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EFFECTIVENESS OF TALKING STICK MODEL WITH WORDWALL MEDIA TO IMPROVE ELEMENTARY STUDENTS'S MATHEMATIC CRITICAL THINKING

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ABSTRACT
Mathematical critical thinking skills are very important for elementary school students because they form the foundation for a deeper understanding of mathematical concepts, enabling them not only to memorize formulas but also to analyze problems, make logical connections, and find various solutions. This study was motivated by the observation that the lack of optimal learning models and media in elementary schools is associated with low mathematical critical thinking skills among students. One-way mathematics teaching methods, dominated by lectures and a lack of interactive media, were identified as the main obstacles to the development of students' critical mathematical reasoning skills. In fact, by using various learning models and media, critical thinking skills can be significantly improved. This study was designed to test the effectiveness of the Talking Stick learning model with Wordwall media support in developing the critical mathematical thinking skills of elementary school students. This study used a pre-experimental design, with second-grade students as the research subjects. The data were analyzed using the Paired t-test and N-Gain test to measure the improvement in students' abilities. The results are expected to prove that the use of this model can significantly improve these skills, offering an alternative solution to existing problems. This study concludes that the Talking Stick model supported by Wordwall media is quite effective in improving the mathematical critical thinking skills of students at SD 1 Padurenan.
Keywords: mathematical critical thinking, talking stick, wordwall

ABSTRAK
Kemampuan berpikir kritis matematis sangat penting bagi siswa SD karena menjadi fondasi untuk pemahaman konsep matematika yang lebih mendalam, memungkinkan mereka tidak hanya menghafal rumus tetapi juga menganalisis masalah, membuat koneksi logis, dan menemukan berbagai solusi. Penelitian ini dilatarbelakangi oleh observasi bahwa variasi model dan media pembelajaran yang kurang optimal di sekolah dasar berhubungan dengan rendahnya kemampuan berpikir kritis matematis siswa. Metode pembelajaran matematika yang bersifat satu arah, didominasi oleh ceramah dan kurangnya pemanfaatan media interaktif, diidentifikasi sebagai kendala utama dalam pengembangan kemampuan penalaran matematis kritis siswa. Faktanya, dengan menggunakan berbagai model dan media pembelajaran, kemampuan berpikir kritis dapat ditingkatkan secara signifikan. Studi ini dirancang untuk menguji seberapa efektif model pembelajaran Talking Stick dengan dukungan media Wordwall dalam mengembangkan kemampuan berpikir kritis matematis siswa sekolah dasar. Penelitian ini menggunakan desain Pre-Experimental, dengan subjek penelitian siswa kelas II. Data dianalisis dengan uji-t Paired dan uji N-Gain untuk mengukur peningkatan kemampuan siswa. Hasilnya diharapkan dapat membuktikan bahwa penggunaan model ini secara signifikan mampu meningkatkan kemampuan tersebut, menawarkan solusi alternatif untuk permasalahan yang ada. Studi ini menyimpulkan bahwa model Talking Stick yang dibantu media Wordwall cukup efektif dalam meningkatkan kemampuan berpikir kritis matematis siswa di SD 1 Padurenan.
Kata kunci*: berpikir kritis matematis, talking stick, wordwall*

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Introduction

Mathematics is a field of science that plays a very important role(Gumilar et al., 2024). Mathematics is a subject that has a single answer, but can be solved in various ways or using different methods (Nia et al., 2024). Mathematics is not just about calculations, but also a tool for training critical thinking skills, solving problems, and making decisions based on data. This shows that mathematics trains students to think logically and systematically, so that they can analyze things more effectively (Nurhaliza et al., 2025). Ermawati et al., (2024) state that the goal of national education is to develop various thinking skills, such as the ability to think logically, analytically, systematically, critically, and creatively, as well as the ability to work together in a team. Critical thinking skills in mathematics learning, or what is called mathematical critical thinking skills, are an important cognitive aspect that students must possess. Mastering this skill is very important in order to face the challenges of work and complex daily life(Haswati et al., 2024). Critical thinking skills are vital for students because they help them face various challenges in the 21st century (Winanda et al., 2025). Critical thinking plays an important role in building knowledge and developing students' conceptual systems, including the ability to analyze, evaluate, draw conclusions, and determine the right strategy (Saputra, 2020). Due to its abstract nature, students often find mathematics difficult to understand, which can hinder the development of their thinking skills (Amaliyah, 2024a). Therefore, teachers should create a pleasant learning environment so that students feel comfortable and find it easier to understand the lessons.

