The Effectiveness of Using Interactive *StoryMath* Based on Articulate Storyline to Improve Mathematical Literacy in San Carlos Manlewana Elementary School

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Abstract. This study aims to examine the effectiveness of using interactive *StoryMath* media based on Articulate Storyline in improving mathematical literacy of students at San Carlos Manlewana Elementary School. The background of this study is based on the low mathematical literacy skills of students which are still relatively low, as well as the need for more interesting, contextual, and interactive learning methods. This study used a quasi-experimental approach with a pretest-posttest design on 60 fifth grade students at San Carlos Manlewana Elementary School. Data were collected through mathematical literacy tests, observations, questionnaires, and teacher interviews. The results showed a significant increase in students' mathematical literacy scores after using *StoryMath* media, namely from an average of 58 in the pretest to 83 in the posttest. In addition, teachers reported that this media made it easier to convey abstract concepts, increase learning motivation, and active student participation during the learning process. Qualitative evaluation also revealed that students felt more interested and helped in understanding mathematical material through contextual and interactive stories. This finding is in line with the theory of experiential learning and the results of previous studies which confirm that interactive narrative-based learning media can improve student understanding and engagement. This study recommends the implementation of *StoryMath* media as an innovation in mathematics learning in elementary schools to support the development of effective and enjoyable mathematical literacy. The practical implications and further development of this media are also discussed as an effort to improve the quality of elementary education in the digital era.

Keywords: mathematical literacy; StoryMath; articulate storyline; interactive learning; elementary school

INTRODUCTION

Mathematical literacy is a basic competency that is very important for elementary school students in understanding the world around them logically, analytically, and critically. Mathematical literacy skills include understanding concepts, applying procedures, reasoning, communicating, and reflecting in the context of everyday mathematics (OECD, 2019). However, based on various national and international surveys and studies, the level of mathematical literacy of Indonesian students is still relatively low. The 2018 Programme for International Student Assessment (PISA) report showed that Indonesia ranked low in mathematical literacy achievement, with more than 70% of students below the minimum level (Kemendikbud, 2019). The phenomenon of low mathematical literacy at the elementary level cannot be separated from several factors, such as learning methods that are still traditional, limited learning media, lack of active student involvement, and low real-life context in teaching materials (Suryanto & Prasetyo, 2021). In addition, teachers often have difficulty integrating meaningful and enjoyable approaches into mathematics learning. This condition has implications for students' negative perceptions of mathematics, which is considered a difficult and boring subject (Susanto, 2020).

Transforming education through the use of technology is a great opportunity to overcome these challenges. Digital-based learning allows for the presentation of materials visually, interactively, and contextually. One of the innovative approaches that is developing is the use of storytelling in

mathematics learning, or what is known as *StoryMath*. *StoryMath* combines narrative stories with mathematical elements to create a more meaningful and interesting learning experience (Redjeki & Suyatna, 2021).

Digital media such as Articulate Storyline provide a means to create interactive learning that integrates text, images, animations, and quizzes with a cohesive storyline. In the context of mathematics learning, the use of Articulate Storyline allows teachers to organize learning materials in the form of stories that are tailored to the themes of students' daily lives. This can help students understand abstract concepts in a more concrete and enjoyable way (Setiawan & Wibawa, 2021). At San Carlos Manlewana Elementary School, the results of the mathematics learning evaluation showed a need to improve students' mathematical literacy. Most students had difficulty understanding story problems, applying problem-solving strategies, and communicating the results of their mathematical thinking systematically. In addition, the learning process is still dominated by lecture methods and practice questions, without involving contexts that are relevant to students' lives (San Carlos Manlewana Elementary School, 2023).

The use of interactive *StoryMath* based on Articulate Storyline is seen as a strategic solution to improve the quality of mathematics learning at the school. This approach is in line with the principles of experience-based and student-based learning recommended in the Merdeka Curriculum. By integrating contextual stories into the learning process, students are expected to be able to build meaning and understanding of mathematical concepts in a more complete and relevant way (Kemdikbudristek, 2022). This study aims to examine the effectiveness of using interactive *StoryMath* media based on Articulate Storyline in improving mathematical literacy of San Carlos Manlewana Elementary School students. The research was conducted through three stages: planning, implementation, and evaluation. The results of this study are expected to contribute to the development of innovative, fun, and effective mathematics learning strategies in shaping students' numeracy competencies from an early age.

