

# Development of Articulate Storyline Media to Improve Students' Critical Thinking Skills

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## ABSTRACT

The integration of technology into elementary mathematics education remains limited, leading to challenges in fostering students' critical thinking skills, especially in abstract topics such as flat shapes. This study aims to develop and evaluate the effectiveness of *Articulate Storyline*-based learning media in improving the critical thinking skills of fifth-grade students on the topic of rectangular flat shapes (squares and rectangles). The research employed a Research and Development (R&D) approach based on the Borg and Gall model. The participants were 34 fifth-grade students from SD Negeri Tambakaji 03, Semarang. Data were collected through expert validation questionnaires (material and media experts), student response questionnaires, and pretest-posttest instruments. Validity and reliability tests were conducted to ensure the quality of the instruments, and effectiveness was analyzed using the N-gain and t-test. The results show that the developed *Articulate Storyline* media achieved a validity score of 92%, indicating it is highly feasible for classroom use. Student responses also showed positive acceptance and high practicality. Statistical analysis revealed a significant improvement in students' critical thinking skills, with an average N-gain score of 0.7084, classified as high. In conclusion, the use of *Articulate Storyline* media effectively enhances students' critical thinking abilities in mathematics, particularly in learning about flat shapes. The study supports the incorporation of interactive digital media as a pedagogical tool to bridge the gap between abstract mathematical concepts and engaging learning experiences at the elementary level.

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## 1. INTRODUCTION

Education plays a crucial role in shaping competent individuals by facilitating the acquisition of knowledge across formal and informal settings. In the context of rapid technological advancement, the cultivation of critical thinking skills among students is increasingly essential. The integration of technology in education not only modernizes learning environments but also offers opportunities to develop students' cognitive abilities, particularly critical thinking (Mansir, 2020; Bitto & Masaong, 2023).

Despite the potential benefits, traditional teaching methods and underutilized learning media in classrooms often fall short in promoting these higher-order thinking skills.

Modern education must adapt to the demands of the 21st century, where the ability to analyze, evaluate, and synthesize information is vital. Critical thinking enables learners to navigate the overwhelming volume of information available, assess its credibility, and make informed decisions. It is, therefore, imperative for educational systems to encourage critical thinking so that students can confront global challenges effectively (Ashari Hamzah et al., 2023). According to Widayanti et al. (2023), drawing on the philosophy of Ki Hajar Dewantara, education should foster the intellectual, moral, and social development of students, enabling them to coexist harmoniously with their environment.

In line with this philosophy, education must empower students by nurturing their knowledge, attitudes, and skills. As emphasized by Delima Kiska et al. (2023), educational processes should support learners in realizing their full potential, equipping them with tools to thrive in a dynamic, information-rich world. The contemporary curriculum reflects this shift by transitioning from teacher-centered to student-centered learning. This approach aims to develop students' autonomy, enabling them to critically assess and filter information, particularly in the face of misinformation and hoaxes (Hadi Elyas et al., 2022). Focusing on student agency is believed to significantly enhance critical and analytical thinking skills.

One educational reform reflecting this approach is Indonesia's Independent Curriculum (Kurikulum Merdeka), which grants autonomy to teachers, schools, and students in designing and implementing effective learning experiences. Central to this curriculum are the 6C competencies: Critical Thinking, Creativity, Collaboration, Communication, Citizenship, and Character (Dharma et al., 2024). Among these, critical thinking is recognized as a foundational skill necessary for lifelong learning and problem-solving.

In the context of elementary mathematics education, learning should go beyond rote memorization of formulas. Instead, it should engage students in problem-solving activities and conceptual understanding. Teachers are instrumental in creating meaningful learning experiences that enable students to articulate ideas and apply mathematical reasoning to real-life situations (Andriyani et al., 2022; Yanti et al., 2021). However, field observations and interviews conducted with fifth-grade teachers at SD Negeri Tambakaji 03, Semarang, in February and March 2024 revealed deficiencies in the application of technology in classroom learning. During mathematics lessons on plane figures—particularly squares and rectangles—students struggled to grasp core concepts due to limited use of interactive media and reliance on conventional textbooks as the primary learning resource.

