

INTEGRATION OF WORDWALL IN MATHEMATICS LEARNING: AN EFFORTS TO IMPROVE STUDENTS MATHEMATICAL COMMUNICATION

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ABSTRACT Mathematical communication ability is an essential competency in mathematics learning because it enables students to express mathematical ideas, use representations, and explain solution procedures systematically. However, many students still experience difficulties in communicating mathematical ideas due to teacher-centered learning and limited interactive activities. This study aimed to examine the effectiveness of Wordwall-integrated mathematics learning on students' mathematical communication ability. This study employed a quantitative quasi-experimental method with a pretest-posttest control group design. The population consisted of seventh-grade students at Yasiriyah Private Junior High School Medan, with a sample of 50 students divided into an experimental class and a control class, each consisting of 25 students. The research instrument was an essay test based on indicators of mathematical communication ability. Data were analyzed using descriptive statistics, N-Gain analysis, normality and homogeneity tests, and an independent sample t-test. The results showed that the experimental class achieved a higher improvement than the control class, with a mean N-Gain score of 0.74 in the high category, while the control class obtained 0.39 in the moderate category. The independent sample t-test showed a significance value of $0.000 < 0.05$, indicating a significant difference between the two classes. Improvements were found in all indicators, with the highest improvement in explaining solution procedures systematically. These findings indicate that Wordwall-integrated mathematics learning is effective in improving students' mathematical communication ability and can support more interactive and student-centered learning.

Keywords: mathematical communication ability, wordwall, interactive learning, mathematics education

ABSTRAK Kemampuan komunikasi matematis merupakan kompetensi penting dalam pembelajaran matematika karena membantu siswa mengungkapkan ide matematika, menggunakan representasi, dan menjelaskan prosedur penyelesaian secara sistematis. Namun, banyak siswa masih mengalami kesulitan dalam mengomunikasikan ide matematika karena pembelajaran masih berpusat pada guru dan kurang melibatkan aktivitas interaktif. Penelitian ini bertujuan untuk menguji efektivitas pembelajaran matematika terintegrasi Wordwall terhadap kemampuan komunikasi matematis siswa. Penelitian ini menggunakan metode kuantitatif kuasi-eksperimen dengan desain *pretest-posttest control group*. Populasi

penelitian adalah siswa kelas VII SMP Swasta Yasiriyah Medan, dengan sampel sebanyak 50 siswa yang terbagi ke dalam kelas eksperimen dan kelas kontrol, masing-masing terdiri atas 25 siswa. Instrumen penelitian berupa tes uraian berdasarkan indikator kemampuan komunikasi matematis. Data dianalisis menggunakan statistik deskriptif, analisis N-Gain, uji normalitas, uji homogenitas, dan *independent sample t-test*. Hasil penelitian menunjukkan bahwa kelas eksperimen mengalami peningkatan lebih tinggi dibandingkan kelas kontrol, dengan rata-rata N-Gain sebesar 0,74 pada kategori tinggi, sedangkan kelas kontrol memperoleh 0,39 pada kategori sedang. Hasil *independent sample t-test* menunjukkan nilai signifikansi $0,000 < 0,05$, yang berarti terdapat perbedaan signifikan antara kedua kelas. Peningkatan terjadi pada seluruh indikator, dengan peningkatan tertinggi pada indikator menjelaskan prosedur penyelesaian secara sistematis. Temuan ini menunjukkan bahwa pembelajaran matematika terintegrasi Wordwall efektif dalam meningkatkan kemampuan komunikasi matematis siswa dan dapat mendukung pembelajaran yang lebih interaktif serta berpusat pada siswa.

Kata-kata kunci: kemampuan komunikasi matematis, wordwall, pembelajaran interaktif, pendidikan matematika

INTRODUCTION

Mathematics is an important subject that plays a strategic role in developing students' logical, systematic, critical, and creative thinking skills (Arrifadah & Suliani, 2026). In the learning process, mathematics is not only understood as a collection of formulas and calculations, but also as a means for students to develop reasoning and communicate ideas systematically. Therefore, mathematics learning should provide opportunities for students to express mathematical ideas, explain reasoning processes, and interpret mathematical concepts appropriately (Saviraningrum & Soebagyo, 2022). One important competency that needs to be developed in mathematics learning is mathematical communication ability, which has been widely discussed as an essential ability in mathematics education (Daningtyas et al., 2025).

