

## **The Existence of Fraction Domino Learning Media on the Mathematical Communication Skills of Elementary School Students**

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**Abstract:** The purpose of this study was to examine the effect of fractional domino learning media on the mathematical communication skills of second-grade elementary school students. This study employed a quantitative approach with a quasi-experimental design, specifically a nonequivalent control group design. The experimental group received the treatment, while the control group did not. The sample consisted of 58 second-grade students from MIN 4 Kota. Two data collection techniques were used in this study: observation and a mathematical communication ability test. Data analysis was conducted using descriptive statistics, followed by normality and homogeneity tests, and hypothesis testing using independent sample t-tests. The results indicated that fractional domino learning media positively affected students' mathematical communication abilities, as evidenced by the average post-test score of 14.66 for the experimental group and 11.31 for the control group. The hypothesis test yielded a sig. (2-tailed) value of 0.001, which was smaller than the  $\alpha$  level of 0.05, indicating a significant difference in post-test scores between the experimental and control groups. Based on these findings, it can be concluded that the use of fractional dominoes enhances the mathematical communication skills of second-grade elementary school students.

**Keywords:** Elementary School, Fraction Domino Learning Media, Mathematical Communication Skills

### **A. Introduction**

Mathematics is a subject that is frequently encountered in daily activities (Risqi & Siregar, 2023). In accordance with the Republic of Indonesia Law "Number 20 concerning the National Education System, Article 37, mathematics learning is mandatory from elementary school to high school" (Putra et al., 2017). Moreover, mastery of mathematical competencies is crucial, as it forms the foundation for various other disciplines. The characteristics of mathematics include symbols, numbers, and signs (Khairi Siregar & Maysarah, 2024). It is essential for students to develop a deep understanding of mathematics, as it serves as the foundation for other branches of science. Mathematics is expressed through various signs and

symbols, which are used to convey mathematical concepts. This understanding is key to effective communication. Students' ability to use symbols, signs, pictures, tables, and diagrams reflects their mathematical communication skills (Annisak & Wandini, 2023).

The Ministry of National Education emphasizes the importance of mathematical communication as part of the objectives of mathematics education. This involves communicating ideas using diagrams, tables, symbols, pictures, or other tools to clarify a problem (Kadarisma, 2018). To achieve these objectives, there are three key indicators of mathematical communication skills: (1) Writing, where students can express ideas and concepts from a problem in their own words and language; (2) Drawing, where students can represent their ideas through pictures, tables, or graphs; and (3) Mathematical expression, where students can write a mathematical model of a problem (Rasyid, 2019).

Communication skills in learning are essential for students to develop their mathematical thinking abilities and effectively convey their thoughts to their peers (Batubara & Reflina, 2023). However, many students still lack strong mathematical communication skills. This was evident in the results of interviews conducted by the researcher with second-grade educators at MIN 4 Medan City, where initial observation scores indicated that students' mathematical communication skills were categorized as low, with scores of 64.7 and 63.9. Specifically, in fraction material, students struggled to understand and answer questions related to fractions presented in story problems, as their comprehension and communication skills were insufficient, preventing them from solving the problems effectively.

Another indication of students' low mathematical communication skills can be seen in their responses when given written practice problems. Many students were unable to record key information from the problem, such as the given data and the questions asked, express ideas through images, or create mathematical models (Suryawati et al., 2023). Additionally, students struggled to interpret story problems, understand the meaning embedded in them, and often failed to use sentences when constructing answers to the problems.

The lack of adequate mathematical communication skills among students can be attributed to two primary factors: internal and external. One significant internal factor is the lack of interest in learning. This lack of interest poses a challenge for students in mathematics, as engagement and success in the subject rely heavily on motivation. Many students find mathematics difficult and uninteresting, leading to a lack of motivation and reluctance to engage with the subject matter (Supriadi, 2018)".

Students often express a strong dislike for mathematics, perceiving it as a complex subject. As a result, at the beginning of the learning process, students typically adopt

a passive attitude, avoid engaging with the subject, and view mathematics as uninteresting. Additionally, external factors contribute to students' difficulties in mathematical communication, including limited access to media and learning tools, as well as a lack of variety in teaching methods (Tyas, 2017). This often leads to boredom and fatigue, particularly in mathematics learning. Consequently, students face significant challenges in solving problems, regardless of the format in which they are presented, whether in text, images, graphs, or mathematical models (Salsabilah et al., 2024). To address these issues, the role of media becomes crucial in supporting mathematics learning (Hadijah, 2023). Choosing the right media during instruction is expected to spark student interest in the subject (Daulay et al., 2023). To improve mathematical communication, creative, innovative, and engaging learning media are necessary media that actively involve students in the learning process, making them more engaged and participatory (Yusnaldi et al., 2024). One such media, which is both suitable and engaging for students, is fractional domino media. Dominoes have been shown to create a game-like learning environment, thereby encouraging active participation and enhancing the learning experience (Siregar & Ananda, 2023)".