The selection of a mathematics learning model is very important to consider. In the teaching and learning process, the mathematics learning model plays a crucial role. A suitable model will make it easier for students to understand the material, which will ultimately improve their critical thinking skills.(Ermawati et al., 2023). The results of interviews and observations at SD 1 Padurenan show that students in grade II find it difficult to understand and solve math problems. Conventional learning, such as the expository learning model, still dominates. Teacher-centered learning is still commonly used in many classrooms (Tri et al., 2024). The lack of variety in learning models and media has resulted in low student motivation and activity, which has impacted learning outcomes below the KKTP standard (average of 68, with only 36% of students achieving KKTP). In line Santoso & Amaliyah, (2022), when conventional learning such as the expository learning model still dominates, it causes students to be passive and bored. This shows that students need to be more trained in critical thinking.

Talking Sticks and Wordwall media can be alternatives to improve students' activity and critical thinking skills. This model encourages students to become more confident in expressing their opinions, thereby developing their mathematical critical thinking skills (Arifin, 2022). Talking Stick involves the use of sticks and accompanying music, where students holding sticks when the music stops must answer the questions asked (Lestari & Yudhanegara, 2015).The use of the Talking Stick model can also increase the effectiveness of learning activities (Nursamsiyah et al., 2024).

Andini et al., (2024)argue that Wordwall is an interactive web-based media developed to create learning materials or as a learning resource. For this reason,

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digital media can be used for learning. In line with (Ermawati et al., 2024), "The utilization of digital learning can be used to support the learning process," which means that digital learning can be used to support the learning process. Learning media is anything that functions to assist the learning process, stimulate knowledge, feelings, attention, and skills of students so that learning is effective and efficient (Ermawati & Rismawari, 2023). With media that can explain material more visually, students become more focused in the learning process (Nurhayati et al., 2021). Media is used to convey messages and information in learning, in the form of images, audio, video, computer software, textbooks, and others(Alwiyah et al., 2024). The choice of Wordwall media is based on the rapid development of technology. Technology-based learning media, especially through games, are increasingly popular in this digital era, particularly for elementary school students(Amaliyah, 2024) . Wordwall media will help students to be more flexible(Zahro et al., 2024). The attractive appearance of Wordwall can motivate students to analyze and explore learning materials (Syaifiullah et al., 2025)

Arifin (2022) research shows that students' mathematical critical thinking skills can be improved through the Talking Stick learning model, with significant hypothesis test results. This model, when combined with Wordwall media, is expected to make learning more varied and interesting, thereby improving students' critical thinking skills. Thus, this study aims to examine the effectiveness of the Talking Stick learning model assisted by Wordwall media in improving elementary school students' mathematical critical thinking skills.

Research Methods

Type and Design of Research

This research is a quantitative pre-experimental study with a one-group pretest-posttest design. In this design, one group of subjects is given treatment and their abilities are measured before and after treatment. The students' mathematical critical thinking abilities were observed directly during the learning process. The students' mathematical critical thinking abilities were measured in advance with a pretest before the Talking Stick model supported by Wordwall was implemented. After that, all students were given treatment by applying the Talking Stick model assisted by Wordwall media and given a post-test to determine the effectiveness of the application of media-assisted learning models on students' mathematical critical thinking abilities.

Location, Subject, and Sample

This research was conducted at SD 1 Padurenan. The subjects of this research were all students in grade II, with a saturated sample of 25 students (11 boys and 14 girls).

Research Instruments

The research instruments used consisted of interview guidelines, observation sheets, and 5 essay questions designed to measure mathematical critical thinking skills. The test instruments and Wordwall media were tested using expert judgement validity by experts to ensure that the questions were relevant and representative of the material and indicators being measured. The experts provided assessments using a scoring rubric.

Data Collection Techniques

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In this study, data was collected using three methods: interviews, observations, and tests. Interviews were conducted face-to-face and structured with teachers and several students in class II of SD 1 Padurenan. Direct observations were made before the treatment to systematically record behaviors and events. Meanwhile, written tests were administered before and after the treatment to measure students' critical thinking skills during learning.

Data Analysis

The pretest and posttest data on students' mathematical critical thinking abilities will be analyzed quantitatively. The statistical software to be used is IBM SPSS Statistics 21.

1. Normality Test

   The purpose is to examine whether the data from the pretest and posttest of students' mathematical critical thinking skills have a normal distribution. This normality test is important because it is a basic assumption for performing parametric statistical tests, such as the paired sample t-test. This study uses the Shapiro-Wilk test. Based on this test, the data is considered to have a normal distribution if the significance value (p-value) obtained is greater than the predetermined significance level, which is 0.05 (α=0.05).
2. Paired Sample T-test

   This test aims to examine whether there is a significant difference between students' mathematical critical thinking abilities before the pretest and after the posttest when they received treatment using the Talking Stick model and Wordwall media. If the test results show a Sig. (2-tailed) value of less than 0.05, it can be concluded that there is a significant difference between the pretest and posttest results. In statistical terminology, this means that Ho (the null hypothesis) is rejected, indicating that the treatment has a real effect on improving students' mathematical critical thinking skills.
3. Gain Test

   Aims to measure the extent of improvement in students' mathematical critical thinking skills after the treatment, and categorize the level of improvement. N-Ga|in normalizes the improvement, making it more accurate in comparing the effectiveness of the treatment. The average N-Ga|in score is expected to be in the “moderate” or “high” category, which indicates an improvement in students' mathematical critical thinking skills after the treatment.