This lack of engaging instructional media often results in monotonous learning environments, which inhibit the development of students' critical thinking abilities (Okta Nadia & Desyandri, 2022). Lestari (2019) emphasized that without being encouraged to seek alternative solutions, students are unlikely to develop flexible thinking strategies. Moreover, assignments completed at home—where teacher oversight is limited—make it difficult to assess students' individual understanding and engagement. These issues underscore the need for digital learning tools that can support the development of critical thinking (Nurvidia & Yulianto, 2024).

Developing appropriate digital learning media requires careful consideration of students' needs and learning characteristics. As Sae and Radia (2023) suggest, digital resources that promote interactivity and reflection can help students become more adept at critical thinking. Such media should stimulate learners to explore problems from various perspectives, generate original ideas, and propose innovative solutions.

In this regard, the use of articulate narrative media—a form of digital storytelling integrated into e-learning platforms—holds significant promise. According to Nurdiansyah et al. (2023), narrative-based digital media can effectively stimulate students' reasoning by guiding them through structured argumentation and decision-making processes. Similarly, Prasetyo et al. (2021) note that critical thinking involves a series of cognitive skills, including analyzing information, evaluating arguments, and solving problems based on evidence.

To assess students' critical thinking skills, several indicators are typically used: (1) identifying and understanding problems; (2) analyzing and investigating issues; (3) evaluating evidence; (4) drawing logical conclusions; (5) presenting structured reasoning; and (6) exercising metacognitive control (Triana Sari et al., n.d.). Learning tools that incorporate these elements can significantly enhance students' cognitive development.

The integration of modern instructional strategies and educational technologies is essential for improving learning quality (Hamzah et al., 2022). One potential solution is the use of Articulate Storyline, a powerful e-learning development tool that allows the creation of interactive and visually engaging content. Firdaus et al. (2022) highlight its features, which enable educators to design dynamic learning modules tailored to students' needs. When applied effectively, such digital media can encourage learners to engage more deeply with content and improve their critical thinking capabilities (Bhuttah et al., 2024; Agus Rustamana et al., 2024).

This study, therefore, aims to explore the impact of articulate narrative media—developed using Articulate Storyline—on students' critical thinking skills, particularly in learning about plane figures in elementary mathematics. Building upon prior research by Legina and Sari (2022), which demonstrated the positive effects of articulate storyline media on learners' cognitive engagement, this study seeks to expand the scope of existing literature by focusing on the specific topic of rectangles and squares in primary education.

In summary, this research addresses the need to enhance critical thinking among elementary school students through the development and application of digital learning media. By focusing on narrative-based, interactive tools, the study contributes to the broader goal of fostering higher-order thinking skills within the framework of 21st-century education.

## 2. METHODS

This study employed a Research and Development (R&D) methodology based on the Borg and Gall model, as adapted by Rustamana et al. (2024). The purpose of the study was to develop Articulate Storyline-based digital learning media aimed at enhancing the critical thinking skills of fifth-grade students. However, due to limitations in time and funding, the implementation of the development process was restricted to the product revision stage. Consequently, the final stages of widespread testing and mass production could not be completed within the scope of this research.

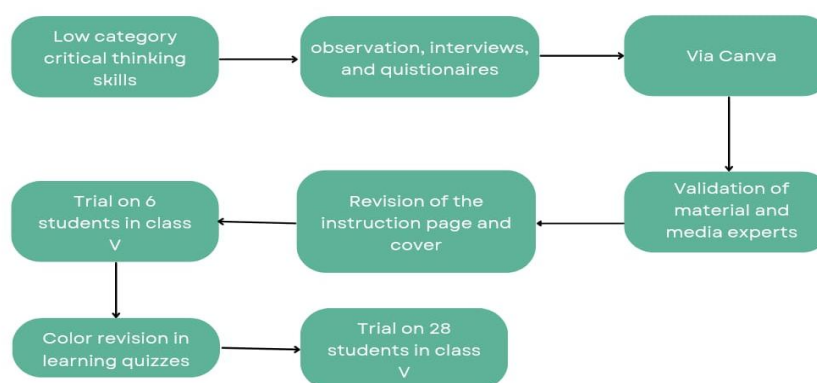
The research involved several key participants, including classroom teachers, students, expert validators (for both material and media), and the researcher. The sample consisted of 34 fifth-grade students from SD Negeri Tambakaji 03 in Semarang City. This school was selected for two main reasons: first, the class size was considered sufficient for R&D research (Okpatrioka, 2023), and second, the school was geographically accessible to the researcher, which facilitated data collection and coordination.

