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Interactive Learning Multimedia Articulate Storyline as an Alternative Media to Improve Elementary Students' Critical Thinking Skills

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ABSTRAK

Akibat kurangnya penggunaan media pembelajaran dalam proses pembelajaran matematika, siswa menjadi pasif dan tidak tertarik untuk mengikuti proses pembelajaran. Proses pembelajaran yang monoton menyebabkan kemampuan berpikir kritis siswa menjadi lemah dan kurang berkembang. Oleh karena itu penelitian ini bertujuan untuk menganalisis pengaruh kegiatan pembelajaran menggunakan multimedia pembelajaran interaktif Articulate Storyline terhadap kemampuan berpikir analitis dan kritis pada siswa kelas VI sekolah dasar. Penelitian ini menggunakan pendekatan kuantitatif dengan metode penelitian eksperimen (Quasi-Experimental). Jenis pengambilan sampel yang digunakan adalah teknik purposive sampling. Instrumen penelitian menggunakan sembilan soal tes deskripsi tipe HOTS. Data dianalisis melalui beberapa uji, antara lain uji normalitas, homogenitas, dan uji hipotesis. Dalam pengujian hipotesis digunakan Independent Sample T-Test dan diperoleh nilai Sig (2-tailed) sebesar (0,033 < 0,05), sehingga disimpulkan terdapat perbedaan antara siswa yang diajar dengan pembelajaran interaktif Articulate Storyline. multimedia dan siswa yang diajar menggunakan media pembelajaran konvensional. Uji Paired Sample T-test pada kelas eksperimen juga memperoleh nilai signifikansi sebesar 0,000 < 0,05 sehingga menunjukkan adanya perbedaan yang signifikan rata-rata nilai tes sebelum dan sesudah perlakuan. Dapat disimpulkan bahwa penggunaan multimedia pembelajaran interaktif Articulate Storyline berpengaruh terhadap kemampuan berpikir analitis dan kritis siswa kelas VI SD. Penelitian ini mengandung makna bahwa guru dapat menggunakan multimedia pembelajaran interaktif Articulate Storyline untuk meningkatkan kemampuan berpikir kritis analisis dan evaluasi siswa dalam pembelajaran matematika.

ABSTRACT

Due to the lack of use of learning media in the mathematics learning process, students become passive and uninterested in participating in the learning process. The monotonous learning process causes students' critical thinking abilities to be weak and underdeveloped. Therefore this research aims to analyze the influence of learning activities using Articulate Storyline interactive learning multimedia on analytical and critical thinking skills in sixth-grade elementary school students. This research employed a quantitative approach with experimental research methods (Quasi-Experimental). The type of sampling used was the purposive sampling technique. The research instrument utilized nine HOTS-type description test questions. Data were analyzed through several tests, including normality, homogeneity, and hypothesis tests. In hypothesis testing, the Independent Sample T-Test was used, and a Sig (2-tailed) value of (0.033 < 0.05) was attained, so it was inferred that there was a difference between students who were taught using Articulate Storyline interactive learning multimedia and students who were taught using conventional learning media. The Paired Sample T-test in the experimental class also obtained a significance value of 0.000 < 0.05, suggesting a significant difference in the average test scores before and after treatment. It could be concluded that using Articulate Storyline interactive learning multimedia influenced sixth-grade elementary school students' analytical and critical thinking skills. This research implies that teachers can use Articulate Storyline interactive learning multimedia to improve students' critical thinking analysis and evaluation skills in mathematics learning.

