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The Effectiveness of Using the Educational Game Wordwall on Students' Learning Outcomes in Fraction Material for Fifth Grade at Ketol Public Elementary School 6

Lina Wati*, Maisura, Yulia Santi
Graduate Program in Elementary Education, Almuslim University, Bireuen, Indonesia, 24261

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* *Corresponding author:*

E-mail: wlina7133@gmail.com

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A B S T R A C T

This study examined the effectiveness of the educational game Wordwall in improving students' learning outcomes in fraction topics among fifth-grade students at Public Elementary School 6 Ketol, Central Aceh, Indonesia. A quantitative approach with a One-Shot Case Study design was employed, involving 37 students as participants. Data were collected through a learning achievement tes. Descriptive statistics, normality tests, and a one-sample t-test were used for data analysis. The mean post-test score was 7.13, slightly above the Minimum Mastery Criterion (KKM) of 7, although the difference was not statistically significant ($p = 0.603 > 0.05$). These results suggest that while Wordwall did not significantly improve test scores, it successfully enhanced motivation, discipline, and active participation in learning. Therefore, the Wordwall educational game can be considered an innovative and engaging digital tool for enhancing both cognitive and affective aspects of elementary mathematics learning.

1. Introduction

Education in the twenty-first century demands a paradigm shift in the learning process at the elementary school level. This transformation no longer focuses solely on cognitive achievement but also emphasizes the development of skills, attitudes, and values that support students' holistic success. Education is expected to nurture not only intellectual ability but also creativity, character, and adaptability to technological progress. Effective learning therefore requires innovation in teaching strategies and the use of technology that allows students to actively construct their own understanding. Arifin et al. (2021) emphasized that primary education forms the basis for developing critical thinking, collaboration, and responsibility. In

addition to technological innovation, contextual learning approaches are equally important because they connect lessons with real-life experiences, making learning more meaningful (Mahbengi, Santi, & Maisura, 2025). Furthermore, effective lesson planning is a key foundation for successful classroom implementation, as systematic instructional design ensures that learning objectives, materials, and media align with student needs and contextual factors (Novalita, 2014).

One of the main indicators of successful learning is student achievement. Learning outcomes show how well students comprehend the material, complete assignments, and demonstrate competence (Wahyuni, 2020). However, many elementary students still struggle to achieve satisfying results, particularly in mathematics. Mathematics is often perceived as an abstract and difficult subject that requires logical reasoning and symbolic representation. Fraction material, for instance, remains one of the most challenging topics for students, as it demands both conceptual understanding and procedural mastery (Heruman, 2014). Yeni (2015) also emphasized that difficulties in learning mathematics at the elementary level often arise from students' limited ability to understand abstract symbols and their low motivation during the learning process. Recent studies report that innovative strategies such as guided inquiry and contextual learning models can significantly improve students' comprehension and engagement (Rodri, N. Z et al., 2025). These findings emphasize the need for learning innovations that make mathematics more interactive and accessible.

A similar challenge was observed at Public Elementary School 6 Ketol, where fifth-grade students showed limited understanding of fractions. Preliminary observations revealed that only one student, or thirty-three point three percent, could correctly answer the easiest question, while none managed to solve the more difficult ones. This indicates that their ability to simplify fractions, find common denominators, and compare values remains weak. The learning process is still dominated by conventional teacher-centered methods with minimal use of interactive or digital media, resulting in low motivation and poor outcomes.

To address this problem, teachers need to integrate learning media that increase students' enthusiasm and participation. One promising medium is the Wordwall educational game, a digital platform offering interactive learning through various game-based activities. Suryani (2021) explained that Wordwall helps teachers design enjoyable learning experiences that combine challenge, competition, and instant feedback. Learning through games allows students to stay motivated and engaged, while Mahbengi et al. (2025) highlighted that contextual and interactive learning can bridge the gap between theory and practice, improving conceptual understanding.