To obtain comprehensive data, the study utilized both test and non-test instruments, following the approach described by Sutikno et al. (2022). The test method involved the administration of pretests and posttests to measure students' critical thinking skills before and after the use of the developed media (Setiawan et al., 2021). The non-test techniques included observations, interviews, questionnaires, and document analysis to support the evaluation process and provide contextual insights into the learning environment (Setiawan et al., 2021).

Prior to data collection, the researcher designed test items aligned with the critical thinking indicators relevant to the learning objectives. These test instruments underwent preliminary validation to ensure their relevance and appropriateness. After collecting the data, several steps of statistical analysis were performed. First, the test items were subjected to validity and reliability tests to assess the quality of the instruments. Subsequently, normality tests were conducted to determine whether the pretest and posttest data followed a normal distribution.

If the data met the criteria for normal distribution, a parametric statistical analysis, specifically the paired sample t-test, was employed to compare students' critical thinking performance before and after the intervention. To further assess the effectiveness of the developed media, the normalized gain (n-Gain) test was used to evaluate the magnitude of students' learning improvements (Ardiansyah et al., 2023).

In addition to measuring learning outcomes, the feasibility of the developed media was assessed through expert validation. This process involved two categories of experts: material validators, who evaluated the content accuracy and relevance, and media validators, who assessed the functionality, design, and usability of the Articulate Storyline product. Both groups completed structured questionnaires developed by the researcher to ensure consistent and objective evaluations.



**Figure 1.** Research Stages

This study utilized both quantitative and qualitative data to evaluate the development and effectiveness of the Articulate Storyline media. Quantitative data included students' pretest and posttest scores (from both small- and large-scale trials), as well as the results of validation assessments conducted by media and material experts, and questionnaire responses from teachers and students. Meanwhile, qualitative data comprised feedback and suggestions provided by expert validators (both media and material) and academic reviewers, which offered valuable insights for refining the product (Sugiyono, 2016).

To assess the feasibility of the developed media, structured assessment questionnaires were distributed to media and material expert validators. The results of these assessments were analyzed using descriptive statistics, then converted into percentage scores to determine the overall feasibility level of both the media and its content. Additionally, to evaluate the effectiveness and user perception of the Articulate Storyline media, the researcher administered a student response questionnaire after implementation in the learning process. These responses provided important data on students' engagement, satisfaction, and the perceived usefulness of the digital media.

### 3. FINDINGS AND DISCUSSION

#### 3.1. Research Findings

This study on the development of articulate storyline media centers on (1) detailing the product design of articulate storyline media, (2) presenting the findings from the feasibility test of articulate storyline media, and (3) outlining the outcomes of the effectiveness test of articulate storyline. Based on the results of the analysis of the needs of teachers and students, this development research was carried out. Where the analysis stage is carried out to collect data through questionnaires addressed to teachers and students to find out their needs. The needs questionnaire that was distributed contained questions

related to mathematics learning carried out in the classroom. These questions include students' difficulties in learning, understanding rectangular flat building materials (rectangles and rectangles), students' interest in mathematics learning media using articulate storylines. The researcher also analyzed the problems that occurred in schools where one of the classes was taken as a sample to be studied. This stage is carried out by direct observation in the classroom by analyzing the classroom environment, student characteristics, and interviews with class V teachers directly.