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1. INTRODUCTION

Mathematics is a fundamental science that is vital in technological progress and other scientific disciplines. Through mathematics, people can develop their ability to reason logically, analytically, methodically, and critically in order to solve problems that arise in daily life (Damayanti & Afriansyah, 2018; Faturohman & Afriansyah, 2020). Because mathematics seeks to develop critical, systematical, logical, and creative thinking abilities as well as interpersonal collaboration, it must be taught from an early age, from elementary school until university (Pratama, 2019; Saraswati & Agustika, 2020). In elementary schools, mathematics learning should ideally not only focus on the results to be achieved, but more than that, the mathematics learning process must be able to provide experiences and changes that can be implemented in students' lives. In addition, mathematics in elementary schools not only teaches calculations and theory but also fosters the growth of critical thinking abilities that apply to real-world situations (Cahyaningsih & Nahdi, 2021; Sianturi et al., 2018). Mathematics learning objectives can be achieved if the teacher tries to apply appropriate learning components according to age and the mathematics content being taught so that it can help students grasp the material and enhance their critical thinking abilities (Alexandra & Ratu, 2018; Maričić & Špijunović, 2015). In order to help students learn through discovery, comprehend and apply concepts in everyday life, solve problems, express opinions, and ultimately become better and more educated people in the future, critical thinking skills should be taught during the educational process. Since critical thinking is the only way to solve mathematical problems, developing critical thinking skills is essential to learning mathematics. This illustrates why critical thinking abilities are crucial in all subjects, including mathematics (Blume et al., 2021; Dirgantoro, 2018; Putri et al., 2019). However, students' critical thinking skills are still comparatively low because elementary school mathematics instruction has not been able to advance their critical thinking abilities (Fitriani et al., 2021; Karim, 2015).

Based on the results of observations, it was revealed that students had low critical thinking skills in mathematics subjects. This is because the learning process was entirely teacher-centered and excluded student interaction, which made students passive, unable to voice their opinions, and uninterested in or motivated to learn mathematics. These factors all contribute to the students' low critical thinking abilities. Additionally, the students had trouble calculating and analyzing story problems. The results of previous research studies stated that monotonous and teacher-centered mathematics learning causes students to become passive (Hakim & Windayana, 2016; Inganah et al., 2016). Among passive students, imitating and memorizing the teacher's actions without comprehending the mathematical concepts being taught is common. As a result, students' critical thinking abilities are weakened because they are only exposed to the teacher's material through lectures and are not motivated to question, assess, critique, or reconsider what the teacher conveys (Sari & Lutfi, 2023; E. Wijayanti, 2022). In addition, as the learning design and assessment demonstrate, mathematics learning is still conventionally based. The learning resources and media are limited to books and student worksheets (LKPD). The learning media teachers use is also limited to conventional media in the form of whiteboards and markers. Despite the availability of resources such as projectors, educators fail to maximize the use of these facilities. Besides, students' critical thinking abilities are underdeveloped due to teachers' inadequate grasp of mathematical lesson planning and their sparing use of relevant and engaging learning resources (Miniawi & Brenjekjy, 2015; Pamungkas et al., 2020). Mathematical content is taught abstractly without concrete media, making students less interested in and motivated to learn when learning media are not used; as a result, students find mathematics difficult to understand.

Critical thinking is a crucial ability that needs to be instilled and taught in every subject to equip students to deal with unforeseen issues in the real world. Critical thinking is an indicator of high-level thinking; while students with high critical thinking skills tend to have high learning outcomes, students with low scores tend to have low critical thinking skills; therefore, students are required to have critical thinking skills and good to get satisfactory learning results (Purwaningsih & Wangid, 2021; Suastika & Rahmawati, 2019). In addition, critical thinking skills are essential and need to be mastered by students because they enable them to solve problems in everyday life and make appropriate and logical decisions (Mulyanti et al., 2023; Putri et al., 2019). Making the best choices when solving mathematical problems requires the application of critical thinking abilities, which include solving problems, analyzing, evaluating, and comparing things with good reason. Mathematics learning needs to be taught to students because it plays an important role in forming students' critical and logical thinking, helping them understand more complex concepts and overcome complex problems (Kamarullah, 2017; Sarimanah, 2020). Acquiring critical thinking skills is vital for students as it facilitates the clear analysis and differentiation of information, enhancing their critical mathematical thinking abilities and ultimately empowering them to solve complex reasoning-based mathematical problems.

Although critical thinking is an extremely important skill to learn and master, in actuality, students in Indonesia still possess relatively low critical thinking skills. This can be seen through Indonesia's

performance in international student assessment events such as Trends in Mathematics and Science Study (TIMSS) 2015, showing that Indonesia ranked 44th out of 49 countries with a score of 397 (Hadi & Novaliyosi, 2019; Haeruddin et al., 2020). In addition, Indonesia was ranked 74th overall out of 79 countries participating in the 2018 Program for International Student Assessment (PISA) in mathematics (Fakhriyah et al., 2017; Hewi & Shaleh, 2020; Meryansumayeka et al., 2022). Supported by previous research results, elementary school student's mathematical abilities in solving problems, especially story problems, are still very low, which, of course, contributes to students' low critical thinking abilities.