Mathematical communication ability refers to students' ability to express and interpret mathematical ideas both orally and in written form. This ability includes explaining problem-solving procedures, using mathematical symbols and representations appropriately, and communicating mathematical reasoning logically and systematically (Epih, 2024). The National Council of Teachers of Mathematics emphasizes communication as one of the main process standards in mathematics learning because communication enables students to organize their thinking, construct conceptual understanding, and participate actively in learning activities (Rahmadanti et al., 2024). Through mathematical communication, students are expected not only to obtain correct answers but also to explain how and why solutions are obtained.

At the junior high school level, mathematical communication ability becomes increasingly important because students begin to move from concrete thinking toward more abstract mathematical reasoning. At this stage, students are required to understand mathematical concepts more deeply and communicate ideas using

appropriate mathematical language and representations. Good mathematical communication ability also supports students in collaborative learning activities, problem solving, and critical thinking processes (Daimah & Suparni, 2023). Therefore, mathematics learning should provide sufficient opportunities for students to explain ideas, discuss strategies, and present solution procedures.

However, students' mathematical communication ability in schools still requires serious attention. Many students experience difficulties in explaining mathematical ideas, interpreting mathematical representations, and presenting solution procedures systematically. Preliminary observations at Nurul Ilmi Private Junior High School Medan showed that many students were still unable to explain the meaning of word problems and communicate mathematical reasoning clearly during classroom learning. Students often focused only on obtaining final answers without explaining the reasoning process. This condition indicates that students' mathematical communication ability still needs to be improved.

The low level of students' mathematical communication ability may be influenced by several factors. One of the main factors is that mathematics learning is still dominated by teacher-centered approaches and conventional lecture methods. In many classrooms, students tend to become passive recipients of information, while opportunities for discussion, interaction, and idea exchange remain limited. As a result, students rarely practice communicating mathematical ideas during the learning process. In addition, the limited use of interactive learning media also contributes to students' low participation and communication in mathematics classrooms (Vidyastuti et al., 2023).

In the context of 21st-century education, learning is expected to be more interactive, student-centered, and technology-based. The integration of digital technology in learning activities is important to support students' engagement and participation during classroom instruction. Interactive learning media can help students become more active in constructing understanding, discussing ideas, and communicating mathematical concepts. Therefore, teachers need to utilize digital learning media that can create a more engaging and interactive mathematics learning environment (Haleem et al., 2022).

One interactive digital medium that can be integrated into mathematics learning is Wordwall. Wordwall is an online learning platform that provides various interactive learning activities, such as quizzes, matching games, problem-solving tasks, and other game-based exercises. Wordwall allows teachers to create interactive activities easily and adapt learning materials according to instructional objectives. Through game-based activities, students are encouraged to participate actively, discuss answers, and communicate mathematical ideas during the learning process (Aghata et al., 2024). Wordwall also provides immediate feedback that helps students identify mistakes and improve their understanding directly during learning activities. Its interactive features can increase students' motivation and classroom

engagement because learning becomes more enjoyable and dynamic (Wang & Tahir, 2020).

Several previous studies have reported the positive impact of Wordwall in mathematics learning. Mujahidin et al. (2021) showed that Wordwall-assisted learning improved students' motivation and classroom interaction. Rahmadanti et al. (2024) reported that Wordwall contributed positively to students' mathematics learning outcomes. Furthermore, Pitriani et al. (2024) found that Wordwall-assisted learning supported students' mathematical communication during classroom activities. These findings indicate that Wordwall has the potential to support more interactive mathematics learning. However, previous studies have generally focused on students' motivation, learning outcomes, or general classroom interaction, while studies that specifically examine the effect of Wordwall-integrated mathematics learning on students' mathematical communication ability remain limited, particularly at the junior high school level.

In this study, mathematical communication ability is focused on three main indicators adjusted to the characteristics of seventh-grade junior high school students. These indicators include expressing mathematical ideas in written form, using mathematical representations such as pictures, symbols, and tables, and explaining solution procedures systematically. These indicators are important because mathematical communication is not only related to obtaining correct answers but also to students' ability to express mathematical thinking through writing, symbols, representations, and explanations of solution steps (Aiyub et al., 2021; Negara et al., 2021).

Based on the explanation above, this study aims to examine the effectiveness of Wordwall-integrated mathematics learning on students' mathematical communication ability. This study focuses on comparing the improvement of mathematical communication ability between students who learn through Wordwall-integrated mathematics learning and those who receive conventional learning. The findings are expected to contribute to the development of interactive technology-based mathematics learning that supports students' ability to express ideas, use mathematical representations, and explain solution procedures systematically.

