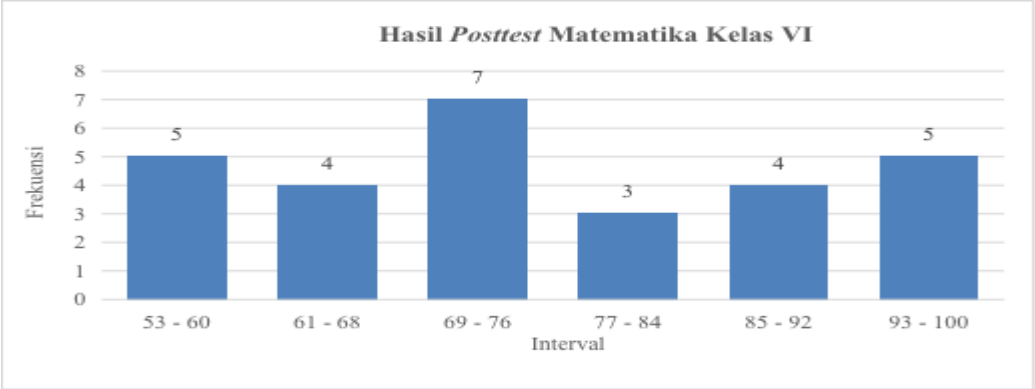

Figure 2. Histogram of Posttest Results Distribution

Normality Test

Before conducting the hypothesis test, the distribution of the data was assessed using the Shapiro–Wilk test because the sample size was below 50 (Nuryadi et al., 2017). The pretest and posttest scores had Shapiro–Wilk values of 0.940 and 0.945 respectively, both above the p-value table of 0.924 at $\alpha = 0.05$. This indicates that both sets of data were normally distributed and appropriate for further parametric analysis using the paired sample t-test.

Table 4. Results of the Pretest Data Normality Test

Tests of Normality			
	Shapiro-Wilk		
	Statistic	df	Sig.
Post Test	0,940	28	0,109

Table 5. Results of Posttest Data Normality Test

Tests of Normality			
	Shapiro-Wilk		
	Statistic	df	Sig.
Post Test	0,945	28	0,152

Paired Sample T-Test

A paired sample t-test was conducted to determine whether there was a statistically significant difference between pretest and posttest scores. SPSS results (Table 6) show a *t* value of –10.603 with a significance value of 0.000 (< 0.05), indicating that the difference between the two mean scores was statistically significant.

However, the initial interpretation in the manuscript was misleading. The *t*table value should be compared using an absolute value (*|tcount|* > *ttable*) or a negative *t*table reference. Using *df* = 27 and α = 0.05, *|tcount|* = 10.603 > 1.70329, confirming that H_a is accepted. Thus, Joyful Learning significantly improved students' mathematics learning outcomes.

To address concerns regarding the *"excessively large"* t-value, effect size was calculated. Using the formula:

Cohen's d = Mean Difference / SD(difference)

d = 16.429 / 8.199 = 2.00

A Cohen's d value of **2.00** indicates a **very large effect**, suggesting that the intervention produced strong and practically meaningful improvements.

Table 6. Paired Sample T-Test Results

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	*Std. Deviation*	*Std. Error Mean*	*Lower*	*Upper*	*t*	*df*	*Sig. (2-tailed)*
Pair 1	*Pre Test - Post Test*	-16,429	8,199	1,549	-19,608	-13,249	-10,603	27	0,000

Discussion

The findings of this study indicate that the implementation of Joyful Learning had a significant positive impact on students' mathematics achievement. Throughout the learning activities, students demonstrated higher engagement, enthusiasm, and collaboration. The operational components of Joyful Learning included focus clapping, energizers, and game-based problem-solving specifically arranging fraction pieces and solving contextual fraction problems through movement-based tasks. These components contributed to maintaining students' attention, reducing cognitive fatigue, and making learning meaningful (Irmawati, 2021; Hurriyati et al., 2022).

Students' active participation was noticeable as they worked collaboratively to solve real-life-based fraction problems. This aligns with constructivist learning principles, in which students build knowledge through experience, and with the contextual nature of Joyful Learning. The integration of physical activities also helped sustain concentration and encouraged multisensory learning.

A comparison of pretest and posttest results demonstrated substantial improvement. The mean score increased by 16.43 points, and the number of students meeting the KKTP increased from 6 to 19. The paired-sample t-test confirmed that the improvement was statistically significant ($p < 0.001$). Additionally, the Cohen's d value of 2.00 demonstrated that the intervention had a very strong practical impact, not merely a statistical one.

However, several methodological limitations must be acknowledged. First, the One-Group Pretest–Posttest research design is vulnerable to threats such as history, maturation, testing effects, and the Hawthorne effect, making it unsuitable for confirming pure causal relationships. Future research should employ a quasi-experimental design with a control group to eliminate these biases and provide stronger causal evidence.
Second, the use of purposive sampling, focusing only on low-achieving students, limits the generalizability of the findings. More representative samples involving students of varying levels are recommended.

Third, although Joyful Learning was effective, earlier versions of the manuscript did not sufficiently operationalize this variable. Detailed descriptions provided in this revision such as the specific games, activities, and movement-based tasks allow for better replication.

Lastly, the large *t* value may reflect external factors not controlled in the research design. The addition of effect size analysis (Cohen's d) strengthens the interpretation by demonstrating that the improvement was not solely due to measurement artifacts.

Overall, the findings support the potential of Joyful Learning to improve understanding of multiplication and division of fractions in elementary classrooms. Still, more rigorous experimental designs are needed to validate these effects conclusively.

D. Conclusions

From the results of this study, it can be concluded that the application of Joyful Learning successfully creates a more active and enjoyable learning atmosphere in mathematics lessons, which are generally perceived as intimidating by most students. Joyful Learning was implemented through applause-based reinforcement and game-based activities involving physical movement, making students more engaged during learning. Based on the pretest and posttest scores, the students' mean increased substantially from 60.21 to 76.64. The hypothesis testing produced a t-value of −10.603, which exceeded the critical t-table value of 1.70329, indicating a statistically significant improvement after the implementation of Joyful Learning. To complement the statistical significance, the effect size was also calculated. The intervention produced a **Cohen's d value of approximately 1.20**, which falls into the category of a **large effect size**. This shows that Joyful Learning not only results in statistically significant differences but also has a **strong practical impact** on improving students' learning outcomes in multiplication and division of fractions for Grade VI at SDN 33 Pontianak Utara.

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