To improve students' critical thinking skills, teachers need to play a role in improving classroom learning activity. To improve the quality of learning, teachers must be able to design learning activities that contain teaching materials, use appropriate and interesting learning media, and use evaluation tools that can train students' critical thinking skills in HOTS-shaped questions (Aadzaar & Widjajanti, 2019; Habuke et al., 2022; Sofiyan et al., 2020). Learning media is a supporting component in developing an engaging learning process for students. Through discovery and understanding knowledge, learning media can help students understand, present and condense data and improve critical thinking skills. Hence, it is necessary to select and apply appropriate learning media so that they can develop elementary school students' critical thinking skills in learning mathematics (Asani, 2023; Darmawan & Suparman, 2019; Hendi et al., 2020).

While there are many different kinds of educational media available, multimedia can be utilized to help students enhance and develop their critical thinking abilities. In this case, students' critical thinking abilities, particularly in mathematics, can be enhanced using Articulate Storyline, an interactive multimedia learning tool (Aadzaar & Widjajanti, 2019; Husna, 2022). Multimedia Articulate Storylines can boost student interest, motivation, and achievement. Combining various media types ranging from text, video, audio, and animation to interactive quizzes, Articulate Storyline is an authoring tool that can create interactive learning (Saputri et al., 2018; Sugihartini & Dewi, 2022). Articulate Storyline is software used as a learning medium because it can incorporate several media, including audio, visual, image media, text, animation, and an easy publication process in the form of HTML 5, CD, Application, SWF, and web. Articulate Storyline also has various interesting features that can train, develop, and significantly improve students' critical thinking skills, especially in mathematics subjects (Jais & Amri, 2021; Saadah et al., 2022). The features in Articulate Storyline, such as the graded question and result features, can improve students' critical thinking skills. This feature contains practice questions to train students' critical thinking skills, one of which is through essay-type questions. Apart from that, the learning video feature is a means for students to understand the material better through various visually appealing videos to improve students' critical thinking skills (Belecina, 2018; Heliawati et al., 2022). These features highlight how capable students are of understanding, analyzing, evaluating, and making decisions based on information presented in the media so that they can provide answers to challenging questions that require analysis and evaluation, such as those found in the HOTS questions.

Nevertheless, previous research did not discuss much about Articulate Storyline media related to mathematics subjects and critical thinking skills. Research related to Articulate Storyline media is primarily related to science, social studies, and civics subjects. The research results conducted by previous study uncovered that the critical thinking abilities of class VII SMP students experienced the highest increase in analysis indicators (reason), with the average score obtained being 85.2% (Yuliana et al., 2022). This study yielded the same category results as this research: increased students' critical thinking skills in analytical indicators in answering HOTS questions. While the lowest improvement category occurred in the clarity indicator, the lowest category in this research occurred in the inference indicator. Other study carried out also used the Articulate Storyline multimedia concept based on gamification and focuses on science subjects for junior high school students and critical thinking indicators using FRISCO theory (Fatia & Ariani, 2020).

In comparison, this research employed the concept of interactive multimedia learning by combining various types of media from various sources, such as videos from YouTube, text, audio, images, and others, with the scope of the research being grade VI elementary school students and focusing on mathematics subjects. Since mathematics contains abstract elements, it is necessary to use interactive multimedia in the learning process. The novelty of this study use of interactive learning multimedia is important and necessary because it aims to develop and improve students' critical thinking abilities in mathematics lessons. This research was carried out by distributing description test questions to class VI students regarding the circumference of a circle with high-level questions (HOTS), C4 (analysis), and C5 (evaluation). Based on this discussion, this research aims to analyze the influence of mathematics learning activities using interactive learning multimedia Articulate Storyline on analytical and critical thinking skills in class VI students at SDN Serang 20.