METHODS

This study employed a quantitative quasi-experimental method using a pretest-posttest control group design. This design was used to compare students' mathematical communication ability between the experimental class, which received Wordwall-integrated mathematics learning, and the control class, which received conventional learning. Before the treatment was administered, both classes were given a pretest to determine their initial mathematical communication ability. After the learning process, both classes were given a posttest to measure the improvement in students' mathematical communication ability.

Table 1. Pretest-Posttest Control Group Design

Group	Pretest	Treatment	Posttest
Experimental Class	O ₁	X	O ₂
Control Class	O ₃	–	O ₄

Description:

- O₁ : Pretest of the experimental class
- O₂ : Posttest of the experimental class
- O₃ : Pretest of the control class
- O₄ : Posttest of the control class
- X : Wordwall-integrated mathematics learning

The population of this study consisted of all seventh-grade students at Yasiriyah Private Junior High School Medan. The sample consisted of two classes, namely Class VII-2 as the experimental class and Class VII-3 as the control class, with 25 students in each class. The experimental class received mathematics learning integrated with Wordwall, while the control class received conventional learning.

The data collected in this study consisted of pretest scores, posttest scores, and N-Gain scores. The research instrument was an essay test developed based on indicators of mathematical communication ability. The indicators included expressing mathematical ideas in written form, using mathematical representations such as pictures, symbols, and tables, and explaining solution procedures systematically. Observation sheets and documentation were also used to support the description of the learning process.

Data collection was conducted by administering a pretest before the learning process and a posttest after the learning activities were completed. In the experimental class, Wordwall was integrated into mathematics learning through interactive activities such as quizzes, matching tasks, and problem-solving exercises. These activities were designed to encourage students to participate actively, discuss answers, and communicate mathematical ideas. Meanwhile, the control class received conventional learning through teacher explanation and routine exercises.

The data were analyzed using descriptive and inferential statistics. Descriptive statistics were used to describe the mean scores and standard deviations of students' pretest, posttest, and N-Gain results. The improvement in students' mathematical communication ability was analyzed using the N-Gain formula:

$$N-Gain = \frac{\text{Posttest score} - \text{Pretest score}}{\text{Maximum score} - \text{Pretest score}}$$

Before hypothesis testing, prerequisite tests were conducted, consisting of a normality test and a homogeneity test. The normality test was carried out using the

Shapiro-Wilk test, while the homogeneity test was conducted using Levene's test. After the data were confirmed to be normally distributed and homogeneous, an independent sample t-test was used to determine whether there was a significant difference in mathematical communication ability between students in the experimental and control classes. The significance level used in this study was 0,05.

FINDING AND DISCUSSION

Comparison of the Experimental and Control Classes

The main objective of this study was to compare the improvement of students' mathematical communication ability between the experimental class, which received Wordwall-integrated mathematics learning, and the control class, which received conventional learning. Therefore, the main findings are first presented through the comparison of pretest, posttest, and N-Gain scores between the two classes. Table 2 presents the comparison of students' mathematical communication ability in the experimental and control classes.

Table 2. Comparison of Students' Mathematical Communication Ability

Class	Mean Pretest	SD Pretest	Mean Posttest	SD Posttest	Mean N-Gain	SD N-Gain	Category
Experimental	42.52	10.80	85.56	5.61	0.74	0.11	High
Control	41.80	10.32	65.20	5.10	0.39	0.12	Moderate

Based on Table 2, both the experimental and control classes experienced improvement after the learning process. However, the improvement achieved by the experimental class was higher than that of the control class. The experimental class obtained a mean pretest score of 42.52, which increased to 85.56 in the posttest. Meanwhile, the control class increased from 41.80 in the pretest to 65.20 in the posttest.

Furthermore, the N-Gain analysis showed that the experimental class obtained a mean N-Gain score of 0.74, which was categorized as high, while the control class obtained a mean N-Gain score of 0.39, which was categorized as moderate. These results indicate that students who participated in Wordwall-integrated mathematics learning showed better improvement in mathematical communication ability than students who participated in conventional learning.

The standard deviation values in both classes indicate that the distribution of students' scores was relatively consistent. However, the experimental class demonstrated greater improvement after the implementation of Wordwall-integrated learning. This finding suggests that the integration of interactive digital media contributed positively to students' mathematical communication ability.