Wordwall combines educational and entertaining aspects in one platform. Arsyad (2020) described educational games as learning tools created to deliver instructional content through engaging and playful experiences. This approach fits the learning characteristics of elementary students, who understand concepts better through interaction and concrete examples. Supporting this, Santi and Is (2015) found that creative play-based activities improved language acquisition and engagement

among early learners, showing that play has a strong cognitive impact. Similarly, Heinich et al. (2010) emphasized that effective media should stimulate multiple senses and promote active thinking. Wordwall fulfills this criterion by presenting learning materials visually and interactively, turning students into active participants rather than passive listeners.

In addition, Wordwall is flexible and easy to use. Putri (2022) noted that the platform allows teachers to create curriculum-aligned games such as quizzes and matching activities accessible on various digital devices. Yuliana (2023) added that it provides automatic scoring and instant feedback for both teachers and students, functioning not just as entertainment but as a pedagogical tool that supports self-evaluation. Similarly, Indrawati and Suardiman (2013) proved through their Travel Game development that interactive media could significantly improve students' understanding of fractions by turning abstract concepts into concrete learning experiences. From a theoretical standpoint, Wordwall is consistent with the principles of behaviorist learning theory, which emphasizes reinforcement and response to stimuli in shaping learning behavior (Yeni & Marisa, 2021).

Numerous studies have also confirmed the effectiveness of Wordwall. Sari and Marlina (2021) found that students using Wordwall scored higher and showed greater enthusiasm than those taught with conventional methods. Fitriyani (2022) reported that the Gameshow Quiz in Wordwall increased numerical ability by twenty-seven percent compared to traditional instruction. Wahyuni (2023) observed that student participation improved by eighty-seven percent when Wordwall was implemented in class. These studies demonstrate that digital game-based learning not only boosts cognitive outcomes but also enhances motivation and emotional engagement. According to constructivist learning theory, students construct knowledge actively through meaningful experiences.

In mathematics education, Wordwall helps bridge abstract and concrete understanding. Hakim (2022) stated that Wordwall visualizes numbers and fractions in engaging ways, making them easier to comprehend. The integration of digital media also promotes digital literacy and critical thinking skills. Nasution (2020) emphasized that game-based learning trains students to use technology responsibly, think reflectively, and collaborate effectively. Joyce and Weil (2015) added that game-based simulations strengthen teamwork, perseverance, and problem-solving skills, qualities that are essential in modern education.

Considering these perspectives, using Wordwall in mathematics learning is highly relevant, especially in fraction material that often poses difficulties for elementary students. Its visual interactivity, competitive elements, and instant feedback create a dynamic classroom atmosphere where students are encouraged to participate actively, think critically, and learn through experience. Based on theoretical insights and empirical evidence, the Wordwall educational game can be regarded as an effective alternative to enhance students' learning outcomes. Therefore, the objective of this study is to analyze the effectiveness of the Wordwall educational game in improving fifth-grade students' learning outcomes on fraction material at Public Elementary School 6 Ketol.

2. Methodology

Research Approach

This study applied a quantitative approach using a quasi-experimental design in the form of a One-Shot Case Study. A quantitative method was chosen because the research aimed to measure students' learning outcomes objectively after a specific treatment (Creswell, 2014). The One-Shot Case Study design involved a single group that received treatment without a control group or pre-test. This design was selected due to field conditions that did not allow random grouping or initial measurement (Sugiyono, 2021). The main goal was to identify changes and effects resulting from the application of the Wordwall educational game in learning fraction material among fifth-grade students, cognitive learning outcomes were obtained through a post-test.

Research Site and Duration

The research was conducted at Ketol Public Elementary School, located in Ketol District, Central Aceh Regency, Aceh Province, Indonesia. The study lasted for approximately eight months, from December 2024 to September 2025, covering several stages such as instrument development, the implementation of Wordwall-based learning, data collection, and data analysis. The school was purposively selected because it implements the Merdeka Curriculum, which emphasizes student-centered learning and promotes the use of digital educational media, making it an ideal setting for applying the Wordwall educational game in mathematics instruction.