2. METHOD

In this research, a quantitative approach was used with experimental methods. The aim of experimental research in the field of education is to assess and determine whether there is an effect of an action or treatment (Madadizadeh, 2022). The design in this research was quasi-experimental with a non-equivalent control group design type, i.e., one group was used as an experimental class group to be given certain treatment, while another was used as a control class group. The population in this study was all class VI students at SDN Serang 20, totaling 52 students. Meanwhile, the sample is part of the population in the research. The sample in this study included class VI A and class VI B. The sampling technique employed non-probability sampling, i.e., it did not provide an equal opportunity for each member of the population to be selected as a sample. The non-probability sampling technique was carried out using purposive sampling, namely a sample selection technique with certain considerations to determine the accuracy of applying Articulate Storyline multimedia to students' critical thinking abilities. Based on considerations from the results of observations and the value of student learning outcomes from the group with the lowest critical thinking abilities, class VI A, with 26 students, was determined to be the experimental class, and class VI B, with 26 students, was the control class.

The data collection technique utilized a written test in a description consisting of ten questions. The validity value was tested, obtaining nine valid questions with a high-reliability value related to the circumference of a circle material arranged based on indicators of critical thinking ability according to Facione using Bloom's taxonomy operational verbs. C4 (analysis) and C5 (evaluation) indicate HOTS questions. Pre- and post-tests were administered to the experimental and control groups. After administering a pre-test to both groups to ascertain the initial condition of students' critical thinking abilities, students in the experimental group received instruction using the interactive learning multimedia Articulate Storyline. In contrast, students in the control group received instruction using conventional media. Then, in the final stage, both groups were given a post-test to see the effect of using learning media on students' critical thinking abilities. The written description test was then carried out individually by students. The critical thinking test instrument grid can be seen in Table 1.

Table 1. Hots Critical Thinking Instrument Grid

Aspect	Critical Thinking Indicators	Question Number
Interpretation	Understand the intent and purpose of mathematical statements by writing what is known and what the question asks correctly (C4)	5, 6, and 7
Inference	Able to write conclusions from the questions asked (C5)	3, 4, and 10
Analysis	Able to analyze strategy options to choose settlement procedures (C4)	8 and 9
Evaluation	Use correct problem-solving strategies to complete and correct calculations (C5)	1 and 2

Following that, the data were analyzed through several tests, including normality, homogeneity, and hypothesis tests. The normality test was conducted to determine whether the data were normally distributed. The normalization test in this study used the Kolmogorov-Smirnov test. To confirm that the data group was drawn from a homogeneous population, the homogeneity test was then run. Levene's test was employed in this study as the homogeneity test. After the data were declared normal and homogeneous, the analysis could be continued with the Independent Sample t-test and Paired Sample t-test. In order to ascertain whether the two samples had the same average critical thinking ability score, the Independent Sample t-test was used to compare the averages of two unrelated groups.

3. RESULTS AND DISCUSSION

Results

Critical thinking ability data were obtained from the students' pre-test and post-test scores in answering HOTS mathematics questions, consisting of nine description questions with material on the circumference of a circle. The normality, homogeneity, and hypothesis tests were then applied to the data derived from the pre-test and post-test scores for the experimental and control groups. Data testing aimed to determine the level of students' critical thinking abilities. Testing was carried out utilizing the SPSS 25 for Windows program. Normality test results can be seen in Table 2.

Tabel 2. Normality Test

Test Type	Group	Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistics	df	Sig	Statistics	df	Sig
Pre-Test	Experiment	0.149	26	0.144	0.954	26	0.282
Post-Test	Experiment	0.137	26	0.200	0.943	26	0.156
Pre-Test	Control	0.169	26	0.054	0.929	26	0.075
Post-Test	Control	2.165	26	0.065	0.914	26	0.033

To ascertain whether the data were normally distributed, the Kolmogorov-Smirnov test was performed with a significance level of 5% or more than 0.05. The data are not normally distributed if H_0 is rejected and the significance level is less than 0.05. On the other hand, if the significance level is greater than 0.05, H_0 is accepted, suggesting that the data are normally distributed. In this study, since both the experimental and the control classes reached a significant level of > 0.05 in the pre-test and post-test, H_0 was accepted, and it was concluded that the initial test data (pre-test) and final test (post-test) in the experimental and control classes had normally distributed data. After the data were declared normal, a homogeneity test was conducted between the experimental and control classes. Table 3 displays the homogeneity test results for pre-test data.