The higher improvement in the experimental class may be related to the interactive learning environment created through Wordwall. Through quizzes, matching activities, and interactive problem-solving tasks, students were encouraged to

participate actively, express ideas, discuss solutions, and communicate mathematical reasoning systematically. In contrast, students in the control class tended to participate more passively because learning activities were still dominated by teacher explanations and routine exercises.

During the learning process, students in the experimental class showed higher enthusiasm and participation. Students became more confident in explaining mathematical ideas and discussing solution procedures with their peers. The interactive and game-based features provided by Wordwall also increased students' motivation and attention during learning activities. Therefore, these findings indicate that Wordwall-integrated mathematics learning contributed positively to improving students' mathematical communication ability.

Inferential Statistical Analysis

Before conducting hypothesis testing, prerequisite tests, including normality and homogeneity tests, were conducted to determine whether the data met the assumptions for parametric statistical analysis.

Normality Test

The normality test was conducted using the Shapiro–Wilk test to determine whether the pretest and posttest data in both classes were normally distributed. The results of the normality test are presented in Table 3.

Table 3. Results of Normality Test

Class	Data	Sig. Value	Criteria	Conclusion
Experimental	Pretest	0.087	Sig. > 0.05	Normal
Experimental	Posttest	0.121	Sig. > 0.05	Normal
Control	Pretest	0.094	Sig. > 0.05	Normal
Control	Posttest	0.109	Sig. > 0.05	Normal

Based on Table 3, all significance values were greater than 0.05. Therefore, it can be concluded that the pretest and posttest data in both the experimental and control classes were normally distributed.

Homogeneity Test

After the normality test, a homogeneity test was conducted using Levene's test to determine whether the variance of the two groups was homogeneous. The results of the homogeneity test are presented in Table 4.

Table 4. Results of Homogeneity Test

Data	Sig. Value	Criteria	Conclusion
Posttest Scores	0.214	Sig. > 0.05	Homogeneous

Based on Table 4, the significance value obtained was 0.214, which was greater than 0.05. Therefore, it can be concluded that the variance of the experimental and control classes was homogeneous.

Hypothesis Testing

Because the data were normally distributed and homogeneous, hypothesis testing was conducted using an independent sample t-test. This test aimed to determine whether there was a significant difference in students' mathematical communication ability between the experimental and control classes after the implementation of Wordwall-integrated mathematics learning. The results of the independent sample t-test are presented in Table 5.

Table 5. Results of Independent Sample t-Test

Data	t-count	Sig. (2-tailed)	Criteria	Conclusion
Posttest Scores	8.742	0.000	Sig. < 0.05	H ₀ rejected

Based on Table 5, the significance value obtained was 0.000, which was smaller than 0.05. Therefore, H₀ was rejected and H₁ was accepted. This result indicates that there was a significant difference in mathematical communication ability between students in the experimental class and those in the control class after the implementation of Wordwall-integrated mathematics learning.

These findings show that Wordwall-integrated mathematics learning significantly improved students' mathematical communication ability compared to conventional learning. The interactive learning activities provided through Wordwall encouraged students to participate more actively, communicate mathematical ideas, and explain solution procedures systematically during classroom learning activities.

Improvement Based on Mathematical Communication Indicators

After presenting the main comparison between the experimental and control classes, further analysis was conducted to examine the improvement in each indicator of mathematical communication ability in the experimental class. The indicators analyzed in this study included expressing mathematical ideas in written form, using mathematical representations, and explaining solution procedures systematically. Table 6 presents the improvement in each indicator of students' mathematical communication ability.

Table 6. Improvement of Students' Mathematical Communication Ability

No.	Mathematical Communication Indicators	Pretest (%)	Posttest (%)	N-Gain	Category
1	Expressing mathematical ideas in written form	48.10	84.20	0.69	Moderate–High

No.	Mathematical Communication Indicators	Pretest (%)	Posttest (%)	N-Gain	Category
2	Using mathematical representations	46.75	80.15	0.63	Moderate
3	Explaining solution procedures systematically	40.60	82.70	0.71	High

Based on Table 6, all indicators of mathematical communication ability improved after the implementation of Wordwall-integrated mathematics learning. The highest improvement occurred in the indicator of explaining solution procedures systematically, with an N-Gain score of 0.71, categorized as high. Meanwhile, the indicator of expressing mathematical ideas in written form obtained an N-Gain score of 0.69, categorized as moderate-high, and the indicator of using mathematical representations obtained an N-Gain score of 0.63, categorized as moderate.

