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Wordwall Educational Games and Elementary Students' Mathematics Learning: A Systematic Review of Interest and Critical Thinking Development

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Abstract
This study aims to examine the effect of Wordwall-based educational game media on elementary students' interest and critical thinking in mathematics learning. The research is motivated by the need for learning approaches that can enhance student engagement and foster higher-order thinking skills (HOTS). Digital platforms such as Wordwall provide opportunities for fun, contextual, and adaptive interactions aligned with the characteristics of mathematical content and students' cognitive development. This study employs a systematic literature review of ten nationally indexed journal articles published between 2020 and 2024. The inclusion criteria focused on studies involving elementary school students, the use of Wordwall in mathematics learning, and outcomes related to learning interest or critical thinking. Exclusion criteria included articles lacking empirical data or those focusing on non-mathematical subjects. The results indicate that consistent use of Wordwall positively influences students' learning interest, classroom participation, and critical thinking skills in understanding basic mathematical concepts. Interactive features such as quizzes, matching pairs, and random wheels encourage students to analyze, evaluate, and draw conclusions both independently and collaboratively. Furthermore, Wordwall has shown flexibility in supporting various learning strategies, including project-based learning, flipped classrooms, and differentiated instruction. In conclusion, the integration of Wordwall contributes to enhancing both cognitive and affective aspects of mathematics learning. Future research with experimental or mixed-method approaches is recommended to measure the real impact of Wordwall implementation in classroom contexts. Thus, Wordwall serves not only as a digital tool but as a strategic medium for fostering active and meaningful learning in the 21st century.

INTRODUCTION

Mathematics learning at the elementary school level has a strategic role in forming logical, systematic, and critical thinking skills from an early age. However, the reality in the field shows that mathematics is often considered a difficult, boring, and anxiety-inducing subject for students (Wiryanto & Jannah, 2022). The weakness of the conventional learning approach that is one-way and does not actively involve students is one of the causes of low student interest and learning involvement in mathematics lessons (Dwi, 2024). As a result, many students have difficulty understanding math concepts in depth. Low motivation and student participation can have implications for poor mastery of basic concepts and critical thinking skills that are important in 21st century learning. Therefore, learning approaches and media are needed that can change students' perceptions of mathematics and at the same time develop high-level thinking skills.

Along with the development of technology, digital-based learning is one of the promising solutions to improve the quality of learning in elementary schools. One of the digital learning media that teachers are starting to use is Wordwall, a web-based platform that allows the creation of interactive educational games (Kusnadi & Azzahra, 2024). Wordwall allows teachers to design learning activities such as quizzes, matching couples, wheel of fortune, and crossword puzzles that can be accessed online or offline. This media is considered to be able to increase student involvement because it combines elements of play with learning objectives (Risal et al., 2024). In addition, the graphical display and live feedback provided by Wordwall also speed up the process of understanding concepts by students. Learning becomes more interesting, varied, and not monotonous, so that it can increase students' motivation to learn.

Research by Stit & Nusantara (2020) shows that the use of educational game media has a significant effect on students' interest in learning. Learning interest is a very important affective factor because it is directly correlated with the level of student involvement during the learning process. Students who have a high interest in a subject tend to be more active, ask questions, and be involved in problem solving. With an attractive appearance and a familiar game format, Wordwall is able to create a fun and competitive learning atmosphere. This makes students more interested in taking lessons and not feeling pressured when learning math. A high interest in learning is an important entry point in building a foundation for critical thinking later in life (Fatimah et al., 2021).

In addition to increasing interest in learning, Wordwall media is also considered to be able to develop students' critical thinking skills, especially in the context of mathematics learning. Critical thinking is the ability to analyze, evaluate, and deduce information logically, an essential skill in solving mathematical problems (Mariana, 2025). Activities in Wordwall often require students to choose the best answer in a limited amount of time, discuss in a group, or explain the reason for choosing the answer. This activity encourages students to not only memorize, but also understand concepts and apply them contextually. In the long run, learning like this will strengthen students' mastery of concepts and independent thinking.

However, it is necessary to conduct a more in-depth study systematically to map how Wordwall affects aspects of students' interests and critical thinking skills in an integrated manner. Most previous research has only addressed one aspect, both in terms of affective (interest) and cognitive (critical thinking), but has not fully linked the two in the context of mathematics learning. Therefore, in this study, the author uses the Systematic Literature Review (SLR) approach to summarize the findings of various related studies. SLR provides a comprehensive methodological framework for evaluating, synthesizing, and concluding the results of previous research objectively and systematically. This approach is relevant in an effort to understand the trends, forms of implementation, and impact of Wordwall on mathematics learning at the elementary school level.

