

Research Article

Cite this article: Amidi, A., Kartono, K., Mulyono, M., & Pudjiastuti, E. (2025). The Effectiveness of Contextual Teaching and Learning with Articulate Storyline in Improving Mathematical Literacy: A Perspective of High Self-Confidence Students. *Educational Process: International Journal*, 16, e2025233. <https://doi.org/10.22521/edupij.2025.16.233>

Received March 27, 2025

Accepted May 1, 2025

Published Online May 29, 2025

Keywords: Mathematical Literacy, Self-Confidence, Contextual Teaching and Learning, Articulate Storyline

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The Effectiveness of Contextual Teaching and Learning with Articulate Storyline in Improving Mathematical Literacy: A Perspective of High Self-Confidence Students

Amidi , Kartono , Mulyono , Emi Pudjiastuti

Abstract

Background/purpose. Mathematical literacy is an important ability that students must acquire, but several studies indicate that Indonesian students' mathematical literacy remains low. Therefore, this study aims to (1) test the effectiveness of CTL assisted by Articulate Storyline in improving students' mathematical literacy and (2) analyze the mathematical literacy of high self-confidence students in CTL assisted by Articulate Storyline.

Materials/methods. This study used a mixed method with a sequential explanatory design. The sample consisted of 64 eighth-grade students selected through multistage random sampling. The subjects were two students with high self-confidence in the experimental class. The instruments included tests, questionnaires, and interview guidelines. Data were analyzed using quantitative (t-test, z-test, and N-gain test) and qualitative (data reduction, data display, and conclusion drawing) methods.

Results. The results showed that the students' mathematical literacy in the experimental class improved individually. Moreover, the mathematical literacy of the experimental class was better than that of the control class in terms of average scores, completion rates, and overall improvement. Students with high self-confidence met all indicators of mathematical literacy during tests and interviews.

Conclusion. The study concludes that (1) CTL assisted by Articulate Storyline effectively improves mathematical literacy, and (2) students with high self-confidence generally have excellent mathematical literacy.

This study offers original insights by integrating the CTL model with Articulate Storyline media to enhance mathematical literacy among highly self-confident students. Previous research has not widely explored this learning innovation.

1. Introduction

Mathematical literacy is an essential ability that students must possess to face the challenges of the 21st century (Murtiyasa & Perwita, 2020). This ability reflects how students can apply mathematical concepts, procedures, and reasoning in various real-life situations (Maslihah et al., 2021). However, various studies and international evaluation results, such as the Programme for International Student Assessment (PISA), indicate that the mathematical literacy of students in Indonesia remains at a low level (Annisavitri et al., 2020; Fitrianawati et al., 2020; Rusdi et al., 2020; Susanta et al., 2022).

As shown in Table 1, Indonesian students' PISA results from their first participation in PISA in 2000 to 2022 are still far below the international average score. The study's results show that Indonesian students must improve their understanding and application of mathematical concepts.

Table 1. Indonesian PISA Scores

Year	Indonesian		Number of Participant Countries	International Average Score
	Score	Rank		
2000	367	39	41	500
2003	360	38	40	500
2006	391	50	57	498
2009	371	61	65	496
2012	375	64	65	494
2015	386	65	70	490
2018	379	73	79	489
2022	359	68	80	472

The problem of low mathematical literacy also occurs at the junior high school level, as seen in one of the junior high schools in Semarang City, Indonesia. Based on the results of a preliminary study conducted through interviews with mathematics teachers at the school, it was found that although students already have mathematical literacy, their level of mastery is still low, which is less than 50% of the total indicators of mathematical literacy. Many students struggle to transform problems into mathematical models, develop problem-solving strategies, and draw appropriate mathematical conclusions.

When given mathematical literacy questions in algebra, most students can only write down the information they know from the questions. However, they cannot systematically design the right strategy or solve the problem. Their answers show that they still depend on explanations and directions from teachers and are not yet familiar with mathematical literacy-based questions. One contributing factor is that the learning model teachers use is still dominated by conventional methods, as well as the lack of interactive learning media that supports student exploration.

One internal factor that influences students' low mathematical literacy is self-confidence (Pratama, 2020). Students with high self-confidence tend to be more confident in solving mathematical problems, are more willing to explore different problem-solving strategies, and do not give up easily when facing challenges. Conversely, students with low self-confidence tend to avoid mathematics lessons, feel incapable, and are less engaged in the learning process (Widjajanti & Dewi, 2022).

Besides internal factors, the teachers' learning model is important in improving mathematical literacy. One learning model that can be applied is Contextual Teaching and Learning (CTL) (F. P. Lestari et al., 2021; Maryani & Widjajanti, 2020). CTL requires teachers to present real-life situations in class so that students can connect their knowledge and apply it contextually (Davtyan, 2014; Yudha et al., 2019). Making connections between real life and mathematics is very important to emphasize in learning as it allows students to understand the values in everyday life (Coskun et al., 2020; Milton et al., 2017). Meanwhile, contextual learning involves students actively seeking knowledge based on their experiences. Therefore, the learning process becomes more meaningful (Selvianiresa & Prabawanto, 2017; Toheri et al., 2020).

To enhance the effectiveness of the CTL model, the use of interactive media is essential (Hadza et al., 2020). One of the media that can be used is Articulate Storyline, a software that enables teachers to deliver learning materials more engagingly and interactively (Ratnaningsih et al., 2024). This media can integrate text, images, animations, and simulations, thereby encouraging students to actively explore mathematical concepts (Nissa et al., 2021). The implementation of Articulate Storyline in learning can help students understand concepts, boost self-confidence, and assist them in solving mathematical literacy-based problems independently.