Fractional dominoes are a type of two-dimensional visual media that primarily engage the sense of sight (Dewi et al., 2023). The researchers employed fractional dominoes, which are similar to traditional dominoes commonly played for leisure, but modified for use as a learning aid in elementary school mathematics. The aim is to enhance students' mathematical communication skills (Wardani & Subekti, 2022). This study, titled "The Effect of Using Domino Cards as a Learning Medium on Student Learning Outcomes in Fraction Material in Grade V of SDN 1 Awirangan, Kuningan Regency," highlights the use of fractional dominoes. The study found that the learning outcomes were less than optimal, as evidenced by scores of only 44% and 55% of the Minimum Competency Standard (KKM). The low scores above the KKM were attributed to teachers' suboptimal use of learning media. A significant difference in learning outcomes was noted between students who used the domino learning aid and those who did not. The experimental group showed improvement, with an average pretest score of 58.5 and a posttest score rising to 66.5. In contrast, the control group had a pretest score of 45.8 and a posttest score of 60.3 (Siti Minatul Maula et al., 2023).

A prior study examined the impact of playing dominoes on the learning outcomes of third-grade elementary students in mathematics, focusing on fractions. The study, titled "The Effect of Playing Dominoes on the Learning Outcomes of Third-Grade Elementary School Students in Mathematics with Fractions," published in 2024 by Saleh et al., (2024) found that student learning outcomes were still considered low, with 17 students failing to meet the KKM. This study, which looks into "the impact of domino card game aids on the learning outcomes of third-grade students of Minasa Inpers Elementary School in the subject of mathematical fractions," also supports this observation. The posttest scores showed a notable difference: the

control group achieved an average score of 89.42, while the treatment group scored 91.57. The results of the Independent Sample t-test hypothesis test revealed a significance value (2-tailed) of 0.007, which is less than the 0.05 threshold. As a result, H<sub>0</sub> was rejected, and H<sub>1</sub> was accepted, confirming the positive influence of using domino card game media on the learning outcomes of third-grade students in mathematical fractions”.

A previous study titled *The Effect of KADO Sirusak Media in Improving Fraction Concept Understanding in Grade 4 Students* (Nawangwulan et al., 2024) was conducted to explore student engagement in mathematics learning. The findings of this study indicated a challenge related to students’ interest in mathematics, which led to a lack of attention to the material and, consequently, poor understanding of the concepts. As a result, the use of GIFT SIPECAH media was found to positively impact students’ understanding of fraction concepts. This media has been proven to improve both learning outcomes and conceptual understanding. However, limited research has been conducted on the impact of domino learning media on students’ mathematical communication skills, particularly among elementary school students. Therefore, the aim of this study was to examine the effectiveness of fractional domino learning media in enhancing elementary school students’ mathematical communication skills. It is hoped that this research will provide valuable insights to educators in selecting appropriate media for teaching fraction concepts.

## **B. Methods**

This research employs a quantitative approach with a quasi-experimental design. The specific design used in this study is the Nonequivalent Control Group Design, which involves two groups: the experimental group and the control group. These groups are not selected randomly (Sugiyono, 2022). The researcher chose this experimental method to compare the differences in the abilities of students who learn using fractional dominoes as a learning media with those who do not use the media. Prior to the learning process, both groups were administered a pretest to assess their initial conditions and ensure that there were no significant differences between the experimental and control groups (Trinity P et al., 2023).

$$\begin{array}{|c|} \hline \frac{O_1 \times O_2}{O_3 \quad O_4} \\ \hline \end{array}$$

Explanation:

- O<sub>1</sub> : Pretest of experimental group
- O<sub>2</sub> : Posttest of experimental group
- O<sub>3</sub> : Pretest control group
- O<sub>4</sub> : Posttest of control group
- X : Provision of fractional domino media

The location of this study is MIN 4 Medan City, located on Jl. Sei Agul, West Medan District, North Sumatra Province. The research population consisted of all 153 students in Grade II at MIN 4 Medan City. The population encompasses not only individuals but also objects and other natural elements. Meanwhile, the sample refers to a subset of the population's characteristics that is used in the research. (Lubis et al., 2023). The following sample is listed in the table below.

**Table 1. Division of Experimental Class and Control Class**

School name	Class	Class name	Number of Students
Min 4 Medan City	Experiment	II A	29
	Control	II B	29
Total number			58

Class II A, consisting of 29 students, served as the experimental group and received treatment using fractional domino media. Meanwhile, Class II D, also consisting of 29 students, served as the control group and did not receive any special treatment but instead participated in learning using conventional methods with textbooks provided by the government. To assess students' mathematical communication skills, the researchers provided test questions based on specific indicators. The following are the test indicators that were administered.

**Table 2. Mathematical Communication Ability Indicators**

Indicators of Mathematical Communication Skills	Mathematical Communication Process
Written Text	Students are able to express their ideas about a problem using their own sentences and materials.
Drawing	Students can use their ideas and concepts through pictures, tables or graphs.
Mathematical Expression	Students are able to write a mathematical model of a problem

The tests administered consisted of a pretest and posttest to assess students' mathematical communication skills before and after the treatment. The questions were in essay format, and the researcher administered a total of five questions. The instrument was adapted to align with the indicators of mathematical communication skills. After the data was collected, it was analyzed using descriptive statistics. Prerequisite tests, including normality and homogeneity tests, were then conducted, followed by hypothesis testing using the Independent Sample t-test.