This study aims to answer three main questions: (1) what is the trend of using Wordwall media in mathematics learning in elementary schools; (2) what are the forms and implementation strategies; and (3) how it affects the improvement of students' critical thinking skills. The results of this review are expected to provide in-depth insights for teachers, researchers, and curriculum developers in effectively integrating digital media in mathematics learning. In addition, this article also contributes to the technology-based education literature, especially in the context of basic education in the digital era. Through an *evidence-based approach*, Wordwall can be optimized to answer the challenge of low motivation and students' thinking ability in mathematics lessons strategically.

METHODS

This study uses the Systematic Literature Review (SLR) method to examine the influence of Wordwall educational game media on the interest and critical thinking ability of elementary school students in mathematics learning. The SLR approach was chosen because it allows researchers to thoroughly examine relevant previous research results, resulting in a comprehensive and evidence-based synthesis. The procedure in SLR includes several stages, namely: (1) identification of research focus, (2) determination of inclusion and exclusion criteria, (3) search for articles through databases, (4) selection and evaluation of article quality, and (5) analysis and interpretation of findings. Articles were collected from Google Scholar, DOAJ, and Garuda databases, focusing on studies published between 2020 and 2024. The following search strings and Boolean operators were used: ("Wordwall" OR "Wordwall games") AND ("mathematics learning" OR "math education") AND ("elementary school" OR "primary students") AND ("critical thinking" OR "learning interest").

The inclusion criteria in this study include articles that: (a) discuss the use of Wordwall media in mathematics learning in elementary school, (b) contain quantitative or qualitative data on students' learning interests and/or critical thinking, and (c) have been published in reputable scientific journals. Meanwhile, articles that are not relevant to the topic, are not available in the full version, or do not go through the peer review process are excluded from the analysis. Of the initial search results of 46 articles, only 10 articles met the criteria and proceeded to the analysis stage.

Table 1. PRISMA Flow Summary

PRISMA Stage	**Description**	**Number of Studies**
Identification	Articles identified through database searching (Google Scholar, DOAJ, Garuda)	46
Screening	Duplicates removed and titles/abstracts screened	32
Eligibility	Full-text articles assessed for relevance and quality	16
Included	Articles meeting all inclusion criteria for final analysis	**10**

Data were analyzed using thematic coding based on each article's focus, research method, results, and conclusions. The findings were then narratively synthesized to describe emerging trends, types of Wordwall implementation, and its impact on students' learning interest and critical thinking. To ensure the validity and reliability of the synthesis, source triangulation and peer debriefing techniques were applied during the coding and interpretation stages.

RESULTS AND DISCUSSION

Results and Discussion

The analysis of the ten scientific articles studied showed the consistency of the findings that the use of Wordwall media in mathematics learning in elementary school had a significant positive impact on two main aspects of learning, namely students' interest in learning and critical thinking skills. These findings were obtained from studies published in the period 2020 to 2025 and involve various learning models, both in the context of classical, online, and innovative learning such as Hyflex Learning and Project-Based Learning. Each study analyzed displays quantitative and descriptive data that supports the effectiveness of Wordwall as a digital-based interactive media in improving the quality of mathematics learning at the elementary education level.

Table 2. Summary of Research Findings on the Use of Wordwall Media in Primary School Mathematics Learning

No	**Author(s) (Year)**	**Key Research Findings**
1	(Putri, 2020)	The use of Wordwall in mathematics learning enhances students' critical thinking and learning interest in a relaxed atmosphere.
2	(Andini, 2022)	Students' average scores increased from 74.5 (Cycle I) to 88.7 (Cycle II) after using Wordwall.
3	(Yusra, 2024)	Wordwall-based games are effective in improving learning outcomes and critical thinking in geometry topics.
4	(Ma'rifah &	Wordwall-assisted Hyflex Learning improved classical mastery learning by

	Mawardi, 2022)	24.31%.
5	(Astuti et al., 2025)	Students' critical thinking skills increased with a mean score difference of 10.29 points.
6	(Muzaini et al., 2023)	Post-intervention critical thinking scores ranged from 50 to 100, with an average of 73.87, proving Wordwall's effectiveness.
7	(Mudrika et al., 2024)	Wordwall enhanced students' critical thinking skills by up to 34% and served as an interactive assessment tool.
8	(Daulay & Harahap, 2024)	Significant improvement found in students' performance before and after using interactive Wordwall-based media.
9	(Hilmi, 2024)	Critical thinking scores improved by 13.75 points from Cycle I to Cycle II.
10	(Salsabila & Tsurayya, 2024)	Project-Based Learning supported by Wordwall significantly enhanced mathematical learning and critical thinking (t-test sig. 0.000 < 0.005).