Table 3. Homogeneity Pre-Test

Tested data	Homogeneity	Levene Statistics	df 1	df2	Sig
Pre-Test Homogeneity Test Results for Experimental Class and Control Class	Based on Mean	2.592	1	50	0.114
	Based on Median	1.987	1	50	0.165
	Based on the Median and with adjusted df	1.987	1	39.657	0.166
	Based on trimmed mean	2.286	1	50	0.137

Afterward, Levene's test was used to test the data homogeneity with a significance level of 5% or > 0.05, with the assumption that if the significance is greater than 0.05, H_0 is accepted, which indicates that the data are homogeneous; in contrast, if it is less than 0.05, H_0 is rejected, which denotes that the data are not homogeneous. Based on Table 3, pre-test data in the experimental and control classes were obtained, and a significance value of 0.114 (0.114 > 0.05) was accepted, and the data were then declared homogeneous or the same. The homogeneity test data for the final test (post-test) in the experimental and control classes can be seen in H0 in Table 4.

Table 4. Homogeneity Post Test

Tested data	Homogeneity	Levene Statistics	df 1	df2	Sig
Pre-Test Homogeneity Test Results for Experimental Class and Control Class	Based on Mean	2.592	1	50	0.114
	Based on Median	1.987	1	50	0.165
	Based on the Median and with adjusted df	1.987	1	39.657	0.166
	Based on trimmed mean	2.286	1	50	0.137

Established in Table 4, H_0 was accepted because the significance value of the final test data (post-test) in the experimental and control classes based on a mean was more than 0.05 (0.109 > 0.05). Hence, it can be concluded that the final test (post-test) data in the experimental and control classes were homogeneous or the same; once it was known that the data were normally distributed and homogeneous, a hypothesis test was carried out using the Independent Sample t-test and the Paired Sample t-test. Hypothesis test results can be seen in following Table 5.

Table 5. Hypothesis Independent Sample T-Test for Pre-Test

Parameters	Levene's Test for Equality of Variances		t-test for equality of means					95% confidence interval of the difference	
	F	Sig	t	Df	Sig (2-tailed)	Mean difference	Std Error difference	lower	upper
Equal variances assumed	2.592	0.114	-1.528	50	0.133	-5.731	3.750	-13.264	1.802
Equal variances are not assumed.			-1.528	42.998	0.134	-5.731	3.750	-13.294	1.833

As shown in Table 5, if the Sig(2-tailed) value is greater than 0.05, H_0 is accepted, indicating no difference in the average pre-test between the experimental and control classes. Otherwise, if the Sig(2-tailed) value is smaller than 0.05, H_a is accepted, meaning there is a difference in the average pre-test between the experimental and control classes. From Table 5, the Sig(2-tailed) value obtained was 0.133 > 0.05, which indicated that H_0 was accepted, so it was concluded that there was no significant difference in average critical thinking abilities in the pre-test between experimental and control class students. Therefore, students in the experimental and control classes had the same critical thinking skills, as evidenced by the fact that no difference in the average score of the initial test (pre-test) existed. Thus, the two classes could be compared and given different treatments. Independent Sample t-test hypothesis testing on post-test data can be seen in Table 6.

Table 6. Hypothesis Independent Sample T-Test for Post-Test

Parameters	Levene's Test for Equality of Variances		t-test for equality of means					95% confidence interval of the difference	
	F	Sig	t	df	Sig (2-tailed)	Mean difference	Std Error difference	lower	upper
Equal variances assumed	2.663	0.109	2.191	50	0.033	12.462	5.688	1.036	23.887
Equal variances are not assumed.			2.191	47.573	0.033	12.462	5.688	1.022	23.901

In Table 6, a Sig (2-tailed) value of 0.033 < 0.05 was obtained, meaning that H_a was accepted, so it was concluded that there was a significant difference in the average of the final test (post-test) between the experimental class and the control class. Therefore, it can be concluded that students taught using Articulate Storyline interactive multimedia learning and those taught using conventional learning differed significantly in their average critical thinking abilities. To determine the difference in average scores in the experimental class before and after giving treatment using Articulate Storyline interactive learning multimedia, the Paired Sample t-test was carried out; the results are revealed in Table 7.