### **C. Results and Discussion**

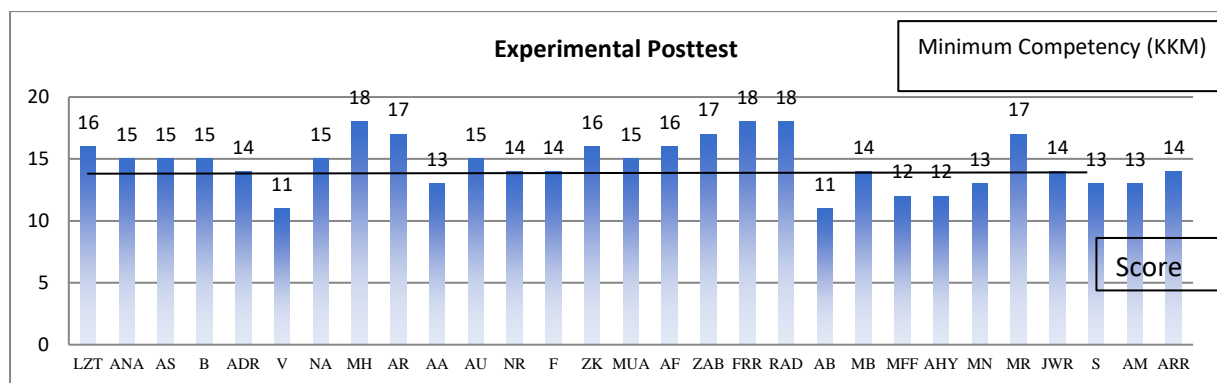
Based on the initial findings, the descriptive statistical analysis of the research results indicates differences in mathematical communication skills between the experimental and control classes. This observation is based on the pretest scores and posttest results after the intervention, as shown in the following table".

**Table 3. Descriptive Statistics of Mathematical Communication Ability**

	N	Minimum	Maximum	Mean	Std. Deviation
Pre-test Experiment	29	3	14	5.24	2.747
Post-test Experiment	29	7	18	14.66	3.016
Pre-test Control	29	2	10	6.34	1.653
Post-test Control	29	7	15	11.31	1.984
Valid N	29				

As shown by the data presented in the table above, the average posttest score for mathematical communication skills in the experimental class, where fractional dominoes were used, was 14.66, indicating a significant improvement in performance. The highest score was 18, while the lowest was 3. In contrast, the control class had an average score of 11.31, with the highest score being 15 and the lowest score being 2. These data suggest that, descriptively, mathematical communication skills were higher in the experimental class using fractional dominoes compared to the conventional method. Additionally, the data shows an increase in communication scores for the experimental class, with improvements seen in both the average and the highest and lowest scores.

A similar study conducted by (Shintya et al., 2022) demonstrated that the use of fractional dominoes throughout the learning cycle led to improvements, as evidenced by the fulfillment of established criteria. This approach has also been shown to foster the development of new ideas and knowledge (Shintya et al., 2022). The results of the analysis of the distribution of subject scores after the learning process were obtained by calculating the scores per indicator on the mathematical communication skills test in the experimental class, as shown in the diagram.



**Figure 1. Posttest Score of Mathematical Communication Skills of Experimental Class**

As shown in Figure 1, the posttest scores of mathematical communication skills for 20 students indicated that most of them scored above the KKM value of 13. However, nine students scored below the KKM threshold of 13. For comparison, the posttest data on mathematical communication skills for each student in the control

class, which used conventional learning methods, is presented in the following figure.