Results and Discussion

Descriptive statistics of pretest and posttest data are presented in Table 1.

Table 1. Descriptive Statistics of Pretest and Posttest Data

	N	*Range*	*Min*	*Max*	*Mean*	*Std. Deviation*	*Variance*
Pretest	25	45	20	65	42.20	12.507	156.417
Posttest	25	35	60	95	77.00	9.789	95.833
Valid N (listwise)	25						

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Based on Table 1, the descriptive statistics show that the average pretest score is 42.2, the lowest score is 20, the highest score is 60, the standard deviation is 12.5, the variance is 156.4, and the range is 45. Meanwhile, the average posttest score was 77, the lowest score was 65, the highest score was 95, the standard deviation was 9.7, the variance was 95.8, and the range was 35. The data was then analyzed using SPSS 21 software through the Shapiro Wilk normality test with the criterion that if the Sig. value was ≥ 0.05, then Ho was rejected (normally distributed). The results of the normality test can be seen in Table 2.

Table 2. Normality Test

	Shapiro-Wilk		
	Statistic	***df***	***Sig.***
Pretest	.934	25	.109
Posttest	.962	25	.447

Based on Table 2, the results of the normality test show that the pretest and posttest data on mathematical critical thinking ability are normally distributed. The hypothesis testing in this study used the Paired T-test and N-Gain test. Based on the theory from Widiyanto (2013), the Paired sample t-test is a statistical method used to evaluate the effectiveness of a treatment. This test works by comparing the average results of two related (paired) measurements, namely the average results before and after the treatment was given. If there is a significant difference between the two averages, it can be concluded that the treatment is effective(Syafitri et al., 2023). The complete calculations can be seen in Table 3.

Table 3. *Paired Sample T-Test*

		Paired Differences					***t***	***df***	***Sig. (2-tailed)***
		Mean	***Std. Deviation***	***Std. Error Mean***	***95% Confidence Interval of the Difference***				
					Lower	***Upper***			
Pair 1	***Pretest - Posttest***	-34.800	4.890	.978	-36.819	-32.781	-35.579	24	.000

Based on Table 3, the results show that the value is 0.000 < 0.05, so Ho is rejected and Ha is accepted. These results are in line with the expected results, namely significance ≤ 0.05, which indicates that there is a difference in the average mathematical critical thinking ability of students before and after the implementation of the Talking Stick model with wordwall media. Then, the N-Gain test was conducted to determine the extent of the improvement. This can be seen in Table 4.

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Table 4. Results of the N-gain Test Scores

	N-Gain Score	N-Gain Score Percent
Average	0,619	61,9%
Category	Medium Strength	Sufficiently Effective

Based on Table 4, the results of the pretest and posttest show that the improvement in students' mathematical critical thinking skills is in the moderate category. This improvement is indicated by an N-Gain value of 0.61, which is greater than 0.3. Furthermore, based on the N-Gain test, the improvement in students' mathematical critical thinking skills after using the Talking Stick model assisted by Wordwall media reached 61.9%. These results show that the application of this learning model is quite effective in improving students' abilities. The improvement in students' mathematical critical thinking skills was clearly seen from the difference in scores between the pretest and posttest questions. This result is supported by the N-Gain test, which shows a moderate improvement in each indicator of mathematical critical thinking skills. The N-Gain test results can be seen in Table 5.

Table 5. N-Gain Test Results Scores per Indicator

No	Mathematical Critical Thinking Ability Indicators	Pretest Average Score	Posttest Average Score	N-Gain	N-Gain Percent	Category
1	Provide Explanation Simple	43	76	0,58	58%	Currently
2	Building Basic Skill	42	79	0,64	64%	Medium
3	Making Conclusions	42	75	0,57	57%	Medium
4	Making Explanations Further	45	78	0,60	60%	Medium
5	Determining Strategy or Tactics	39	77	0,62	62%	Medium

Based on Table 5. In the first indicator, which is providing simple explanations, students' mathematical critical thinking skills have improved. This is indicated by an increase in the average score from 43 on the pretest to 76 on the posttest, as well as an N-Gain score of 0.58, which indicates a moderate improvement. Previously, students had difficulty understanding the concept of multiplication as repeated addition. However, after using the Talking Stick model, students' understanding improved so that they were able to provide simple explanations related to this concept. This is in line with the research by Suriyat et al. (2021), which states that understanding of the material correlates with the ability to provide explanations.