Furthermore, the story-based approach in mathematics learning not only targets cognitive aspects, but also affective and psychomotor. Students not only learn to solve problems, but are also invited to think critically, collaborate, and convey ideas orally and in writing. Within this framework, *StoryMath* becomes a learning medium that supports the formation of the profile of Pancasila students who have critical, creative, and character-based reasoning skills (Kemdikbudristek, 2022). The importance of digital transformation in basic education is further strengthened by the demands of the industrial revolution 4.0 and the era of society 5.0, where basic literacy skills, including mathematical literacy, are the foundation for the success of future generations. Therefore, the implementation of interactive digital media such as Articulate Storyline in mathematics learning is part of a strategic response to the dynamics of the times (Trilling & Fadel, 2009). With this background, this study focuses on how effective interactive *StoryMath* media based on Articulate Storyline can improve students' mathematical literacy at SD San Carlos Manlewana. This research not only offers a new approach to mathematics learning, but also becomes an important contribution in the development of digital-based educational media that is in accordance with the characteristics and needs of today's elementary school students.

METHODS

This Community Service is designed to implement and test the effectiveness of interactive learning media *StoryMath* based on Articulate Storyline in improving students' mathematical literacy at San Carlos Manlewana Elementary School, Timor Leste. The location of this community service activity was at San Carlos Manlewana Elementary School, Timor Leste, and is carried out from May 12 to May 16, 2025. This activity uses instruments in the form of tests and questionnaires. Participants in this community service activity use the training method with a total of 60 students and 9 teachers. This activity is carried out in three stages, namely:

Planning Stage

In the planning stage, an analysis of mathematics learning needs was conducted at SD San Carlos Manlewana through classroom observations, interviews with teachers and principals, as well as document studies related to the curriculum and learning evaluation results. Based on the results of the analysis, the implementation team prepared interactive *StoryMath* media based on Articulate Storyline which contains mathematics learning content with a contextual story approach. In addition, supporting teaching tools such as learning implementation plan, digital Students Worksheet, and assessment instruments to measure students' mathematical

literacy were also prepared.

Implementation Stage

Next, in the implementation stage, activities focused on teacher training and implementation of *StoryMath* media in the classroom. Teachers were given training on the use of Articulate Storyline and the integration of story narratives in mathematics learning. After the training, teachers carried out learning in the classroom by utilizing the media that had been prepared. Students were invited to actively participate in exploring the story and solving the mathematical challenges inserted in the storyline. During the implementation, the implementation team provided assistance to monitor the process and student involvement.

Evaluation Stage

In the evaluation stage, measurements were made of the increase in students' mathematical literacy through the pre-test and post-test that had been prepared. In addition, interviews and questionnaires were conducted with students and teachers to obtain qualitative data on the effectiveness and experience of using *StoryMath* media based on Articulate Storyline. Quantitative data were analyzed descriptively, while qualitative data were used to enrich understanding of the impact of media implementation on student motivation and learning engagement. This method not only focuses on students' cognitive achievements, but is also oriented towards strengthening teacher capacity in developing creative and contextual technology-based learning media.

RESULTS AND DISCUSSION

The implementation of this program is carried out through three main stages that are systematically and participatively arranged: Planning Stage, Implementation Stage, and Evaluation Stage. Each stage is arranged as an active invitation to all elements of the school to be involved in efforts to improve mathematical literacy based on *StoryMath*. The following is a description of each stage: Planning Stage The planning stage is the main foundation in implementing the interactive *StoryMath* program based on Articulate Storyline. In this stage, various activities are carried out to analyze initial conditions, identify needs, design learning interventions, and prepare relevant devices.

Needs Analysis

The analysis is carried out through classroom observations, interviews with teachers and principals, and distributing questionnaires to students. The following are the results of field research that show the initial conditions of mathematics learning in elementary schools San Carlos Manlewana:

Table 1. Teacher Observations and Interviews

Indicator	Findings	%
Teachers use lecture methods	7 of 9 teachers	80
Teachers use digital media	1 of 9 teachers	10
Teachers prepare contextual questions	1 of 9 teachers	10

Table 2. Student Questionnaire Results (n = 60)

Indicator	Findings	%
Difficulty understanding story problems	18	30
Don't like math	18	30
Consider mathematics boring	18	30

From the results of observations and interviews with teachers at SD San Carlos Manlewana, it can be seen that most teachers still use conventional learning methods, namely the dominance of the lecture method (80%). This shows that learning interactions tend to be one-way and have minimal active involvement of students in the mathematics learning process. As many as 30% of students have difficulty understanding mathematical story problems, which indicates low mathematical literacy skills, especially in connecting the context of the story with the mathematical concepts being studied.