### 3.2. Articulate Storyline Media Design

At this stage of the research, the Articulate Storyline media was developed as an interactive digital learning tool. The media was designed as a desktop-based application that can be accessed across multiple platforms, including computer-based devices, iOS, and Android systems. According to Nissa et al. (2021), products developed using Articulate Storyline are typically packaged in HTML5 and executable (.exe) formats, allowing compatibility with a wide range of devices such as computers, laptops, tablets, smartphones, and Chromebooks.

The Articulate Storyline media created for this study contains diverse content types, including learning materials and interactive educational games, which aim to support student engagement and comprehension. One of the key reasons for choosing Articulate Storyline was its offline usability, making it accessible without the need for continuous internet connectivity.

As noted by Kurnia et al. (2021), Articulate Storyline media can be tailored to meet the specific needs of teachers and students, and aligned with the objectives of the mathematics curriculum. In this study, the researcher designed the media to include several components: an introductory page, user instructions, learning objectives and achievement indicators, instructional materials integrated with videos, and quizzes to assess understanding of the presented content. These features were intended to provide a comprehensive and interactive learning experience that supports the development of students' critical thinking skills in mathematics.

### 3.3. Expert Validation Results

Furthermore, the completed product underwent expert validation by specialists in the fields of mathematics education and media development. This validation stage aimed to evaluate the feasibility and quality of the Articulate Storyline media prior to its implementation in student trials. The material experts rated the media with a feasibility score of 92%, while the media experts provided a score of 90%, both of which fall into the "very feasible" category.

Despite these positive evaluations, the expert validators also provided constructive feedback to enhance the product. Specifically, they noted that the color contrast on the title page was insufficient, potentially affecting readability. Additionally, they recommended the inclusion of clearer instructional prompts or command words to guide students through learning activities more effectively (Fayrus et al., 2022). These suggestions were considered by the researcher for subsequent revisions to improve the overall usability and instructional quality of the media.

**Table 1.** Expert Validation Recapitulation

Expert Validation	Percentage	Category
Material	92%	Highly Worthy
Media	90%	Highly Worthy

Based on the main points of the experts' evaluation, it can be said that the media with an articulate plot satisfies the requirements in a very practical way. Therefore, it is quite possible to employ the articulate tale media as a teaching tool for mathematics for grade V students at SD Negeri Tambakaji 03 when it comes to rectangular flat building materials.

Table 2. Outcome of Media and Material Revision

Number	Before Revision	After Revision
1		
2		

### 3.4. Product Effectiveness Results

The media articulated tale was tested on students both on a larger and smaller scale, depending on the revision's outcomes and the expert validators' advice. 6 students in grade V of SD Negeri Tambakaji 03 participated in a small-scale experiment utilizing articulate tale learning materials. This small-scale trial was carried out so that researchers knew the fault of the articulate storyline media that had been developed. The effectiveness test process started from a small-scale test with 6 students to test the product. The results of the small-scale trial showed that the small-scale pretest score had an average score of 61.6 and an average posttest score of 85. Meanwhile, a large-scale trial was carried out on 22 students in grade V of SD Negeri Tambakaji 03. Large-scale results with a total of 22 students showed that the average score of the pretest was 58.1 and the average score of the posttest was 86.8. It can be summarised that both results have improved critical thinking skills before and after using articulate storyline media.

In addition to pretest and posttest data, the responses of questionnaires distributed to students revealed that students' critical thinking skills improved significantly with the use of articulate storyline media. The majority of questionnaires filled out showed the effectiveness of articulate storyline media, where 16 out of 28 students. This increase is indicated by the analysis of posttests which show better scores and positive responses from students to the learning media used. The following is a diagram of the results of small-scale and large-scale trials of both pretest and posttest as well as the results of students' critical thinking ability questionnaires.