In the second indicator of developing basic skills, there was an increase in mathematical critical thinking skills, where students were able to provide reasons based on existing facts. This is evidenced by an increase in the average score from 42 (pre-test) to 79 (post-test), as well as an N-Gain score of 0.64, which indicates a moderate improvement. Previously, students had difficulty providing reasons based

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on information and were unable to provide information from analyzing multiplication tables. However, after implementing the Talking Stick model, students showed improvement in giving reasons correctly. The opportunity to express opinions during discussions was the key to this improvement, showing that students were able to think and reason mathematically. This is in line with the research by Riswari & Ermawati (2023) that mathematical reasoning enables students to provide logical reasons. This ability is very important in building basic skills, which will ultimately improve students' mathematical critical thinking skill

In the third indicator, namely drawing conclusions, there was an increase in mathematical critical thinking skills. This was evidenced by an increase in the average score from 42 in the pretest to 79 in the posttest. This increase, with an N-Gain value of 0.57, falls within the moderate criteria. This means that there was an increase in mathematical critical thinking skills where students were able to draw conclusions from a problem. Previously, students had difficulty summarizing information in multiplication problems. However, after using the Talking Stick model, students became accustomed to discussing and drawing conclusions from worksheets and questions on Wordwall. This is in line with the research by Anggraeni et al., (2022)and the arguments of Padmakrisya & Meiliasari (2023)that discussion and the opportunity to draw conclusions based on facts can improve critical thinking skills, including drawing conclusions.

The fourth indicator provides further explanation. In this indicator, the pretest average score was 45, and the posttest average score was 78. This increase resulted in an N-Gain score of 0.60, which indicates a moderate improvement in ability. This means that there was an improvement in mathematical critical thinking skills, where students were able to provide explanations when there were terms in the questions. Previously, students had difficulty working on HOTS questions related to multiplication symbols. However, after using the Talking Stick model, students became accustomed to practicing questions related to multiplication symbols during discussions, enabling them to identify terms in multiplication, both symbols and nouns in story questions. This is in line with the research by Anggraeni et al. (2022)that discussion can foster critical thinking skills. Thus, students can provide more detailed explanations about multiplication based on their identification results.

In the fifth indicator, there was an increase in mathematical critical thinking skills in determining strategies or tactics for solving multiplication problems. This was evidenced by an increase in the average score from 39 (pretest) to 77 (posttest), as well as an N-Gain score of 0.62, which indicates a moderate improvement. Previously, students had difficulty determining the right strategy for solving math problems. However, after using the Talking Stick model, students became accustomed to practicing problems so that they understood and were able to determine the steps to solve multiplication problems. This is in line with the opinion of Wira Suciono (2021)that understanding a problem well is the main key to being able to solve it. Problem-solving skills are also important in mathematics (Nugraha & Pendidikan, 2025). Thus, students' skills in solving multiplication problems are honed, enabling them to find solutions to determine the right strategy for solving problems.

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This difference in scores occurred because the application of the Talking Stick learning model integrated with Wordwall media created a more interactive and enjoyable learning atmosphere. Each stage of the Talking Stick model provides optimal opportunities for students. Students are encouraged to participate more actively, dare to express their ideas, and answer the questions given, which ultimately trains them to think critically. Wordwall media also presents math problems in various interesting formats, so that students not only memorize, but are also challenged to analyze and solve problems logically.

The Talking Stick learning model can improve critical thinking skills, in line with the findings of Kumullah & Yulianto (2020). The use of interactive media such as Wordwall has also been proven to hone students' critical thinking skills(Mawaddah, Emilda, 2024). In its implementation, teachers act as facilitators. The teacher's role is to facilitate students to actively develop their understanding by utilizing various sources and teaching materials, both when studying independently and in groups.

The results of the study showing the effectiveness of the Talking Stick model assisted by Wordwall media in improving elementary school students' mathematical critical thinking skills can be a strong basis for further study. This approach proves that combining interactive methods with digital technology significantly improves students' higher-order cognitive skills. These findings also underscore the importance of learning strategies that focus on interaction, collaboration, and problem solving to develop 21st-century skills, namely critical thinking, which is relevant for future curriculum improvements.

Conclusion and Suggestion

From the results of the research and discussion, it can be concluded that the Talking Stick model assisted by Wordwall media is effective in improving the mathematical critical thinking skills of elementary school students. This is evidenced by the difference in average scores of 42.2 (pretest) and 77 (posttest) before and after the Talking Stick model treatment, and there was an increase of 61.9%, which shows that the Talking Stick model assisted by Wordwall media is interpreted as quite effective in improving the mathematical critical thinking skills of elementary school students.

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