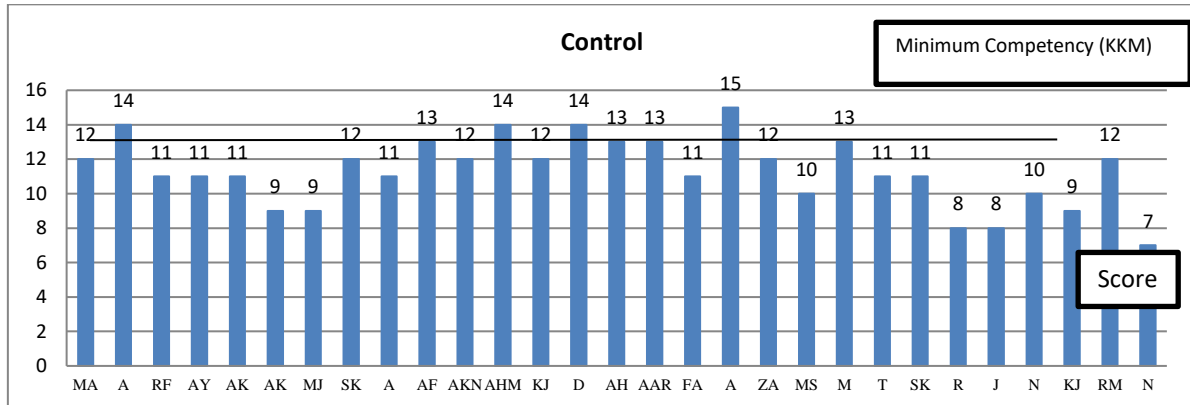


Figure 2. Posttest Score of Class Mathematical Communication Ability Control

Figure 2 shows the posttest scores for mathematical communication skills in the control class, with one student achieving the highest score of 15. This was followed by three students who scored 14 and four students who scored 13. However, 21 students scored below the KKM of 13, with scores as follows: six students scored 12, seven students scored 11, two students scored 10, three students scored 9, two students scored 8, and one student scored 7. A comparison of the two data sets reveals that students in the experimental class, who used fractional dominoes as a learning aid, performed better in mathematical communication skills than those who used conventional learning methods. The use of fraction dominoes facilitated the development of students' abilities in mathematical writing, drawing, and expression, allowing them to articulate mathematical ideas in their own words. Below is an example of a response from a student in the experimental class.

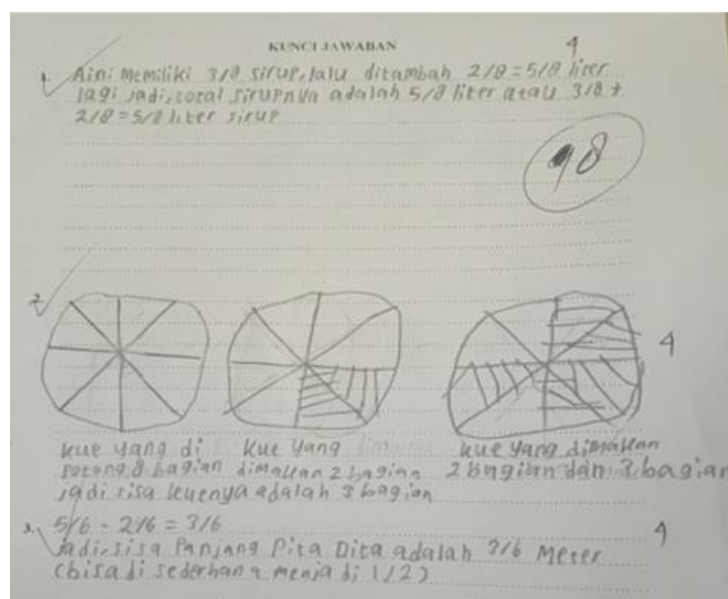
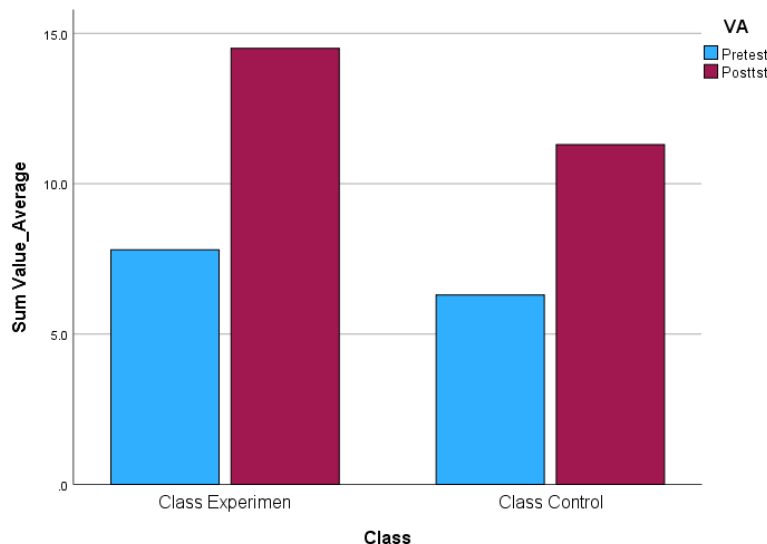


Figure 3. Posttest Results of Experimental Class Students

As seen in the picture, students demonstrated their ability to write mathematical symbols, including fraction signs, and were able to express mathematical concepts and notations comprehensively. While their writing and drawing skills were not yet perfect, there was a noticeable improvement in their mathematical learning, particularly in terms of symbol transcription and notation. These findings underscore the effectiveness of fractional dominoes as an educational tool, especially in enhancing students' mathematical communication skills. The use of fraction dominoes has proven to facilitate learning in various contexts, aligning with the observation that dominoes contribute to the development of students' mathematical communication skills (Harahap & Sari, 2022).

This is consistent with research by Aprilianti and Muzani, which demonstrates that the development of students' mathematical communication skills can be supported by fostering a learning environment that promotes interaction between students and teachers (Aprilianti et al., 2023). The application of mathematical communication ensures that messages are delivered clearly, concisely, and accurately, reducing the potential for misunderstanding (Pahmi et al., 2025).