Sample

The participants of this study were 37 fifth-grade students at SDN 6 Ketol in the 2025/2026 academic year, consisting of 19 females and 18 males aged 10–11 years. They were selected using a saturated sampling technique, in which the entire population was involved due to the small and homogeneous class size (Arikunto, 2019). All students participated in the learning process using the Wordwall educational game, engaging actively in interactive activities that promoted collaboration, motivation, and a deeper understanding of fraction concepts in a dynamic classroom environment.

Instrument

Main instruments were used in this study a learning achievement test (post-test). The learning achievement test was designed to measure students' cognitive understanding after learning with Wordwall. The test consisted of 10 multiple-choice items based on indicators of learning objectives from the *Merdeka Curriculum* for fifth-grade mathematics. Validity testing used the Product Moment Correlation, showing all items were valid with *r* values greater than *r* table (0.334). The reliability coefficient, analyzed using Cronbach's Alpha, was 0.766, indicating a high level of reliability (Marwan et al., 2019).

Data Collection

Data were collected through two main stages. First, the implementation of Wordwall-based learning was conducted using an interactive game format (*Gameshow Quiz*), where students actively engaged in solving fraction problems through collaborative and competitive play, making the learning process more enjoyable and meaningful (Hamalik, 2018). Finally, after the learning session, a post-test was administered to assess students' mastery of fraction concepts, particularly in addition and subtraction with both similar and dissimilar denominators.

Data Analysis

All collected data were analyzed quantitatively using SPSS version 25. The analysis was carried out in several stages. First, the normality of the data was tested using the Shapiro–Wilk Test, which is suitable for sample sizes under 50 students. Data were considered normally distributed if the significance value (Sig.) was greater than 0.05 (Ghozali, 2021). Second, hypothesis testing was performed using a One-Sample t-Test to determine whether the use of the Wordwall educational game significantly improved students' learning outcomes. The mean post-test score was compared to the Minimum Mastery Criterion (KKTP) of 70. The decision rule was: if $t_{\text{hol}} > t_{\text{taβle}}$, the alternative hypothesis (H_a) was accepted, meaning the Wordwall game had a significant positive effect; otherwise, H_a was rejected.

3. Results and Discussion

Results

The study was conducted at Public Elementary School 6 Ketol, located in Central Aceh Regency, Aceh Province, Indonesia. A total of 37 students participated as research respondents in this study. After the implementation of interactive digital learning using the Wordwall educational game, the researcher directly administered a post-test to measure the students' understanding and learning outcomes. The use of Wordwall aimed to create a more engaging and enjoyable learning atmosphere, motivating students to participate actively throughout the learning process. Based on the questionnaire data, the respondents were classified by gender, consisting of 18 male students (48.64%) and 19 female students (51.36%). This indicates that female participants slightly outnumbered male students. However, both groups showed equal enthusiasm and meaningful contributions during the research activities, reflecting balanced participation in the implementation of the digital-based learning approach.

During the implementation of the research, the learning activities were conducted in three sessions using an interactive digital-based learning approach through the educational game Wordwall on the topic of addition and subtraction of fractions. The teacher began the lesson with an introduction and a brief explanation of the basic concept of fractions, then guided students to access Wordwall using laptops

or mobile phones alternately. The learning activities were carried out in small groups to ensure that each student could actively participate in answering questions presented in the *game show quiz* format. After the learning session, the researcher administered a post-test directly to assess students' learning outcomes and character development. Data collection was conducted through observation sheets, character questionnaires, and learning outcome tests, which were later analyzed using SPSS version 25 for statistical processing. Throughout the activities, the classroom atmosphere was active and engaging—students appeared enthusiastic while participating in the educational game, and the interaction between the teacher and students was dynamic, as illustrated in Figures 1 below.