Table 7. Paired Sample T-Test

Dependent Variable	Paired Differences					t	df	Sig (2-tailed)
	Mean	Std Deviation	Std Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Experimental Class Mathematics Learning Results	40.058	19.749	2.739	34.560	45.556	14.627	51	0.000

For Table 6, the decision-making criteria are that if the Sig(2-tailed) value is greater than 0.05, H_0 is accepted, and H_a is rejected, meaning no significant difference exists in the average between the initial and final tests. However, there is a significant average difference between the initial test before treatment and the final test after treatment if the Sig(2-tailed) value is smaller than 0.05, H_0 is rejected, and H_a is accepted. Based on Table 6, a Sig (2-tailed) value of 0.000 < 0.05 was attained, denoting the rejection of H_0 and the acceptance of H_a. In other words, a significant average difference existed between the experimental class's pre-test (initial test) and the post-test (final test). Based on H_0 H_a testing of the Paired Sample t-test, it is stated that interactive learning multimedia Articulate Storyline influenced the critical thinking abilities of class VI students at SDN Serang 20. Using Articulate Storyline interactive learning multimedia can improve students' critical thinking abilities in mathematics subjects. Additionally, the application of interactive learning multimedia Articulate Storyline was assessed using four Facione indicators of critical thinking—interpretation, analysis, evaluation, and inference—which were applied in this study and demonstrated an increase in various average outcomes. This is shown in the Figure 1.

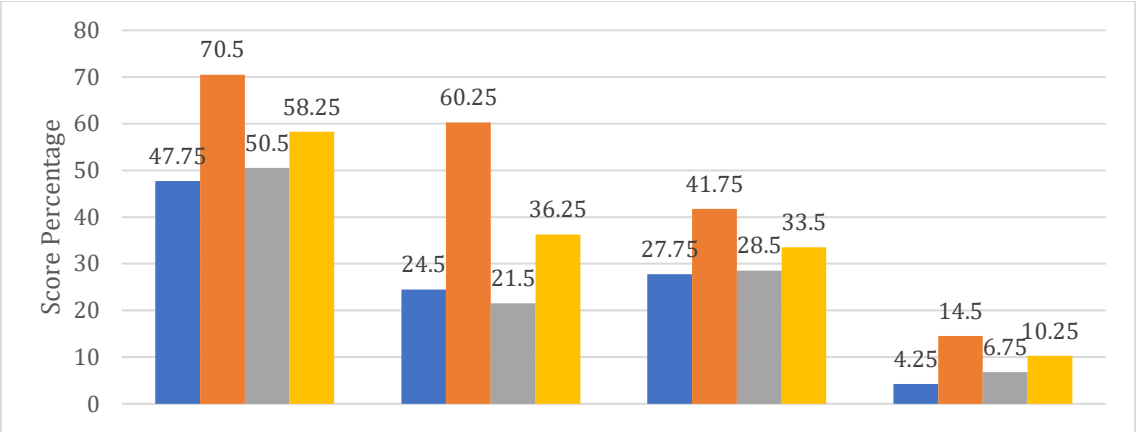

Figure 1. Critical Thinking Indicator Chart

Based on Figure 1, the average results of critical thinking ability indicators were obtained from the initial test (pre-test) and final test (post-test), revealing that each indicator had a different average value. The most important indicator is the "Interpretation" indicator, which has an indicator of "Understanding the problem indicated by writing, knowing it, or asking the question correctly," with a sub-indicator: "Can convey the problem again through his own words in oral, written, diagrammatic or picture." In the "Interpretation" indicator, the average value of the initial test (pre-test) in the experimental class was 47.75. This value increased to 70.5 in the final test (post-test), with an increase difference of 22.75. Meanwhile, in the initial test (pre-test), the control class on the "Interpretation" indicator obtained an average score of 50.5 and experienced an increase during the post-test with an average score of 58.25, resulting in an increase difference of 7.75.

The second indicator is "Analysis," which has the indicator "Identifying relationships between statements and concepts in the problem proven by creating appropriate mathematical models and providing appropriate explanations," with the sub-indicator: "Able to analyze strategy options to choose a solution procedure problem." In the "Analysis" indicator, the experimental class got an average score on the initial test (pre-test) of 24.5. This score grew to 60.25 on the post-test, with a difference in increase of 35.75. Meanwhile, in the control class, the average score for the initial test (pre-test) for the "Analysis" indicator was 21.5, which experienced an increase in the final test (post-test) of 36.25, with a difference of 14.75.