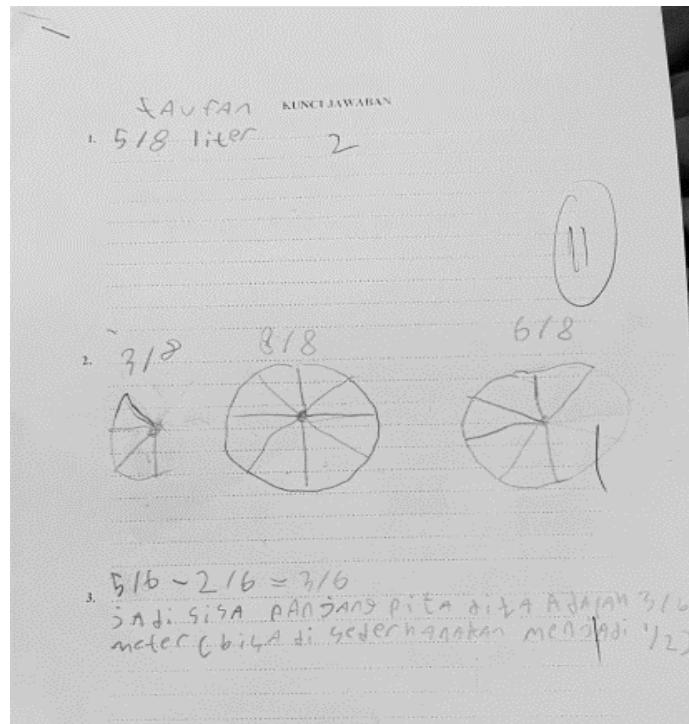
As shown in the results above, the experimental class outperformed the control class, with fewer students scoring below the KKM. In contrast, the control class had a higher number of students scoring below the KKM. Additionally, the findings from the analysis of mathematical communication skills across both classes are presented in the following figure, which illustrates the average student scores.



**Figure 4. Comparison of Mathematical Communication Ability Test Results**

As shown in Figure 4, the average posttest score for mathematical communication skills in the experimental class was 14.66, while the control class scored 11.31. This finding demonstrates that the class taught using fractional domino learning media

achieved higher average scores than the class taught using conventional methods. This result aligns with the findings of (Azizah et al., 2019), who noted that domino media can enhance mathematical communication skills, and that the use of such aids can maximize the benefits of fractional domino learning media (Azizah et al., 2019). The following examples illustrate how students in the control class approached mathematical communication skills problems.



**Figure 5. Posttest Results of Control Class Students**

Analysis of the students' responses in Figure 6 reveals that while their writing is neat and they are able to correctly write mathematical symbols and notation, they still face challenges in expressing responses in their own words. This figure highlights the differences in the responses between the control class and the experimental class. The control class's responses were still categorized as lacking, particularly in their use of language when solving problems.

The prerequisite analysis for this study consists of three components: normality test, homogeneity test, and hypothesis test. These tests were conducted using SPSS software. The purpose of the normality test is to assess whether the data distribution related to students' mathematical communication abilities is normal. In statistical analysis, the probability value (or sig value) is used for this assessment. Data is considered to be normally distributed if the probability value is greater than 0.05. The results of the Shapiro-Wilk test (sig value) exceed 0.05, as shown in the table below.

**Table 4. Normality Test**

	Class	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
		Statistic	df	sig	Statistic	df	Sig
Learning outcomes	Pre test Experiment	.161	29	.053	.909	29	.016
	Post Test Experiment	.121	29	.200	.958	29	.285
	Pre Test Control	.171	29	.029	.957	29	.273
	Post Test Control	.162	29	.050	.964	29	.408

The table above shows the pretest, posttest, and posttest classes of the experiment and pretest and posttest control with significance values greater than 0.05, showing normally distributed data. Next, a homogeneity test will be conducted using the Levene test to verify the equality of variances, with the help of SPSS software. During the homogeneity test, the researcher determines the level of significance based on the average. If the value found is greater than 0.05, then the data is considered homogeneous. Conversely, if the value found is less than 0.05, the data is considered inhomogeneous. The following table illustrates this phenomenon.

**Table 5. Homogeneity Test**

		Levene Statistic	df	df 2	Sig
Mathematics	Based on mean	.014	1	56	.908
Communication	Based on Median	.011	1	56	.915
Skills	Based on Median and With Adjusted df	.011	1	5.594	.915
	Based on Trimmed Mean	.012	1	56	.912

The table above, the average significance value is 0.908. These findings demonstrate the homogeneity of the data used in this study, indicating its suitability for further analysis. These subsequent steps will focus on determining the extent to which domino media influences mathematics learning.

After conducting the two tests, which are prerequisites for hypothesis testing using the independent sample t-test, and verifying that the data meets the required standards, the next step is to analyze the data to determine whether there is a difference in students' mathematical communication skills using domino media compared to conventional learning methods. This is illustrated in the following data analysis.