This difficulty is a major challenge that must be overcome so that students can develop problem-solving skills effectively. In addition, only 10% of the Learning Implementation Plans integrate real-life contexts in mathematics learning. This indicates that mathematics learning in the school has not utilized many contextual approaches that can help students relate material to their daily experiences.

Seeing this condition, the proposed follow-up

plan is to provide training to teachers to use interactive learning media based on contextual narratives (*StoryMath*). This training is expected to change learning methods to be more innovative and interesting, so that students can more easily understand mathematical concepts through relevant and interactive contexts. With the implementation of this learning media, it is hoped that students' difficulties in understanding story problems can be reduced and teachers' teaching methods will become more varied and effective, which will ultimately improve overall mathematical literacy.

Documentation Study

A document study was conducted as an initial step in identifying the initial conditions of students' mathematical literacy and the school's readiness to adopt interactive digital learning media based on *StoryMath*. The documents analyzed included the learning syllabus, lesson implementation plan, daily assessment results, and student learning outcome reports from the previous semester. From the analysis of the mathematics learning implementation plan for grades IV and V, it was found that most of the learning was still oriented towards memorization and practice questions.

Contextual elements in mathematics learning have not yet appeared dominant, and there has been no systematic integration of the use of digital media. This shows that the learning approach has not fully led to the development of mathematical literacy as required in the Merdeka Curriculum. The results of the documentation of students' daily test scores also show a gap in conceptual understanding. As many as 58% of students scored below the Minimum Completion Criteria in mathematics. This indicates the need for intervention through more innovative and enjoyable learning methods and media.

Table 3. Recapitulation of Daily Mathematics Test Scores for Grade 3 Students

Value Range	Number of Students	%	Category
85 – 100	4	7	Very good
70 – 84	12	20	Good
55 – 69	20	33	Enough
< 55	24	40	Not enough
Total	**60**	**100**	

Based on Table 3, it is obtained that most students are in the "Enough" and "Less" categories, namely 44 students (73%) who scored above 70.

This shows that the majority of students still do not understand the material taught well through conventional media requiring special attention and the possibility of a more individual learning approach. As many as 12 students (20%) are in the "good" category, which indicates that they have understood some of the material although they still need further guidance.

While 4 students (7%) are in the "Very Good" category, which means they do not need special attention and the possibility of a more individual learning approach. This distribution of values reflects the achievement of mathematics learning outcomes through conventional media indicating that the media is not yet effective in supporting students' understanding of mathematical concepts. Therefore, there needs to be innovation in learning media to improve students' mathematics learning outcomes.

Preparation of Media and Learning

Tools In the planning stage, the preparation of media and learning tools becomes the main foundation before implementation in the classroom. This process not only includes the creation of teaching content, but also ensures that each element that is prepared is relevant, contextual, and able to encourage increased mathematical literacy of elementary school students. There are several stages in the Preparation of Media and Learning Tools including; Learning Needs Analysis, Interactive Storyboard Design, Interactive Digital Media Development, Preparation of Learning Tools, Preparation of Learning Tools, and Initial Validation and Trial. The initial step is to conduct a learning needs analysis that includes: (1) Characteristics of San Carlos Manlewana Elementary School students, including initial abilities, learning interests, learning barriers, and socio-cultural backgrounds; (2) Curriculum analysis, especially Basic Competencies (KD) and Learning Objectives in the targeted Mathematics class; (3) Identification of learning gaps, including weak understanding of story problems, lack of application of problem-solving strategies, and low mathematical communication skills; (4) The results of this analysis serve as a reference in determining mathematical topics that need to be developed in the form of *StoryMath* media based on Articulate Storyline.

A storyboard is an initial design in the form of a story sketch and a learning activity flow that is integrated with mathematical concepts. At this stage, the following are carried out: (1) Determining a contextual story theme that is close

to students' lives, for example a traditional market theme, playing in the park, cooking activities, or going on vacation to the village; (2) Integrating mathematical material into the story, such as arithmetic operations in shopping transactions, measurements in gardening activities, or fractions in food recipes; (3) Writing the narrative flow, dialogue between characters, and visual illustrations that will be used in digital media; (4) This storyboard is developed collaboratively between the implementing team (media developers), teachers, and mathematical literacy facilitators in order to have continuity between the story and teaching content.