RQ1: Trends in the Use of Wordwall Media in Mathematics Learning in Elementary Schools

The trend of using Wordwall as a math learning medium has shown a significant increase in the last five years. In the early period (2020–2021), the use of Wordwall focused more on improving students' motivation and basic learning outcomes. However, from 2022 to 2025, there has been a shift towards more complex uses, such as integration in model-based learning designs such as ADDIE and implementation in active learning approaches (Andini, 2022; Mudrika et al., 2024). Research began to lead to the measurement of higher-order thinking skills, including analysis, evaluation, and mathematical problem-solving. These improvements show that Wordwall is not just a visual aid, but has evolved into an important component in a more strategic and pedagogical technology-based learning strategy.

Research also shows that the math topics most often associated with Wordwall are concrete and visual materials such as flat and spatial building (Yusra, 2024), as well as basic arithmetic. These materials are perfect because the quizzes, interactive images, and drag-and-drop features in Wordwall support students' conceptual understanding in a more enjoyable way. In addition, features such as "matching pairs," "open the box," and "random wheel" allow teachers to present questions with a variety of formats and avoid student boredom with conventional questions.

RQ2: Form and Strategy of Wordwall Media Implementation

The form of implementation of Wordwall in learning is very varied and adjusted to the characteristics of the material and the learning objectives. Some of the most commonly used formats are Match Up, Quiz, Open the Box, and Random Wheel, each of which supports specific cognitive processes, such as concept classification, term understanding, and quick decision-making (Ma'rifah & Mawardi, 2022; Daulay & Harahap, 2024). This medium is very flexible and can be adjusted to the student's ability level. For example, in differential learning, teachers can set the difficulty level of the questions in the Wordwall to accommodate the needs of low, medium, and high ability students.

Wordwall's implementation strategy is also increasingly creative and involves active learning approaches, such as Think-Pair-Share, Flipped Classroom, and Game-Based Learning. In a cooperative context, Wordwall is often used in small group discussions, where students discuss first before answering questions collectively. This strategy has been proven to be able to increase social interaction, collaboration, and students' courage to present arguments based on data and logic (Astuti et al., 2025). Several studies have also reported that the use of online Wordwall remains effective, especially when combined with an online learning system based on a Learning Management System (LMS).

RQ3: The Impact of the Use of Wordwall Media on Students' Critical Thinking Skills

The impact of the use of Wordwall on students' critical thinking skills is very evident from the increase in grades, average scores, and changes in the classification of students' thinking skills after learning interventions. For example, a study conducted by Muzaini et al. (2023) showed that students' critical thinking ability scores after the use of Wordwall ranged from 50 to 100, with an average of 73.87. These findings indicate that Wordwall is able to stimulate students' reflective and evaluative thinking activities, especially in the context of math problems that require in-depth analysis and decision-making. In addition, the results of a study by Hilmi (2024) showed an increase of 13.75 points in students' critical thinking scores between cycles I and II. This increase occurs not only quantitatively, but also qualitatively, where students show improvements in critical thinking indicators such as identifying problems, providing logical reasons, and evaluating arguments. Wordwall, as an educational game-based medium, provides an exploration space for students to try out various possible solutions, discuss, and reflect on the solution strategies used. Furthermore, Wordwall has been proven to boost students' confidence, especially due to its competitive and interactive form of play. When Wordwall is used in group learning, students show improvements in communication and argumentation skills, which are integral parts of critical thinking skills (Salsabila & Tsurayya, 2024). A fun and non-intimidating learning atmosphere is also a major supporting factor in achieving these outcomes. Research by Putri (2020) confirms that Wordwall creates a relaxed classroom atmosphere, but is still conducive to critical thinking.

Based on the results of the analysis, it can be concluded that Wordwall is not only effective in increasing learning motivation, but also plays a role in fostering a reflective and analytical mindset. Therefore, the integration of this media in the basic mathematics curriculum can be a long-term strategy in developing students' critical thinking skills in the digital era. Further research is suggested to explore the linkage between the use of Wordwall and other dimensions of mathematical literacy, such as creativity and divergent thinking skills.