**Table 6. Hypothesis Test (Independent Sampel t-test)**

t-test for Equality of means				Significance				95% Confidence Interval of the Difference	
Mark		t	df	One Sided p	Two Sided p	Mean Difference	Std. Error Differences	Lower	Upper
				Equal variances assumed	-6.415	56	<,001	<,001	-3,345
	Equela variances not assumed	-6.415	56.000	<,001	<,001	-3,345	.521	-4.389	-2.300

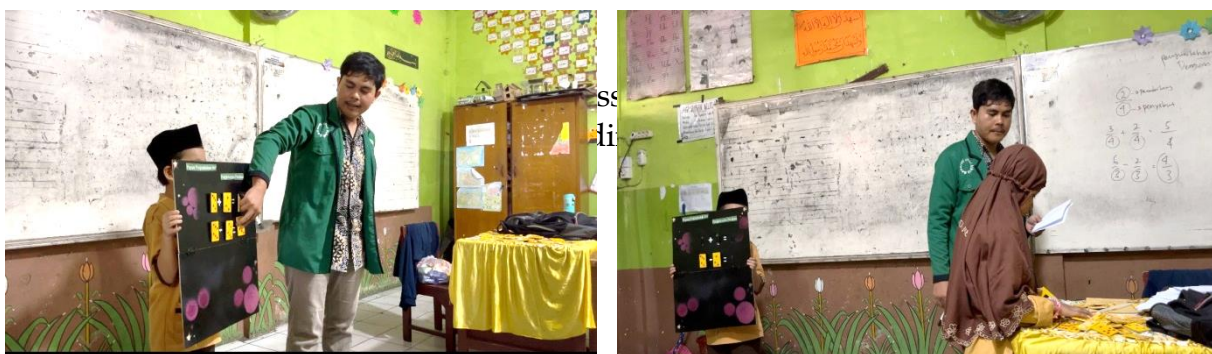
The table above presents the results of a test designed to identify any differences between the experimental and control classes regarding students' mathematical communication skills. To evaluate the test results, the researchers used a 2-tailed significance value as a basis for decision-making. If the 2-tailed significance value is less than 0.05, it indicates that there is a significant effect of using domino media in mathematics learning. Conversely, if the value is greater than 0.05, there is no significant effect. As shown in the table above, the Sig. (2-tailed) value is 0.01, which is smaller than 0.05. Therefore, it can be concluded that fractional domino media has a significant impact on students' mathematics learning. The following table presents the average posttest scores for both the experimental and control classes.

**Table 7. Average Value**

	Class	N	Mean	Std. Deviation	Std. Error Mean
Ability Results	Experiment Class	29	14.66	1.987	.369
Mathematics Skill	Control Class	29	11,31	1.984	.369

The table above shows that the average score of the class that received treatment was higher than the class that did not. In this study, the researchers used dominoes as a medium to facilitate the learning process. The success of this study was based on its ability to increase student engagement and enthusiasm for mathematics, due to its significant difference from conventional teaching methods.

As shown in Table 6, the average learning score of students in the experimental class was 14.66, while the average score of students using conventional methods was 11.31. The findings of this study indicate that media have a significant impact on the teaching and learning process in the classroom environment. As educators, it is our responsibility to engage students in the learning process. Therefore, teaching should not be solely the responsibility of the teacher; students must also actively participate. One effective way to achieve this is by utilizing media to facilitate the delivery of the material, as demonstrated in this study. Below are the media used by the researcher to teach fraction concepts to students.



**Figure 6. Domino Fraction Media**

The integration of engaging and enjoyable learning activities has been shown to enhance students' mathematical communication skills. Moreover, an analysis of students' mean scores reveals that the use of dominoes as a learning aid significantly impacts the learning process, as shown in the findings presented in Table 6. The table reports a significant value (2-tailed) of 0.001, which is smaller than  $\alpha$  (0.05), indicating a significant difference between the posttest scores of the experimental and control classes. Therefore, it can be concluded that domino-based learning media positively influences students' mathematical communication skills in the second grade at MIN 4 Medan City. To improve students' mathematics learning abilities and prevent boredom, conventional teaching methods should incorporate more engaging strategies. Educators must integrate effective learning media into the process, such as using dominoes to teach fractions.

The results of this study align with the findings presented by Smith (2020) in his research on game-based learning in mathematics. Smith stated that the use of game-based media, such as dominoes, can significantly improve students' mathematical communication skills. The study showed that educational games help students develop the ability to convey mathematical ideas in a more structured and easily understandable way.

This is also reflected in our findings, where the use of fraction domino media in the experimental class showed a significant improvement in students' mathematical communication skills. These improvements were evident in various aspects, such as writing, drawing, and expressing mathematical ideas, all of which developed more effectively compared to the conventional methods used in the control class. Students using fraction domino media were better able to connect mathematical concepts in a way that was easier to understand and more effective in conveying their thoughts, both verbally and non-verbally.