After the storyboard is complete, the next step is to transform it into digital media using Articulate Storyline. This process involves: (1) Creating interactive scenes based on each part of the story; (2) Integration of multimedia elements: audio narration, motion animation, visual illustrations, and interactive practice questions; (3) Insertion of reflective quizzes and mathematical challenges at the end of each scene, to encourage students to think and apply the concepts learned; (4) Addition of automatic feedback that encourages independent learning and deep understanding; (5) Digital media is tested in beta before being used in class to ensure technical stability and pedagogical feasibility. To support the effectiveness of media use, various teaching tools are also prepared, namely:

Lesson Implementation Plan: (1) Prepared with a contextual teaching and learning approach and oriented towards mathematical literacy. The learning implementation plan contains learning steps that encourage exploration, group discussion, and contextual problem solving through *StoryMath* media based on Articulate Storyline; (2) Student Worksheets, Designed to encourage students to reflect on the story and complete context-based challenges. Student Worksheets also includes creative activities such as redrawing the story, creating their own version of the story with math problems, and group work, and; (3) Assessment Instruments, Cognitive assessment (quizzes, conceptual understanding), Affective assessment (attitudes, interests, motivation), Psychomotor assessment (concrete activities in solving problems with aids), and Rubrics are prepared so that teachers can assess the process and results of student learning authentically.

Before full implementation, all media and learning devices: (1) Validated by experts, both in terms of content (mathematics), instructional design, and digital learning technology; (2) Limited

trials are carried out in one class as a pilot project. During the trial, student engagement, media effectiveness, and teacher responses in using the media were observed, and; (3) The results of the trial were used to make improvements, both in the storyline, the appropriateness of the questions, and technical aspects such as display time, click response, and narrative accuracy.

By compiling media and learning tools comprehensively at this planning stage, the PkM activity ensures that the *StoryMath* approach based on Articulate Storyline that is applied is truly contextual, in accordance with the needs of students and teachers, and is suitable for use as an innovative learning medium at SD San Carlos Manlewana.

Implementation Stage

The implementation stage is not only a moment of implementation, but also a stage of strengthening teacher capacity, validating materials, and initial evaluation of the effectiveness of *StoryMath* media based on Articulate Storyline. This series of activities lasts for 5 days with the following details:

(1) Teacher Training Activities

Teacher training is intensive with a hands-on training approach that allows teachers to directly try out the Articulate Storyline features. The following are the details of the training activities:

Table 4. Teacher Training Activities

Day	Main	Method	Material Output
1	Prepare	Preparing research materials	Teaching materials, lesson plans, related infrastructure
2	Mathematical Literacy Concept and Introduction to *StoryMath*	Presentation and Discussion	Basic understanding of *StoryMath*
3	Introduction to Articulate Storyline	Demonstration and Practice	The teacher makes a simple scene
4	Storyboard & Media Creation	Small Group	*StoryMath* low grade media draft
5	Integration into Learning Implementation Plans	Discussion and Reflection	Digital media based Learning Implementation Plans completed

The training provided to teachers was able to equip them with skills and confidence in using interactive digital media. The preparation of collaborative and contextual learning devices further strengthens teachers' readiness in implementing meaningful learning.