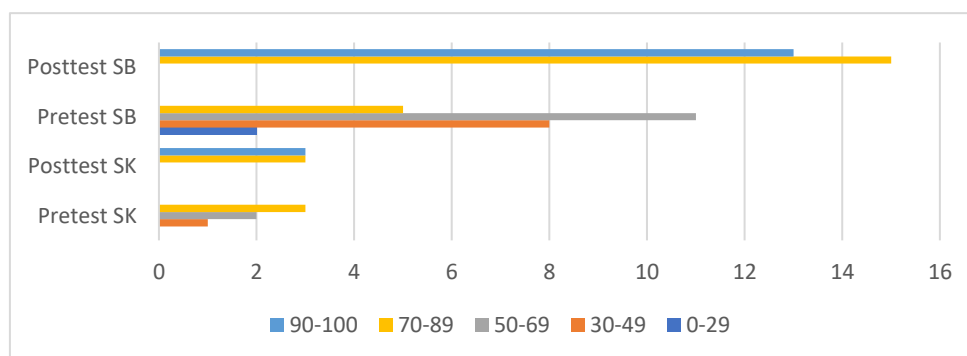
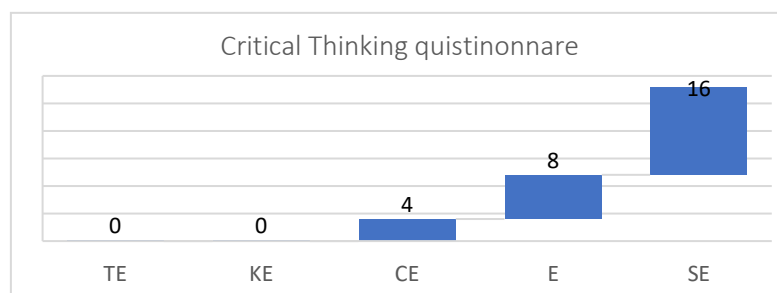


Figure 2. Recapitulation of Pretest & Posttest Result



**Figure 3.** Outcomes of the Critical Thinking Questionnaire

From the accumulated data, the effectiveness of articulate storyline media was tested to see the improvement of students' critical thinking skills. With the assistance of the SPSS version 30 application, a normality test using the Shapiro-Wilk test because the sample used was only 34 students.

**Table 3.** Recapitulation of Normality Test Results

Class		Shapiro-Wilk		
		Statistic	df	Mr.
Result	Pretest SK	.958	6	.804
	Posttest SK	.960	6	.820
	Pretest SB	.957	28	.424
	Posttest SB	.952	28	.350

From the normality test results in the table above, all data are normally distributed where the significant value of the pretest and posttest on a small scale and large scale is more than 0.05. On a small scale, the result value of the pretest was 0.804 and the posttest was 0.820. Meanwhile, on a significant large scale, the result value of the pretest was 0.424 and the posttest was 0.350. This normality test is useful for analyzing the initial data, which is then tested for the effectiveness of articulate storyline media on students' critical thinking skills, as reviewed from the average pretest and posttest scores by applying a t-test. The researcher applied SPSS 30 for the t-test with the t-Test: Paired Two Sample For Means. The following are the results of the t-test using a paired sample for means.

**Table 4.** t-Test outcomes

Paired Samples Test						
	N	Mean	Std. Deviation	t-count	Df	T table
Large-scale	28	-28.636	12.265	-10.951	28	2.048
Small-scale	6	-23.333	10.328	-5.534	5	2.571

Based on the t-test in the table, it is evident that if the null hypothesis (H0) is rejected and the alternative hypothesis (H1) is accepted, then the t-value calculated is greater than the t-table value, indicating a significant difference or influence from the use of learning media. On the other hand, if H0 is accepted and H1 is rejected, then  $t_{count} < t_{table}$  so that it can be concluded that there is no difference and influence from the use of learning media. The results of the small-scale t-test show that the calculated t obtained is 5,534 and the table t is 2,571. From the t-test, it can be concluded that the result of t calculation

is greater than the  $t_{table}$ , then  $H_0$  is rejected and  $H_1$  is accepted. Meanwhile, on a large scale, the t-test results were obtained of 10,951 and the t-table of 2,048, then  $H_0$  was rejected and  $H_1$  was accepted. Based on the results of the t-test analysis, it can be concluded that on a small scale and a large scale, there are differences and influences on students' critical thinking skills before and after being treated with articulate storyline media.