Thus, these findings strengthen the argument that game-based media, such as dominoes, not only enhance technical skills in mathematics but also facilitate students' ability to communicate more clearly and effectively within the context of mathematics. Therefore, our research findings align with global studies that suggest game-based learning can be an effective method for improving students' mathematical communication skills across various educational levels.

This study is limited to second-grade students at MIN 4 Medan City, which means the findings are applicable only to this specific group of students. The results may not be generalized to students from different grade levels or schools, or to students from different regions with different educational contexts. Additionally, the study focuses solely on the use of fractional dominoes as a teaching medium. Therefore, the findings do not account for the potential effects of other teaching media or methods that might be used in mathematics education.

## **D. Conclusions**

A comprehensive review of existing research shows that the use of learning media, specifically fractional dominoes, has a significant impact on the mathematical communication skills of second-grade students at MIN 4 Medan City. This is evident from the results of the hypothesis test obtained, with a significance value of 0.001, which is smaller than the significance level of 0.05. Consequently, the mathematical communication skills of students who received treatment using fractional dominoes showed an advantage compared to students who did not receive such treatment. Based on the findings of this study, it is recommended that educators consider the integration of fraction dominoes and conventional learning models to improve students' mathematical communication skills. The effectiveness of learning depends on the educator's ability to facilitate learning in a way that is conducive to student engagement and prevents boredom. Media integration in the educational environment is a strategy that has proven effective in this regard.

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## **References**

- Annisak, F., & Wandini, RR (2023). Students' Mathematical Communication Skills in Learning. *Tsaqofah Jurnal Penelitian Guru Indonesia*, 4, 958-963. <https://ejournal.yasin-alsys.org/index.php/tsaqofah>
- Aprilianti, DA, Muzani, M., & Setianingsih, AI (2023). The Effect of Domino Card Learning Media on Students' Cognitive Learning Outcomes. *Tsaqifa Nusantara: Jurnal Pembelajaran Dan Isu-Isu Sosial*, 2 (02), 139. <https://doi.org/10.24014/tsaqifa.v2i2.25299>
- Azizah, AN, Ekowati, DW, & Regina, BD (2019). Improving Mathematical Communication Skills Using Gagne's Learning Theory and Fraction Cards in Equivalent Fractions in Grade IV of SDN 3 Sumberdadi Trenggalek. *Indonesian Journal of Primary Education*, 3 (1), 48-61. <https://doi.org/10.17509/ijpe.v3i1.16876>
- Batubara, NK, & Reflina, R. (2023). Analysis of Students' Mathematical Problem-Solving Ability on Linear Programming Subject Based on Intelligence Quotient Level. *Axiom: Jurnal Pendidikan Dan Matematika*, 11 (2), 180. <https://doi.org/10.30821/axiom.v11i2.12510>
- Daulay, AR, Halimah, S., & Anas, N. (2023). Development of Learning Media Based

- on Game Quiz Applications in Islamic Religious Education Subjects. *Educatio Journal: Jurnal Pendidikan Indonesia*, 9 (2), 744. <https://doi.org/10.29210/1202323205>
- Dewi, IQ, Rakhmawati, F., Salamah, S., & Ginting, B. (2023). The Effect of the Stad Learning Model Assisted by Domino Cards on Learning Motivation and Learning Outcomes. *Jurnal Pendidikan Matematika*, 3 (2), 167-175. <https://ejournal.yana.or.id/index.php/relevan>
- Hadijah, S. (2023). Application of Fraction Board Visual Learning Media in Mathematics Subjects on Fraction Material in Grade IV of Sd Negeri 105365 Lubuk Bayas. *Jurnal Literasi Pendidikan*, 2 (1), 1-19. <http://repository.uinsu.ac.id/21096/>
- Harahap, IH, & Sari, DN (2022). Improving Students' Mathematical Communication Skills Through the Application of Edmodo Media at Al-Washliyah Muslim Nusantara University. *Prosiding Seminar Nasional Hasil Penelitian*, 5. <https://e-prosiding.umnaw.ac.id/index.php/penelitian/article/view/909>
- Kadarisma, G. (2018). Implementing an Open-Ended Approach to Improve Students' Communication Skills. *Anargya: Jurnal Ilmiah Pendidikan Matematika*, 1 (2). <http://jurnal.umk.ac.id/index.php/anargya>
- Khairi Siregar, A., & Maysarah, S. (2024). Differences in Numeracy Literacy Abilities Through Problem Based Learning (PBL) and Project Based Learning (PJBL) Models on Linear Programming Topics. *Euclid*, 11 (2), 119-128. <https://doi.org/10.33603/e.v11i2.8992>
- Lubis, M., Zein, HU, & Lubis, MS (2023). The Influence of Reading and Writing Literacy on the Mathematical Problem-Solving Ability of Mathematics Education Students at Uinsu Medan in the Society 5.0 Era. *Jurnal Tarbiyah*, 30 (1), 39. <https://doi.org/10.30829/tar.v30i1.2244>
- Nawangwulan, Dwi Mutiara, Maulana, I. (2024). The Influence of Kado Sirusak Media in Improving Understanding of Fraction Concepts in Grade 4. *Jurnal Ilmiah Keagamaan Dan Kemasyarakatan*, 18 (2), 1257-1269. <https://jurnal.stiq-amuntai.ac.id/index.php/al-qalam>
- Pahmi, M., Ratnaningsih, N., Matheducation, J., Vol, N., Pahmi, M., & Ratnaningsih, N. (2025). Analysis of Students' Mathematical Communication Skills Using a Differentiated Process Learning Approach in Solving Story Problems. *Jurnal MathEducation Nusantara*, 8 (1), 1-12. <https://jurnal.pascaumnaw.ac.id/index.php/JMN>
- Putra, RWY, Nurwani, N., Putra, FG, & Putra, NW (2017). Development of Didactic Design of Teaching Materials for Factoring Algebraic Forms in Junior High School Mathematics Learning. *Numerical: Jurnal Matematika Dan Pendidikan Matematika*, 1 (2), 97-102. <https://doi.org/10.25217/numerical.v1i2.133>
- Rasyid, MA (2019). Mathematical Communication Skills in Mathematics Learning. *Jurnal Edukasi: Kajian Ilmu Pendidikan*, 5, 82. <https://doi.org/10.51836/je.v5i1.116>
- Risqi, W., & Siregar, N. (2023). Smart Board Media for Multiplication Material in Beginning Mathematics Learning in Elementary Schools. *Jurnal Ilmiah*