Figure 1. Teachers and Mentors After Training

(2) Implementation of Learning in Class

Media implementation was carried out systematically in five classes (grades III, IV, and V) with 20 students per class. Teachers used *StoryMath* media based on Articulate Storyline in 4 hours 1 x meeting. Each session includes; Interactive story media screening, Group discussion based on math problems in the story, Reflection session through students worksheet and digital quizzes, and Formative assessment with rubrics.
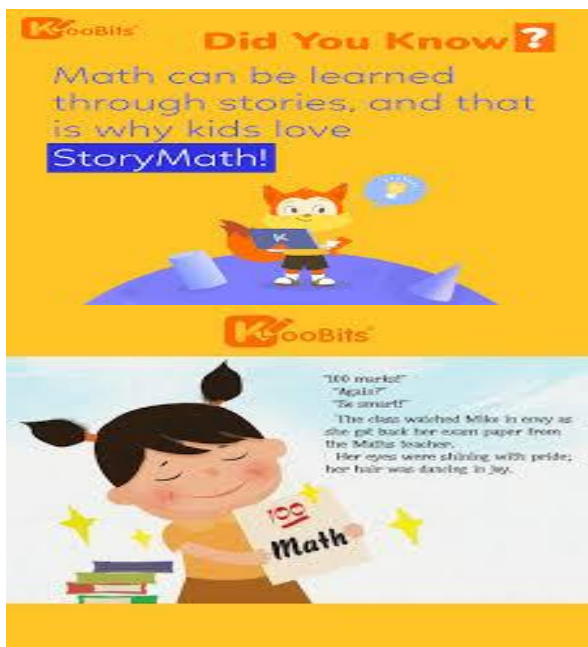

Figure 2. *StoryMath* media based on Articulate Storyline

(3) Analysis of Student Participation and Response

Student participation was observed using an observation sheet, with indicators such as enthusiasm, collaboration, and task completion in table 5. More than 30% of students showed high enthusiasm in *StoryMath* media-based learning based on Articulate Storyline.

Table 5. Level of Student Participation in *StoryMath* Learning

Class	Enthusiasm High (%)	Active Collaboration (%)	Completed (%)	Information
IV	30	30	30	Active
VA	40	40	40	Very Active
VB	30	30	30	Active

Figure 3. Student Responses After Implementing *StoryMath* Media Based on Articulate Storyline

Positive responses were also seen from student comments, such as:

"I like math because I can watch stories while learning!"
"The questions are easy to understand because they are like real events."

(4) Improvement in Learning Outcomes (Pre-test vs Post-test)

The improvement in student learning outcomes through the *StoryMath* media approach based on Articulate Storyline can be seen from the pretest and posttest in table 6.

Table 6. Improvement in Learning Outcomes (Pre-test vs Post-test)

Class	Mark Pre-test	Mark Post-test	Ascension (%)
IV	59	81	31
VA	58	86	47
VB	57	84	32

The results of the implementation in the classroom showed that students were more interested, active, and able to understand mathematical concepts better, with an increase of 47%. The increase in scores from pre-test to post-test strengthens the finding that the use of *StoryMath* is able to improve students' mathematical literacy.

Figure 4. Student Enthusiasm During the Learning Process

Student enthusiasm during the learning process also indicates that the story-based approach is able to change the perception of mathematics to be more positive and enjoyable.

(5) Obstacles and Solutions During

Implementation During the implementation stage of the activity, there were several obstacles faced by both teachers and students. These obstacles were successfully identified and overcome through a collaborative and adaptive approach, as follows: (a) Limited Mastery of Technology by Teachers, Several teachers had difficulty in operating Articulate Storyline independently, especially in the process of creating and editing media. This obstacle was overcome by providing additional technical assistance sessions outside of the main training, as well as compiling usage guides in the form of video tutorials and easy-to-understand printed modules; (b) Limited Technology Facilities in Schools, ICT facilities in several classrooms were inadequate, such as the limited number of computers or LCD projectors. To overcome this, the implementation team coordinated with the school to arrange a schedule for the use of the multimedia room alternately and maximize teachers' personal devices; (c) Variation in Student Abilities in Following Interactive Media, Not all students have the ability to read and understand story narratives at the same speed. For this reason, teachers are directed to provide additional explanations verbally, and to compile differentiated students worksheet in order to accommodate differences in student learning abilities; (d) Technical Constraints during Media Display, Several constraints such as power outages or internet connections occurred during implementation in class. The solution, *StoryMath* media is also prepared in offline format (HTML offline package) which can be run without an internet network, and teachers are advised to bring backup devices such as laptops and portable speakers; (e) Adjustment to Curriculum and Learning Schedule, Due to the tight lesson schedule, teachers had difficulty integrating *StoryMath* media without reducing time for other materials. The solution implemented was to align the topics in the media with the current curriculum material and insert the use of media during reinforcement activities or project-based learning.

With early identification and handling of obstacles, the implementation process of *StoryMath* media continues to run smoothly and has a positive impact on improving students' mathematical literacy. In addition, these obstacles are important lessons in developing similar programs in the future.