Disscussion

The use of Wordwall media in mathematics learning in elementary school shows a positive impact on student engagement and participation. This media integrates elements of play into learning activities, which are significantly able to attract students' attention and increase their motivation to learn (Wati et al., 2025). In the context of mathematics learning that is often considered difficult and boring, the presence of Wordwall is an innovative alternative that can create a fun learning atmosphere. Interactive activities such as *matching*, *quizzes*, and *random wheels* make students more active in answering questions and fostering curiosity about the material. This effectiveness is also supported by attractive visual displays and interactive designs so that students feel learning while playing. In many studies, students show increased concentration and engagement when Wordwall is used repeatedly in the learning process (Mumtazah et al., 2025). This shows that Wordwall is not just a teaching tool, but part of a pedagogical strategy that is able to form a participatory learning pattern. Therefore, its use in mathematics classrooms is worthy of widespread development.

From a cognitive perspective, Wordwall is able to stimulate the development of students' critical thinking skills. The questions presented in Wordwall, such as image analysis, concept matching, and problem-solving-based questions, encourage students to think logically and systematically (Putra et al., 2024). This is in accordance with the characteristics of mathematics learning which requires students to be able to identify patterns, analyze data, and make conclusions based on evidence. Wordwall allows teachers to design questions with varying levels of difficulty, so students can be challenged to think beyond memorization. In addition, the randomized question model helps avoid memorization patterns and encourages flexible thinking skills (Hartati et al., 2024). With repetitive exercises in a varied format, students learn to develop alternative approaches to solving problems. As a result, students become more confident and independent in facing math problems. Thus, Wordwall can be categorized as a medium that supports learning based on *Higher-Order Thinking Skills* (HOTS). This is also relevant to the demands of the Independent Curriculum which emphasizes the strengthening of literacy and numeracy.

Research shows that there is an increase in students' critical thinking skills after the consistent use of Wordwall. Rohman et al. (2024) reported a 24.31% increase in classical learning completeness after the implementation of Wordwall in mathematics learning. This increase does not only occur in the final score, but also in the indicators of the thinking process such as identifying problems, providing logical reasons, and drawing conclusions based on available information. Some studies even mention that students' average critical thinking scores have increased by more than 10 points (Rusani et al., 2025). This improvement indicates that Wordwall not only targets affective aspects such as learning interests, but is also able to significantly strengthen students' cognitive domains. This can be explained through interactive activities that require students to evaluate answers, discuss arguments, and correct mistakes independently. With this approach, Wordwall provides enough space for students to reflect on their thought process. Therefore, this medium is very appropriate to be applied in the context of learning that demands complex cognitive processes.

Not only for high-ability students, Wordwall is also effective in differentiated learning. Teachers can arrange activities with varying levels of difficulty, adapting to the abilities of students in the classroom (Wahyuni et al., 2025). This allows students with low abilities to still be able to understand basic concepts, while students with high abilities can be challenged with more complex problems. This strategy reinforces the principle of inclusivity in learning, where all students have learning opportunities that suit their needs. Thus, Wordwall becomes a flexible and adaptive tool for heterogeneous classroom conditions. In addition, teachers can easily monitor each student's progress through Wordwall results that can be recapbed automatically. It supports the formative assessment process efficiently and accurately (Nufus et al., 2025). Through this approach, learning becomes more personalized, responsive, and oriented to individual growth. Therefore, Wordwall not only supports the achievement of learning goals, but also strengthens the process of learning differentiation.

In terms of implementation strategies, Wordwall is used in a variety of active learning approaches. One of them is the integration with the *Think-Pair-Share* model, where students are given questions through Wordwall, discuss in small groups, and then deliver answers in a classical way (Fauziyah & Fanani, 2025). This strategy not only increases cooperation, but also strengthens students' argumentative abilities. Wordwall is also used in the *Flipped Classroom model*, where students access Wordwall questions at home before discussing them together in class. This approach gives students the opportunity to build an initial understanding before face-to-face learning. In addition, Wordwall is used as a formative evaluation tool and also a remedial learning medium for students who have not completed it (Ferlina & Fratiwi, 2024). Teachers can design simpler, more visual questions for students with learning difficulties. In other words, Wordwall reinforces the principles of active, collaborative, and differentiated learning in a real way in elementary school math classes.

Materials that match Wordwall are generally concrete materials such as building spaces, flat buildings, and measurements. These materials are greatly helped by Wordwall's visual features, such as picture quizzes or *drag and drop*, which make it easier for students to visualize concepts (Al-Qonita et al., 2023). In addition, basic arithmetic such as addition, subtraction, and multiplication are also effectively taught through Wordwall using a fast-paced game format. In some studies, the use of Wordwall in these materials increased students' accuracy and speed of thinking. This is in accordance with the need to strengthen numeracy literacy which is the focus of basic education in Indonesia. Students are not only able to solve problems correctly, but are also able to explain their solving strategies reflectively. Therefore, Wordwall is an effective medium in strengthening conceptual understanding and practical skills. With the right selection of materials, teachers can maximize the pedagogical benefits of this medium.