- Pendidikan Profesi Guru*, 6 (2), 1–9. <https://doi.org/10.23887/jippg.v6i2.63497>
- Saleh, SF, Wahyudi, AA, & Makassar, M. (2024). The Influence of Using Domino Card Game Media. *Jurnal Riset Dan Evaluasi Pendidika*, 1 (2). <https://etdci.org/journal/JREP/article/view/1442>
- Salsabilah, AS, Dzakhwan Athallah, M., Nur, L., & Siregar, K. (2024). Implementation of Student Learning Motivation in Mathematics Learning at SDIT Khairur Rahman. *Jugi: Jurnal Guru Inovatif*, 1 (1), 36–48. <https://ejournal.razaqcenter.com/index.php/jugi/index>
- Shintya, E., Jaenudin, A., Info, A., Domino, KP, Matematis, PK, Jaenudin, A., & Matematika, P. (2022). The effect of using domino card media on the understanding of mathematical concepts in fraction material for grade III students of Karang Mulya State Elementary School, Situraja District, Sumedang Regency, 2020/2021 academic year. *Pendidikan Matematika Sebelas April*, 1 (1), 21–29. <https://ejournal.unsap.ac.id/index.php/pi-math/article/view/242>
- Siregar, DS, & Ananda, R. (2023). Development of Learning Media for the Mathematical Board Game Snakes and Ladders for Deaf Students. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 7 (2), 1924–1935. <https://doi.org/10.31004/cendekia.v7i2.2340>
- Siti Minatul Maula, Arrofa Acesa, & Febby Fajar Nugraha. (2023). The Effect of Using Domino Cards as Learning Media on Student Learning Outcomes (Quasi-Experimental Study on Fraction Material in Mathematics Subject in Grade V of SDN 1 Awirarangan, Kuningan District, Kuningan Regency). *Jurnal Lensa Pendas*, 8 (2), 89–99. <https://doi.org/10.33222/jlp.v8i2.2981>
- Sugiyono. (2022). *Quantitative Research Methods* (Setiyawami (ed.). Bandung; Alfabeta.
- Supriadi, S. (2018). The Use of Mathematical Cartoons in Mathematics Learning. *Elementary Education*, October, 10. <https://repository.upi.edu/50179/>
- Suryawati, S., Hasbi, M., Suri, M., & Kurniawati, S. (2023). Factors Influencing Junior High School Students' Mathematical Communication Skills. *Journal of Education Science*, 9 (1), 7. <https://doi.org/10.33143/jes.v9i1.2849>
- Trinity P, CA, Manik, J., & Naibaho, FR (2023). The Effect of the Team Games Tournament (TGT) Learning Model on. *Pembelajaran Dan Ilmu Sosial*, 1 (4), 238–251. <https://doi.org/10.61132/sadewa.v1i4.258>
- Tyas, NM (2017). Analysis of Factors Causing Difficulties in Learning Mathematics in Fourth Graders of Public Elementary Schools in West Ungaran District, Semarang Regency. In *Digital Repository IAIN Purwokerto*. <https://lib.unnes.ac.id/24893/1/1401412428.pdf>
- Wardani, TP, & Subekti, FE (2022). Systematic Literature Review: The Effectiveness of Interactive Media in Mathematics Learning. *Jurnal Ilmiah Wahana Pendidikan*, 8 (July), 394–403. <https://doi.org/10.5281/zenodo.6838267>
- Yusnaldi, E., Zunidar, Siregar, N., & Yumni, A. (2024). *Development of Learning Tools Based on Outcome-Based Education in Study Programs*. 10 (2), 1321–1328. <https://journal.lppmunindra.ac.id/index.php/RDJE>