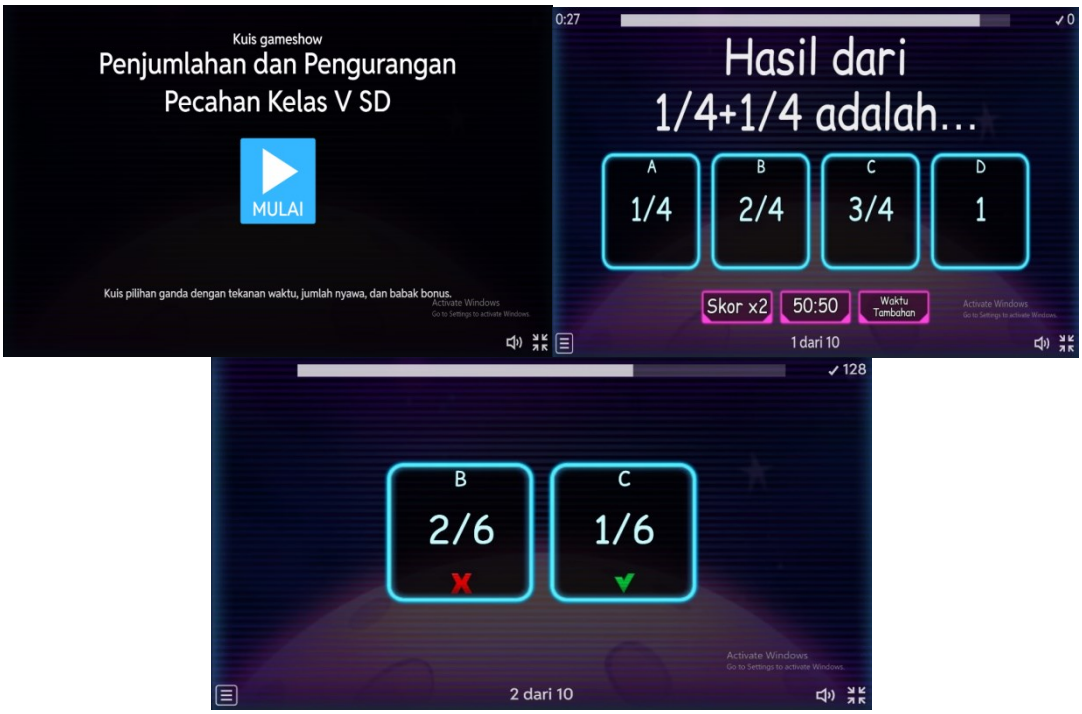

Figure 1. Display of the Wordwall Quiz on Fraction Materials.

Analysis of Students' Learning Outcomes

A descriptive analysis was conducted to illustrate the level of students' achievement after the implementation of the Wordwall-based learning media in the topic of fractions. This analysis aimed to identify the mean score, highest and lowest scores, as well as the standard deviation, which indicates the variation in students' performance levels. This approach was used to provide a clear overview of how effectively the integration of Wordwall supported students' understanding and mastery of fraction concepts. The descriptive data of learning outcomes from 37 students who participated as respondents in this study are presented in Table 1 below.

Table 1. Descriptive Statistics of Students' Learning Outcomes

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Learning Outcomes	37	4	10	7.13	1.566

Source: SPSS Output Version 25, processed in 2025

Table 2 shows the descriptive statistics of students' learning outcomes after the application of *Wordwall* in the learning process. Based on the analysis of 37 respondents, the lowest score obtained was 4, and the highest was 10, with a mean score of 7.13 and a standard deviation of 1.566. The mean score indicates that, in general, students' learning outcomes have surpassed the Minimum Mastery Criteria (KKTP) set at 7. However, the standard deviation of 1.566 suggests that there was still some variation in individual performance. Most students demonstrated a good understanding of the fraction material, while a small number of students were still below the mastery level. This indicates that the use of *Wordwall* as an educational medium had a positive impact on improving students' learning outcomes, as it successfully created an interactive, enjoyable, and motivating learning atmosphere that encouraged active participation.

In addition, the variation in scores also implies that individual factors, such as prior knowledge and cognitive ability, played a role in influencing the final results. Nevertheless, overall findings show that Wordwall was effective in helping students understand fraction concepts more concretely and engagingly, thereby contributing significantly to improved learning outcomes. This effectiveness reflects how digital learning media can enhance students' motivation and active participation, leading to a deeper comprehension of mathematical concepts. To better visualize the distribution of students' learning outcomes, the histogram of score distribution is presented in Figure 2 below.