(6) Implementation Reflection

The implementation shows that the integration of narrative-based media such as interactive *StoryMath* based on Articulate Storyline; Increases students' interest and motivation in mathematics., Makes learning more contextual and meaningful, and Makes it easier for teachers to explain abstract material through visualization. Overall, the implementation of interactive *StoryMath* media based on Articulate Storyline has succeeded in increasing student enthusiasm and involvement in the mathematics learning process. Teachers have also proven to be able to integrate this media into teaching and learning activities effectively. This activity is a real example that a creative digital-based approach can bridge the gap in mathematical literacy at the elementary school level.

(7) Evaluation Stage

The evaluation of the interactive *StoryMath* program based on Articulate Storyline not only covers cognitive aspects in the form of improving learning outcomes, but also affective aspects such as students' interest and motivation in learning mathematics. In addition, teacher and student responses to the media used are also important indicators in assessing the effectiveness of the implementation of this media.

Based on quantitative data analysis, the increase in value from an average of 58 (pre-test) to 83 (post-test) reflects a significant increase in students' mastery of mathematical concepts. This result is supported by statistical tests that show a significant difference ($p < 0.05$). Visually, this increase is depicted in Figure 5.
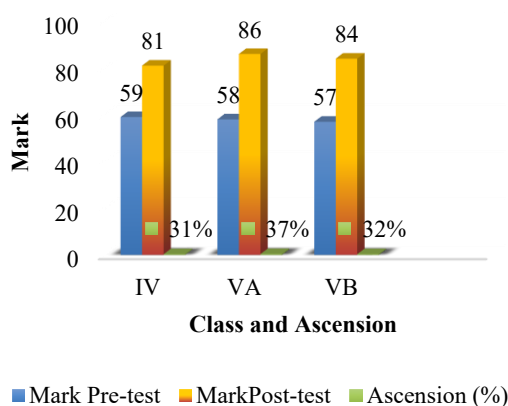

Figure 5. Improvement of Learning Outcomes (Pre-test and Post-test

On the other hand, qualitative data obtained from questionnaires and interviews showed that 80% of students stated that they felt happier learning mathematics with a story approach, and found it easier to understand story problems. Teachers also said that the use of this media made students more active in asking questions and discussing, especially when they were involved in contextual stories.

This finding strengthens the results of previous research by Nasution (2024) which stated that the use of interactive story-based learning media can increase students' emotional involvement, thereby contributing to increased absorption of the material. Research by Dai et al. (2020) also concluded that digital media that presents mathematics learning in the form of contextual narratives significantly improves students' problem-solving abilities. The following is a summary of student responses to the *StoryMath* media in table 7.

Table 7. Student Response Recapitulation to Interactive *StoryMath* Media Based on Articulate Storyline

Assessment Aspects	Strongly agree (%)	Agree (%)	Not Agree (%)	Total (%)
Media makes learning fun	63	30	7	100
Stories help understand concepts	60	32	8	100
More enthusiasm when learning mathematics	67	25	8	100

In addition to improving learning outcomes, the success of this program is also reflected in the creation of a collaborative and communicative learning environment. Teachers stated that students who were usually passive became more courageous in expressing their opinions because they felt "in" the story conveyed through the media. In terms of sustainability, the reflections of teachers and the implementation team agreed that this media has the potential to be applied to other mathematics topics at the elementary school level. In fact, several teachers expressed their desire to be trained to create similar media so that they would be more independent in developing story-based digital learning. Referring to the findings of Ediyani et al (2022), the success of a learning media is largely determined by the extent to which the media is able to build meaningful and relevant learning experiences.

Therefore, *StoryMath* can be said to be not only academically effective, but also pedagogically and emotionally relevant for elementary school students. Thus, the evaluation stages in this study show that the use of *StoryMath* media based on Articulate Storyline is effective in improving students' mathematical literacy as a whole, both in terms of cognitive, affective, and participatory.

CONCLUSION

Based on the results of the analysis and evaluation of the implementation of interactive *StoryMath* media based on Articulate Storyline in mathematics learning at SD San Carlos Manlewana, it can be concluded that this approach has proven effective in improving students' mathematical literacy. This can be seen from the significant increase in student learning outcomes and positive responses to more interesting and

contextual learning experiences. *StoryMath* media not only helps students understand abstract concepts more concretely, but also fosters motivation, involvement, and positive attitudes towards mathematics. Teachers also feel the benefits of using this media in delivering complex material in a more visual and interactive way.

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