Next, the next test was carried out, namely the N-gain test. It is known from the N-gain test value on small and large scales that the critical thinking ability of grade V students of SD Negeri Tamabakaji 03 has increased in rectangular flat building materials (square and rectangular). The increase in critical thinking ability can be seen from the small-scale N-gain value with medium criteria, with a value of 0.6093, and the large-scale N-gain value with high criteria, with a value of 0.7066. Thus, it can be concluded that there is an effectiveness of articulate storyline media because there is an increase in students' critical thinking skills when applying articulate storyline media to mathematics learning of rectangular flat building materials (square and rectangular squares). The results of the N-gain test of this study can be seen in the following table.

**Table 5.** N-gain Test Recapitulation

Scale	Category	Value
Small-scale	Pretest installment	61.6
	Posttest installment	85
	N-Gain	0.6093
	Category	Keep
Large-scale	Pretest installment	58.18
	Posttest installment	86.8
	N-Gain	0.7066
	Category	High

### 3.5. Discussion

Critical thinking is a fundamental skill in education, especially in the 21st century, where students are expected not only to absorb knowledge but also to apply it creatively and innovatively. Critical thinking involves the capacity to generate new ideas, develop creative solutions to problems, and construct meaningful and valuable outputs through analytical reasoning (Afifah et al., 2023). It empowers learners to make decisions based on evidence, evaluate arguments, and apply learned concepts in novel and real-life contexts.

Recent studies have highlighted various instructional strategies that support the development of critical thinking skills. For example, gamification, which involves incorporating game elements into the learning process, has been shown to increase student engagement, motivation, and critical thinking ability (Arman Cahyanto et al., 2022). Similarly, experiential learning, where students engage directly with problems related to their everyday lives, has a positive impact on fostering deeper understanding and reflective thought (Prasasti et al., 2023). When students participate in learning activities that challenge them to analyze, interpret, and solve real-world problems, they are more likely to demonstrate improved critical thinking skills (Haryanto et al., 2022).

One effective approach to nurturing critical thinking in mathematics is through the use of mathematical story problems, which require students to contextualize mathematical operations within real-life scenarios. These types of problems help students identify relevant information, understand the relationships among variables, and apply appropriate problem-solving strategies. According to Afifah et al. (2023), solving story problems not only improves students' analytical thinking but also enhances their ability to evaluate alternative solutions and make logical decisions. Additionally, the open-ended

nature of many story problems encourages creativity, as students may arrive at different valid solutions through various reasoning pathways.

However, classroom observations and teacher interviews conducted in Class V A of SD Negeri Tambakaji 03 revealed several challenges that hinder the development of critical thinking skills. First, there was underutilization of technological facilities in the learning process. Second, the existing learning media were not integrated effectively into lessons, resulting in reduced student engagement. Third, instructional media were often limited to simple printed materials, such as paper-based images, which failed to support interactive and dynamic learning experiences. These limitations contributed to students' difficulties in understanding and solving mathematical story problems, especially in topics such as rectangular plane figures (e.g., squares and rectangles).

Given these challenges, there was a clear need to develop interactive digital learning media that could better support students' engagement and problem-solving skills. To address this gap, the present study developed learning media using Articulate Storyline, a platform that allows for the creation of interactive multimedia content. The goal was to improve students' critical thinking by providing visually rich, contextually relevant, and interactive learning experiences tailored to the topic of rectangular plane figures.

The use of story-based digital media is particularly effective in motivating students and encouraging critical thinking. Story-based questions help students situate mathematical problems in familiar contexts, making abstract concepts more relatable and meaningful. This relevance increases emotional engagement, which, in turn, motivates students to think more deeply and critically about the problems at hand. Furthermore, when students discuss story problems in groups, they engage in collaborative reasoning, which enhances their ability to articulate ideas, consider multiple perspectives, and refine their problem-solving strategies through peer feedback and discussion.