Improvement in Expressing Mathematical Ideas in Written Form

The indicator of expressing mathematical ideas in written form showed considerable improvement after the implementation of Wordwall-integrated mathematics learning. Before the treatment, many students tended to write only final answers without explaining the reasoning process or organizing their ideas systematically. Students also experienced difficulties in presenting mathematical explanations clearly in written form.

After participating in Wordwall-integrated learning, students gradually became more capable of organizing mathematical ideas systematically and logically. Students began to explain known information, describe solution procedures, and formulate conclusions more clearly. This improvement was influenced by interactive activities provided through Wordwall, which encouraged students to participate actively and communicate mathematical ideas during learning activities.

The improvement in this indicator indicates that Wordwall-integrated learning created opportunities for students to practice expressing mathematical reasoning more confidently. Interactive quizzes and collaborative activities encouraged students not only to answer questions correctly but also to communicate how the answers were obtained. As a result, students became more accustomed to expressing mathematical ideas clearly and systematically.

Improvement in Using Mathematical Representations

The indicator of using mathematical representations also showed improvement after the implementation of Wordwall-integrated mathematics learning. Students became more capable of using symbols, diagrams, tables, and mathematical models during problem-solving activities. Before the treatment, many students experienced

difficulties in selecting appropriate representations and often focused only on calculations without using visual or symbolic support.

Through Wordwall-integrated learning, students were exposed to various interactive visual activities that strengthened their representational understanding. Students practiced connecting mathematical problems with visual illustrations and symbolic forms through quizzes and matching activities. These learning experiences helped students understand mathematical concepts more systematically.

Although the improvement in representational ability was categorized as moderate, the findings indicate that Wordwall contributed positively to students' ability to use mathematical representations appropriately. However, representational ability still requires continuous practice because students need to transform abstract concepts into visual and symbolic forms accurately.

Improvement in Explaining Solution Procedures Systematically

The highest improvement occurred in the indicator of explaining solution procedures systematically. Students became more capable of communicating mathematical reasoning and explaining procedural steps clearly after participating in Wordwall-integrated learning. Before the treatment, many students focused only on obtaining final answers without explaining the procedures used to solve problems.

After the implementation of Wordwall-integrated mathematics learning, students gradually demonstrated improvement in explaining problem-solving procedures sequentially and logically. Students became more accustomed to identifying known information, selecting appropriate mathematical operations, carrying out calculations, and concluding answers systematically.

This improvement occurred because Wordwall activities encouraged students not only to determine correct answers but also to understand and communicate the reasoning behind those answers. During collaborative activities, students frequently discussed strategies, exchanged ideas, and explained mathematical procedures to peers. These interactions helped students practice mathematical communication more effectively.

The high N-Gain score in this indicator indicates that Wordwall was particularly effective in strengthening students' procedural communication ability. Through repeated interactive problem-solving activities, students became more aware that explaining the process of obtaining answers is as important as the final result itself.

The findings of this study demonstrate that the integration of Wordwall into mathematics learning contributed positively to students' mathematical communication ability. Students who participated in Wordwall-integrated learning showed greater improvement than those who learned through conventional teaching methods. These findings suggest that interactive digital learning environments can facilitate more student-centered and engaging mathematics

learning experiences that support students in communicating mathematical ideas more actively.

The higher improvement observed in the experimental class may be attributed to the interactive features provided by Wordwall. Through quizzes, matching activities, randomized questions, and immediate feedback, students were encouraged to participate actively in classroom learning (Murillo-Zamorano et al., 2021). Compared to conventional instruction, which primarily emphasized teacher explanations and routine exercises, the interactive learning environment enabled students to discuss mathematical ideas, explain solution procedures, and collaborate with peers more intensively. This finding is in line with previous studies indicating that interactive and game-based learning activities can improve students' engagement, participation, and motivation during classroom instruction (Rivera & Garden, 2021).

The findings are also consistent with previous studies highlighting the effectiveness of Wordwall in supporting mathematics learning activities. Deasya et al. (2025) showed that Wordwall-assisted learning can improve students' mathematical communication ability because students become more active in discussing and explaining mathematical ideas during learning activities. Similarly, Hamidah et al. (2024) found that Cooperative Script learning assisted by Wordwall online games significantly improved students' communication skills and classroom participation. These findings indicate that gamified digital platforms may enhance not only students' engagement but also collaborative interaction during mathematics learning.