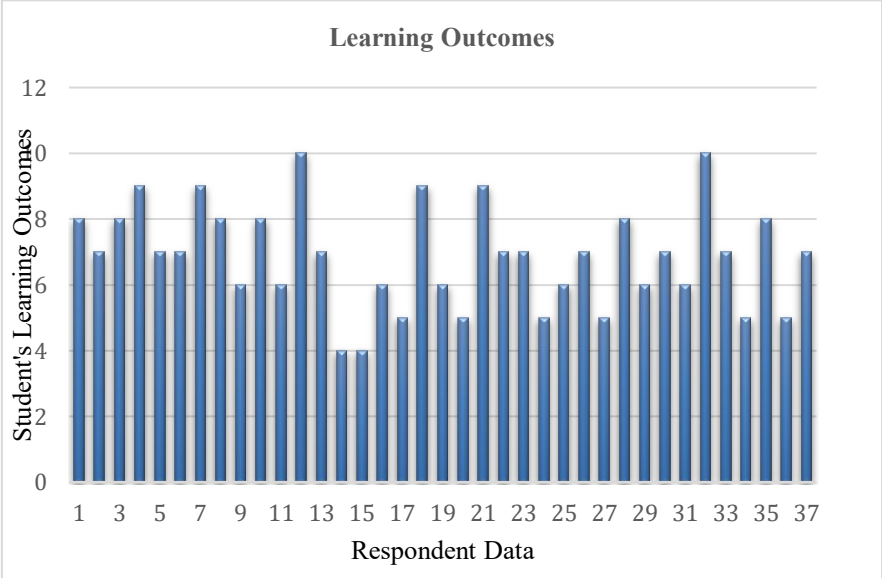

Figure 2. Histogram of Students' Learning Outcomes in Grade V of SDN 6 Ketol

The histogram illustrates that most students obtained scores within the range of 6 to 8, which is consistent with the mean score of 7.13. Only a few students scored below 6 or achieved the maximum score of 10. This distribution indicates that students' learning achievements were generally concentrated in the upper-middle category. These results suggest that the learning process using Wordwall successfully accommodated students with different abilities, enabling most of them to reach satisfactory learning outcomes. Therefore, it can be concluded that the use

of Wordwall in learning fractions was effective in helping students achieve the expected mastery level and improve overall learning performance.

Effectiveness of Wordwall in Improving Students' Learning Outcomes

This research aimed to determine the effectiveness of using the educational game Wordwall in improving students' learning outcomes on the topic of fractions among fifth-grade students at SDN 6 Ketol. The analysis was conducted based on students' post-learning test scores after the implementation of the Wordwall-based learning media. The analytical process consisted of two main stages: the normality test to verify whether the data were normally distributed, and the hypothesis test to determine whether there was a significant difference between the students' average learning outcomes and the predetermined mastery criterion (KKTP).

a. Normality Test

The normality test was conducted to examine whether the distribution of students' learning outcomes followed a normal pattern. This test used the Shapiro–Wilk Test through the SPSS version 25 software, as the sample size was less than 50 participants. The decision criterion used was that if the significance value (*Sig.*) was greater than 0.05, the data were considered normally distributed; conversely, if the *Sig.* value was less than or equal to 0.05, the data were considered not normally distributed. The results of the normality test are presented in Table 2 below.

Table 2. Normality Test Results

One-Sample Shapiro–Wilk Test	N	Test Statistic	Sig.	Conclusion
Unstandardized Residual	37	0.954	0.134	Normal

Source: SPSS Output version 25, processed in 2025

As shown in Table 5, the significance value obtained was 0.134, which is greater than 0.05, indicating that the data were normally distributed. This confirms that the assumption required for conducting parametric tests has been met. Furthermore, the histogram of learning outcomes revealed a distribution pattern resembling a bell-shaped curve, where most students' scores were concentrated within the range of 6 to 8. The mean score was 7.13, while the median was 7.00, indicating a close relationship between the two measures and supporting the conclusion that the data were symmetrically distributed and approximately normal.