Students' active participation in math learning increases significantly when Wordwall is applied consistently. This can be seen from the activeness of students in answering questions, involvement in discussions, and increasing initiatives for independent learning (Al-Qonita et al., 2023). Some teachers report that students become more enthusiastic about taking lessons because of the element of surprise and healthy competition in Wordwall games. This kind of engagement is an important factor in building critical thinking skills, as students are encouraged to evaluate information and give reasons for the answers. In addition, students are also encouraged to reflect on their mistakes and improve completion strategies. This process is an integral part of meaningful learning based on reflection and metacognition. Therefore, Wordwall not only improves learning outcomes quantitatively, but also forms a positive learning attitude in students. This is an important contribution in creating humanistic and holistic mathematics learning.

Wordwall media also contributes to improving students' mathematical communication skills. Through the discussion of the results of quizzes or Wordwall games, students learn to express opinions, explain reasons, and defend mathematical arguments logically (Handayani, 2024). This is especially important in 21st century learning that demands effective communication skills. Students learn to appreciate the perspective of other friends and build mutual understanding through discussion. In other words, Wordwall is not only an evaluation tool, but also a medium for social and communication competency. In some studies, students become more open and confident in conveying their mathematical ideas. This shows that Wordwall encourages students to not only think critically, but also to think collaboratively. Thus, this media contributes to the simultaneous strengthening of personal, social, and cognitive competence.

Pedagogically, Wordwall helps teachers in conducting formative assessments quickly and in real-time. This feature allows teachers to instantly know students' answers, identify errors, and provide immediate feedback (Alya, 2024). This rapid feedback process is critical in correcting students' mathematical misconceptions before they develop into conceptual errors. In addition, teachers can revise questions based on the results of previous assessments, so that learning becomes more adaptive. Wordwall also supports the reflection process for both teachers and students in designing more effective learning strategies. In this way, the learning process becomes more dynamic and data-driven. Teachers no longer only rely on final grades as a measure of success, but pay attention to students' thought processes more deeply. Therefore, Wordwall reinforces the principles of process-oriented and student-centered learning.

Overall, Wordwall media makes a positive contribution to mathematics learning in elementary school, especially in increasing students' interest in learning and critical thinking skills. Its advantages lie in its interactivity, flexibility, and ability to be integrated in a variety of learning strategies. The studies analyzed in this study consistently show that Wordwall encourages students to learn actively, think reflectively, and participate meaningfully in the learning process. Considering today's learning needs that emphasize creativity, collaboration, and problem-solving, Wordwall is a relevant and strategic medium. This technological support not only makes it easier for teachers, but also improves the overall quality of student learning. Therefore, the use of Wordwall should continue to be developed and integrated into learning policies at the basic education level. Proper implementation will result in significant learning transformation, in accordance with the demands of the digital era and the education revolution 4.0.

CONCLUSION

Based on the analysis of relevant literature and research findings from the last five years, it can be concluded that the use of Wordwall as an educational game-based media in elementary mathematics learning contributes significantly to improving students' critical thinking skills. Wordwall facilitates an interactive and engaging learning environment, encouraging students to analyze, evaluate, and reflect on mathematical problems. Its visual, auditory, and gamified elements align with the cognitive development needs of elementary learners, thus enhancing their motivation and participation. This study also identifies that Wordwall's flexible implementation—whether through individual or collaborative learning, formative assessment, or differentiation—can accommodate various learning styles and achievement levels. However, this study has certain limitations. It relies primarily on secondary data through literature review and does not include original empirical findings or classroom experiments. Therefore, the generalization of findings should be made with caution, particularly regarding diverse educational contexts, technological access, and teacher readiness in using digital platforms effectively. Despite these limitations, the study adds value to the growing body of knowledge on digital media in mathematics education by showcasing how Wordwall can support critical thinking development in elementary students. It also emphasizes the pedagogical shift toward active, student-centered learning supported by technology.

Future research should explore empirical investigations through classroom-based experiments or quasi-experimental designs to measure the direct impact of Wordwall on students' critical thinking, using both qualitative and quantitative approaches. Researchers are encouraged to develop and test Wordwall-based instructional models that integrate inquiry-based learning or problem-based learning frameworks. It is also recommended that future studies examine teacher competencies and students' digital literacy as factors influencing the successful implementation of Wordwall. Exploring the integration of Wordwall with hybrid or flipped classroom strategies may further enrich mathematics learning experiences and outcomes in diverse educational settings.

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