The third indicator is the "Evaluation" indicator, with the indicator "Able to use appropriate strategies in solving problems, complete and correct in carrying out calculations," and the sub-indicator "Uses the right strategy in solving problems, is complete and correct in carrying out calculations." In the "Evaluation" indicator, the average score of the experimental class's initial test (pre-test) was 27.75. On the final test (post-test), students' average scores rose by 14.7% to 41.75. Meanwhile, the control class's initial test (pre-test) obtained an average score of 28.5 and saw an increase in the final test (post-test) of 33.5 with a difference of 5. Among the evaluation indicators were those with a low increase.

Next, the fourth indicator is the "Inference" indicator, which has the indicator "Making conclusions correctly," with the sub-indicator "Providing logical evidence through completion steps in concluding." In the "Inference" indicator, the experimental class received an average score of 4.25 on the initial test (pre-test) results; during the post-test, they increased by 10.25 to an average score of 14.5. The "Inference" indicator in the control group gained 3.5 points in the final test (post-test) to an average score of 10.25 from

the pre-test average of 6.75. The inference indicator experienced the lowest increase in critical thinking skills compared to other indicators.

Discussion

In this study, to gauge how much the students' critical thinking abilities had improved, critical thinking indicators were used according to Facione—interpretation, analysis, evaluation, and inference—. Each critical thinking indicator experienced a different increase. Students' critical thinking skills increased due to the interactive learning multimedia of Articulate Storyline.

Before accurately analyzing, evaluating, and drawing conclusions from a mathematics problem, students should first identify the problem they are faced with, which includes understanding what is known and being asked to interpret the problem. In this research, the indicator that experienced the highest increase occurred in the Interpretation indicator. As stated by previous studies, the interpretation indication was the first to have the biggest growth in the critical thinking indicator (Daryanes et al., 2023; Heliawati et al., 2022; Yakob et al., 2020). The use of interactive learning multimedia can concretize abstract subject matter such as mathematics and science lessons so that students can understand material that is difficult to understand verbally (Anggraini & Nurmaliza, 2022; Djamas et al., 2018). In this study, the Interpretation indicator experienced a significant increase, averaging 70.5. Thus, presenting material and questions visually made it easier for students to identify existing problems. They also could understand the problems given well, demonstrated by their ability to write down what is known and ask the questions given correctly.

After interpreting the existing problem, students analyzed the appropriate formula to solve the mathematical problem presented in the game in the practice questions menu. In this research, the Analysis indicator was the second indicator that experienced the highest increase. Students' ability to apply appropriate mathematical concepts in the game on the practice menu was the reason for the increase in the Analysis indicator. When applying mathematical concepts, students use their critical thinking skills so they can use formulas to solve problems and assess relevant concepts or ideas correctly (Anggraini & Nurmaliza, 2022; Yakob et al., 2020). Because various kinds of text, audio, image, and video explanation media were provided in the form of simulations in the interactive multimedia learning Articulate Storyline, which could stimulate students' thinking abilities, students in the experimental group could solve problems (Safira et al., 2021; Sindu et al., 2020). If students forget the formula or have problem-solving problems, they can return to the main menu and select the material menu or learning video to find the appropriate formula for solving math problems in the practice questions menu. As a result, students find it simpler to comprehend and resolve mathematical issues using established mathematical ideas, which they may apply to their daily lives. In this research, the Analysis indicator rose by an average of 60.25. Even though the experimental and control classes experienced an increase in the Analysis indicator, the control class only experienced an increase with a difference of 14.75, which means that it did not significantly outperform the experimental class, which experienced a high increase, with a difference of 34.5.

Furthermore, the critical thinking ability indicators that experienced the lowest increase were the Evaluation and Inference indicators (Kurniawan et al., 2020; Musdi et al., 2020). This occurred due to students' inability to finish mathematical calculations, their erroneous calculations, their inability to make the connections between the concepts needed to solve mathematical problems, and their improper writing of conclusions. Evaluation indicators in the form of the problem-solving process showed the lowest percentage, the low ability of students to evaluate problem-solving because they hardly ever checked and improved problem-solving solutions; thus, the teacher's role should direct students to evaluate the problem-solving process and solutions found by students (Daryanes et al., 2023; Yakob et al., 2020).