Based on a teacher needs analysis, it was found that many students struggled with story-based mathematics problems due to a lack of engaging and visually appealing instructional materials. The existing media, such as static images on paper, were insufficient to support students' understanding or stimulate their interest in mathematics. Therefore, learning media needed to be designed with contrasting colors, engaging visuals, interactive features, and clear instructional prompts to better capture students' attention and support their comprehension (Emas Susilo et al., 2023).

The Articulate Storyline platform was selected for development due to several key advantages. First, it offers an interactive interface that is user-friendly for both teachers and students, resembling the familiar layout of PowerPoint (Nissa et al., 2021). Second, the developed media can be packaged as a standalone application that may be distributed via platforms such as the Play Store. Third, and crucially for resource-limited settings, the media can be accessed offline, making it suitable for schools in areas with poor or inconsistent internet connectivity.

The effectiveness of the developed media was evaluated through pretest and posttest scores collected from 34 fifth-grade students at SD Negeri Tambakaji 03. The analysis included small-scale trials with 6 students and large-scale trials with 28 students. The results demonstrated a significant improvement in students' critical thinking skills following the intervention. The n-Gain test was used to assess learning gains. In the small-scale trial, an n-Gain score of 0.6093 was recorded, categorized as moderate. In the large-scale trial, the n-Gain score increased to 0.7066, classified as high. These findings indicate that the Articulate Storyline media was effective in enhancing students' critical thinking, particularly in understanding and solving problems related to rectangular flat shapes.

These results are consistent with previous research conducted by Nissa et al. (2021), which found that learning media developed with Articulate Storyline were rated highly in terms of usability and instructional quality. In their study, media validators gave a feasibility rating of 3.94, while material validators rated the content 4.5 out of 5. Additionally, the media received positive feedback from users, with an average response score of 4.54, indicating strong user satisfaction and perceived usefulness.

The current study contributes valuable insights into how interactive media can be used effectively in primary education to improve not only students' engagement but also their cognitive development. The positive results suggest that Articulate Storyline has the potential to be a valuable tool in mathematics instruction, especially for abstract or complex topics that benefit from visual representation and interactive learning pathways.

Moreover, the findings have broader implications for curriculum design and teacher practice. Teachers can draw on this research to enhance their pedagogical strategies by integrating multimedia learning tools that foster critical thinking and student-centered learning. The use of such tools can also increase student motivation, promote active participation, and improve the overall quality of classroom instruction. Furthermore, the study supports the idea that teachers should be empowered and trained to become facilitators of learning, who use technology to create engaging, personalized, and effective educational experiences (Miftahul Jannah et al., 2023).

Beyond its practical contributions, this research also adds to the academic literature on technology-enhanced learning in elementary education. It provides empirical evidence supporting the role of interactive story-based media in developing students' critical thinking skills, particularly in mathematics. The success of the Articulate Storyline-based media highlights the importance of integrating contextual problem-solving and narrative-driven learning into instructional design.

In conclusion, the development and application of Articulate Storyline media in this study proved to be an effective approach to improve critical thinking skills among fifth-grade students. The combination of interactive features, real-life contexts, and visual engagement enabled students to connect mathematical concepts to practical situations, think critically, and collaborate meaningfully with peers. This study lays a solid foundation for further research into the application of digital learning tools in elementary classrooms and opens new pathways for innovation in curriculum delivery.

#### 4. CONCLUSION

This study concluded that the development of Articulate Storyline learning media, designed using Canva and enhanced with engaging visual, auditory, and interactive elements, is both feasible and effective in improving fifth-grade students' critical thinking skills in mathematics. The media received a feasibility score of 90% from material validators and 92.5% from media validators, placing it in the "very feasible" category. In terms of effectiveness, the n-Gain score of 0.7066 indicates a high level of improvement in students' critical thinking abilities after using the media. Despite these promising results, the study faced limitations, particularly in its scope of implementation, which was restricted due to limited time and funding, preventing full-scale deployment and long-term evaluation. Future research is recommended to conduct broader trials across multiple schools, explore the media's impact on other cognitive and affective learning outcomes, and further refine the media design by incorporating adaptive learning features and student feedback to maximize engagement and personalization.

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