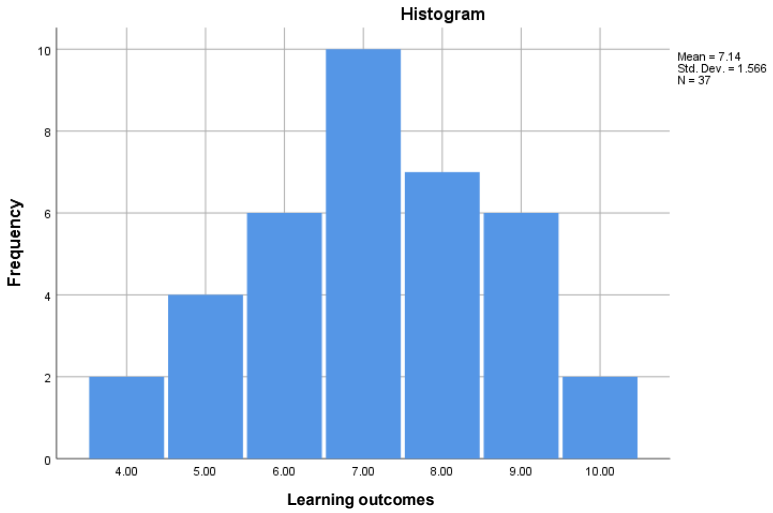

Figure 3. Histogram of Students' Learning Outcomes
Source: SPSS Output version 25, processed in 2025

b. Hypothesis Test

After confirming the normality of the data, the next stage was to perform the One-Sample t-Test to determine whether there was a significant difference between the students' mean score and the minimum mastery criterion (KKTP) of 7. The results of this test are summarized in Table 4 below.

Table 4. Hypothesis Test Results (One-Sample t-Test)

Variable	Test Value = 7	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference
Learning Outcomes		0.525	36	0.603	0.135	Lower -0.3871

Source: SPSS Output version 25, processed in 2025

The results of the *one-sample t-test* involving 37 respondents revealed that the average learning outcome score was 7.13, with a standard deviation of 1.57. The calculated *t*-value was 0.525, with a degree of freedom (*df*) of 36 and a significance value (*Sig. 2-tailed*) of 0.603, which is greater than the alpha level (α) of 0.05. Therefore, the null hypothesis (H_0) was accepted, while the alternative hypothesis (H_1) was rejected. This indicates that there was no statistically significant difference between the mean of students' learning outcomes and the mastery criterion value of 7. Moreover, the 95% confidence interval, ranging from -0.3871 to 0.6574, includes zero, which further confirms that the difference was not statistically significant.

Based on these findings, it can be concluded that the use of the educational game Wordwall did not lead to a statistically significant increase in students' learning outcomes, although the average score exceeded the minimum mastery criterion. This result implies that Wordwall had a positive influence on students' engagement

and learning motivation, as it made the learning process more interactive and enjoyable. However, from a quantitative perspective, the improvement in cognitive performance remained moderate. In other words, Wordwall proved effective in creating an active and stimulating learning atmosphere, yet additional pedagogical strategies may still be required to achieve a more substantial and statistically significant improvement in students' academic achievement.

Discussion

Students' Learning Outcomes Test

The normality test using the Shapiro–Wilk method obtained a value of W = 0.954 with a significance level of 0.134 ($p > 0.05$). This indicates that the data residuals were normally distributed, thus meeting the assumption required for parametric testing. Visually, the histogram of score distribution displayed a bell-shaped curve with a mean score of 7.13 and a median of 7.00. The proximity between these two values suggests a relatively symmetrical distribution without significant skewness, confirming the validity of inferential analysis. The one-sample t-test was then conducted using the Minimum Mastery Criterion (KKTP) score of 7 as a benchmark. The result showed $t = 0.525$, $df = 36$, and $p = 0.603$ ($p > 0.05$), indicating that the null hypothesis (H_0) was accepted. This means that the students' average score ($M = 7.13$) was not significantly different from the KKTP. In other words, the use of Wordwall as a learning medium in the topic of fractions had a positive contribution to students' engagement and comprehension, even though its statistical impact on cognitive performance remained modest.