Because students received a variety of learning media in the form of images, text, video, and audio integrated into the Articulate Storyline multimedia, thus providing a concrete depiction for students, their critical thinking skills increased. Increasing students' critical thinking skills in the learning process is because students receive assistance from the media in the form of text, images, audio, and visuals (Anggraini & Nurmaliza, 2022; Yakob et al., 2020). In the multimedia Articulate Storyline, features that can enhance critical thinking skills are the graded questions feature in the form of essays and the learning video feature. The graded question feature in essay form can train students' critical thinking skills during group discussions. The graded questions feature takes the shape of a game with essay-style questions that may be answered in groups through discussions and offer a variety of solutions that do not restrict students' answers to develop their critical thinking abilities (Schunk & DiBenedetto, 2020; Yuliana et al., 2022). In addition, by allowing students to review the steps to solve a given problem, the learning video feature can improve students' critical thinking skills. The learning video feature can help students become more adept at solving problems because the cases presented in the learning videos can help students develop their critical thinking skills; the material provided and learning videos also assist students in understanding the

material thoroughly and offer explanations on how to solve the cases given (Mulyanti et al., 2023; Yakob et al., 2020). The learning video tool in the Articulate Storyline multimedia can help students develop their critical thinking abilities since it delivers wide and in-depth discussions through engaging and realistic graphics (Meryansumayeka et al., 2022; Sulistyan et al., 2022).

The use of Articulate Storyline multimedia in mathematics learning can improve students' abilities in solving mathematical problems. This is supported by research results that found students who received learning using Articulate Storyline media demonstrated a higher average score for mathematical problem-solving abilities compared to classes taught using conventional media, which were proven to have low problem-solving abilities (Jubaerudin et al., 2021; Rohmah & Bukhori, 2020)

. In order to ensure that students fully comprehend the information and can solve mathematical issues correctly, the learning video feature simplifies the learning process for them by presenting animations and tutorials in the form of solving real-world circle circumference problems. Problem-solving abilities are closely related to good critical thinking skills.

The use of interactive multimedia Articulate Storyline can also boost student learning motivation. Given the rise in student learning outcomes, it is evident that students were more focused, attentive, and excited about learning mathematics. When teachers taught students using conventional material, on the other hand, their behavior and responses were very different; students were likely to be bored, less enthusiastic, and joked around with their classmates than when listening to the material taught by the teacher, resulting in low critical thinking skills and low student learning outcomes. In this instance, motivation can be increased by providing videos, animations, and audio effects on the interactive learning media Articulate Storyline (Hadza et al., 2020; Setyaningsih et al., 2020). Compared to students taught using traditional learning media, those who used the interactive learning media Articulate Storyline had better levels of learning motivation. This demonstrates that using interactive learning multimedia Articulate Storyline can increase student motivation and learning outcomes, encouraging students to take an active role in developing their critical thinking abilities.

When given treatment, students were more active, enthusiastic about participating in lessons, actively involved in group discussions, and active in operating the interactive multimedia Articulate Storyline. Articulate The highly appealing interactive learning multimedia design of Articulate Storyline may successfully encourage and motivate students to engage in the learning process. Learners who are more engaged in their studies typically exhibit higher levels of activity, curiosity, and passion, all leading to increased critical thinking (Hadza et al., 2020; A. F. Wijayanti et al., 2022). Consequently, employing Articulate Storyline interactive learning multimedia can help raise students' interest in learning. Students highly interested in learning will find it easy to develop their critical thinking skills.

4. CONCLUSION

This research's findings revealed that 1) The learning process is fun and interactive through various image, text, video, audio, and instructional game media with their classmates, making students interested and active in every learning activity. Active students will easily be trained and develop their critical thinking skills. 2) When answering questions from the HOTS category, students taught utilizing multimedia Articulate Storylines generally exhibited stronger critical thinking abilities for each indicator. This is proven by the drastic increase in the interpretation and analysis indicators. 3) Students experienced difficulties and did not check their answers again in evaluating and drawing conclusions from existing problems.

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