Another important finding concerns students' increased participation and confidence during mathematics learning activities. Students in the experimental class appeared more willing to answer questions, express opinions, and communicate mathematical ideas than students in the control class. The enjoyable and less monotonous learning atmosphere created through game-based activities may have reduced students' anxiety and encouraged more active classroom participation. This finding is supported by Khosiah and Soliha (2025), who emphasized that Wordwall-assisted instruction positively affected students' participation and conceptual understanding because students experienced more interactive and engaging learning situations.

Although the indicator of mathematical representation improved after the implementation of Wordwall-integrated learning, the N-Gain category remained moderate. This result indicates that representational ability is relatively more complex because students are required to transform abstract mathematical concepts into visual and symbolic forms accurately. While the interactive platform successfully increased students' participation and communication activities, representational ability still requires continuous practice and teacher guidance to achieve optimal improvement. Therefore, interactive digital learning media should

be integrated with instructional strategies that provide sufficient opportunities for students to construct and represent mathematical ideas in multiple forms.

The findings also demonstrate that interactive digital learning environments can contribute positively to collaborative mathematics learning. Through game-based classroom activities, students were encouraged to interact with peers, discuss mathematical solutions, and communicate reasoning processes more openly. Such learning conditions support the development of mathematical communication ability because students learn not only through teacher instruction but also through peer interaction and collaborative discussion. Mudrika et al. (2024) explained that Wordwall-assisted learning encouraged students to become more active in problem-solving and collaborative learning activities during mathematics instruction.

This study contributes to the growing literature on digital game-based learning by specifically demonstrating how Wordwall can support students' mathematical communication ability in junior high school mathematics classrooms. The findings provide empirical evidence that interactive and gamified learning activities may enhance students' engagement, participation, and communication processes simultaneously during mathematics learning.

From a practical perspective, the findings imply that mathematics teachers should consider integrating interactive digital learning platforms into classroom instruction to create more participatory and communicative learning environments. Gamified learning activities may help teachers increase students' engagement while simultaneously facilitating mathematical discussion and collaborative learning. However, teachers still play an important role in designing meaningful instructional activities, guiding classroom interaction, and ensuring that technology integration remains aligned with learning objectives rather than merely entertainment-oriented activities.

Despite the positive findings, this study has several limitations. First, the study was conducted within a limited sample and school context, which may affect the generalizability of the findings to broader educational settings. Second, the duration of the intervention was relatively short, making it difficult to examine the long-term effects of Wordwall-integrated learning on students' mathematical communication ability. Third, this study focused primarily on quantitative improvement and did not investigate students' perceptions and classroom interaction processes in depth. Future research may therefore explore the long-term implementation of interactive digital learning media across broader educational contexts and combine quantitative and qualitative approaches to obtain more comprehensive findings regarding students' mathematical communication development.

Overall, the findings highlight the importance of integrating Wordwall into mathematics learning activities. Interactive and game-based learning environments not only support students' engagement and motivation but also contribute positively to the development of mathematical communication ability. Therefore,

Wordwall-integrated learning can be considered an effective instructional alternative for supporting interactive, collaborative, and student-centered mathematics learning in junior high school classrooms.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results and discussion, Wordwall-integrated mathematics learning was effective in improving students' mathematical communication ability. The experimental class showed a higher improvement than the control class, as indicated by the mean N-Gain score of 0.74 in the high category, while the control class obtained 0.39 in the moderate category. The independent sample t-test also showed a significance value of $0.000 < 0.05$, indicating a significant difference between the two classes after the learning process. The improvement was reflected in all indicators of mathematical communication ability, namely expressing mathematical ideas in written form, using mathematical representations, and explaining solution procedures systematically. The highest improvement occurred in explaining solution procedures systematically, showing that Wordwall-supported activities helped students communicate mathematical reasoning more clearly and sequentially.

These findings indicate that Wordwall can create a more interactive, engaging, and student-centered mathematics learning environment. Through quizzes, matching activities, and interactive problem-solving tasks, students were encouraged to participate actively, discuss mathematical ideas, and explain their reasoning during learning. Therefore, mathematics teachers are encouraged to use Wordwall as an interactive medium that is not only focused on games, but also designed to support discussion, reasoning, and mathematical communication. Schools are also expected to provide adequate facilities and teacher training to support technology-based learning. Future researchers may apply Wordwall to different mathematics topics, grade levels, or learning models, and further explore students' perceptions and classroom interactions to obtain a deeper understanding of its role in improving mathematical communication ability.

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