These findings align with prior game-based learning (GBL) studies emphasizing that educational games primarily enhance motivation, engagement, and retrieval practice, while significant cognitive improvements generally require longer intervention periods, better alignment between game content and assessment indicators, and consistent feedback (Clark, Tanner-Smith, & Killingsworth, 2016; Lee, 2023). In mathematics learning, especially in fraction topics, similar results have been observed. Zhao et al. (2023) reported significant improvements in rational number understanding, whereas Nuraydin et al. (2022) found no notable difference when the game question format was misaligned with formal evaluation indicators. Likewise, Kuwayyis (2023) in the *JIEET Journal* developed an Android-based mathematics game for fifth-grade students and found that interactive gameplay positively influenced their conceptual understanding of fractions, although the effect was not statistically significant. This indicates that, similar to Wordwall, the effectiveness of digital learning games often lies more in improving motivation and engagement than in producing immediate quantitative gains.

Theoretically, Wordwall's interactive features, such as quizzes, point rewards, leaderboards, timers, and instant feedback, greatly support the learning process. These features facilitate retrieval practice, which, according to Shute (2008) and Roediger & Butler (2011), strengthens memory retention and concept mastery. However, the effectiveness of Wordwall depends on how well the quiz items reflect the targeted learning indicators. If the game items do not fully represent KKTP

competencies, the resulting scores may not be fully transferable to formal assessments. Furthermore, referring to Mayer's Multimedia Learning Theory (2009), digital learning media should present integrated visual and verbal messages clearly and concisely to avoid cognitive overload. The findings from Kuwayyis (2023) in the *AUTOMATA Journal* also support this notion, showing that digital game-based learning significantly increased students' enthusiasm and mathematical reasoning when visual and auditory elements were effectively integrated. These results confirm that the combination of interactive features and multimodal presentation is crucial to achieve optimal learning impact.

In summary, the findings indicate that Wordwall is an effective tool for improving students' learning outcomes in fractions. The mean score of 7.13 demonstrates that most students achieved the mastery criterion of 7.00, suggesting that Wordwall-based learning provides meaningful academic support. Although the difference from the KKTP was not statistically significant, the results reflect that Wordwall successfully created an interactive, enjoyable, and motivating learning experience, enabling students to attain and even surpass the expected learning standards. From a pedagogical perspective, this effectiveness can be interpreted as gradual effectiveness. Wordwall effectively enhances motivation, increases engagement, and contributes to cognitive achievement. However, to strengthen its statistical impact, several improvements are recommended: (1) use Wordwall in more structured and repeated sessions to ensure consistent practice; (2) design game questions aligned with KKTP indicators for better transferability; (3) provide more elaborative feedback to deepen conceptual understanding; and (4) integrate Wordwall with non-game activities such as conceptual discussions or scaffolded exercises. Through these refinements, the current average score of 7.13 could be elevated to a statistically significant improvement. This reaffirms that Wordwall is not merely an educational entertainment tool but a pedagogical instrument capable of optimizing students' learning outcomes—both cognitively and motivationally.

4. Conclusion

The findings of this study indicate that the use of the Wordwall educational game in learning fraction material has a positive effect on students' learning outcomes and classroom engagement. Although the statistical analysis showed that the improvement in students' scores was not significantly different from the Minimum Mastery Criterion (KKTP), the learning process became more interactive, enjoyable, and motivating. Wordwall helped students understand abstract mathematical concepts more easily through visual and interactive elements, which increased their participation and focus during learning activities. The findings also confirm that digital game based learning can serve as an effective medium to strengthen students' affective and cognitive development when properly designed and integrated with curriculum goals.

Based on the results, it is recommended that teachers use Wordwall not only as a supplementary activity but as part of structured learning sessions that include discussion, reflection, and feedback. Repeated use of Wordwall can help reinforce

conceptual understanding and gradually improve students' academic performance. Future research may extend the duration of implementation or compare Wordwall with other digital platforms to explore its long term impact on students' learning motivation and achievement.

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