Given the reasons outlined above, this study addresses the issue of students' low levels of mathematical literacy as indicated by international assessments, such as PISA, and field findings from one of the junior high schools in Semarang City, Indonesia. Previous studies have shown that mathematical literacy is often not optimal because conventional methods and minimal use of interactive media still dominate learning. Moreover, students frequently struggle to solve mathematical literacy-based problems, particularly in transforming contextual problems into mathematical models and drawing mathematical conclusions. Internal factors, such as low self-confidence and the suboptimal use of instructional models, also contribute to the low level of mathematical literacy. Therefore, a contextual learning model supported by interactive media, specifically Contextual Teaching and Learning (CTL) assisted by Articulate Storyline, is needed to improve students' mathematical literacy, especially for those with high self-confidence. Based on this background, the research questions addressed in this study are as follows:

RQ 1: How effective is the CTL model assisted by Articulate Storyline in improving students' mathematical literacy?

RQ 2: How is the description of the mathematical literacy of students with high self-confidence in the CTL model supported by Articulate Storyline?

2. Literature Review

2.1. Relationship Between Mathematical Literacy and Self-confidence

Mathematical literacy refers to students' ability to formulate, apply, and interpret mathematical concepts in various situations (Annisavitri et al., 2020; Thomson et al., 2013). Students' self-confidence plays an important role in improving mathematical literacy. Students with high levels of self-confidence tend to perform better in solving math problems because they are more composed, assured, and capable of communicating effectively during the learning process (D. E. Lestari et al., 2025).

A study by Widjajanti and Dewi (2022) found that students with high self-confidence achieved higher mathematical literacy scores than those with low self-confidence. Confident students are generally more capable of meeting various mathematical literacy indicators, including communication, mathematizing, representation, reasoning, argumentation, devising strategies for solving problems, and the use of symbols and formalism (Husna et al., 2020).

2.2. Contextual Teaching and Learning (CTL) in Improving Mathematical Literacy

The CTL model has been proven to enhance students' mathematical literacy. Research conducted by Wahyuni et al. (2021) demonstrated that the application of CTL had a significant impact on improving mathematical literacy among students learning about relations and functions at MTsN 2 Sambas. The findings indicated a notable difference in the improvement of mathematical literacy between students taught using the CTL model and those who received instruction through a direct learning approach on the same material.

Fatkurochman et al. (2024) also found that the CTL model can enhance students' mathematical literacy at MTsN 4 Ponorogo. CTL is a learning model that helps students connect the material they learn with real-world contexts and encourages them to relate their existing knowledge to its application in everyday life (Afni & Hartono, 2020). This approach aligns with mathematical literacy goals, which involve applying mathematical concepts to solve problems in everyday activities. Through the CTL approach, students become more actively engaged in making connections between mathematical concepts and daily experiences. As a result, the learning process becomes more meaningful and easier to comprehend (Nazmihaolah et al., 2025).

The following table presents a comparison between the Contextual Teaching and Learning (CTL) model and the traditional instructional model based on several key aspects to highlight the advantages of the CTL model. This comparison underscores the strengths of the CTL model in fostering mathematical literacy, in contrast to the traditional model, which tends to be teacher-centered.

Table 2. Comparison Between the CTL Model and the Traditional Model

Aspect	CTL (Contextual Teaching and Learning)	Traditional
Learning Focus	Students actively construct knowledge from real-life contexts	The teacher as the center of information
Role of the teacher	Facilitator, mentor	Knowledge transmitter
Student Engagement	Active, collaborative, contextual	Passive, listening to teacher explanations
Learning Resources	Surrounding environment, real-life experiences	Students' textbooks, teacher lectures
Learning Objectives	Meaningful understanding and application	Concept mastery and memorization
Methods	Discussion, projects, exploration, reflection	Lectures, practice exercises

2.3. Constructivist Learning Theory

The constructivist learning theory proposed by Lev Vygotsky (1896-1934) emphasizes the significant role of social interaction in students' cognitive development (Remorosa et al., 2024). In constructivism theory, two important terms are the Zone of Proximal Development (ZPD) and scaffolding. ZPD refers to the range between what a person can do independently and what can be achieved with assistance, highlighting that the most effective learning occurs through support and social interaction. In the ZPD, students can attain a more complex understanding with guidance from

teachers or peers in the learning process (Shabani et al., 2010). Scaffolding can be interpreted as temporary support provided by teachers to help students grasp new concepts or solve problems that they are unable to handle by themselves. Once students are capable of working independently, this support will be gradually withdrawn (Northern Illinois University Center for Innovative Learning, 2012).

Scaffolding is one of the main principles in technology-assisted learning, enabling students to build understanding and solve complex problems gradually (Mikić et al., 2022). Technology in education, often in the form of interactive media, provides adaptive support such as instructions, feedback, and visualizations, allowing students to learn independently with appropriate guidance (Kruger, 2020). This technology-based approach makes learning more personalized and effective, supporting students' active involvement in constructing their own knowledge.

2.4. Articulate Storyline as Interactive Learning Media

Interactive media used in learning can enhance students' mathematical literacy. Articulate Storyline is one such tool that integrates animation, video, text, audio, and images to create a more engaging learning experience (Hidayati Rofiah et al., 2024).

Studies by Sindu et al. (2020) and Wijayanti et al. (2022) have demonstrated that the use of Articulate Storyline in mathematics learning increases students' confidence in solving problems. Similar findings were also reported by Ariffah and Rusnilawati (2023), who stated that students felt more confident when learning with interactive media compared to regular textbooks. The integration of CTL and Articulate Storyline fosters a more effective learning environment in which students gain a deeper understanding of mathematical concepts and feel more confident in applying these concepts in various contexts.

A theoretical model is presented to clarify the relationship between the theories underlying this research. This model illustrates the relationship among the constructivist approach, self-confidence, and mathematical literacy.

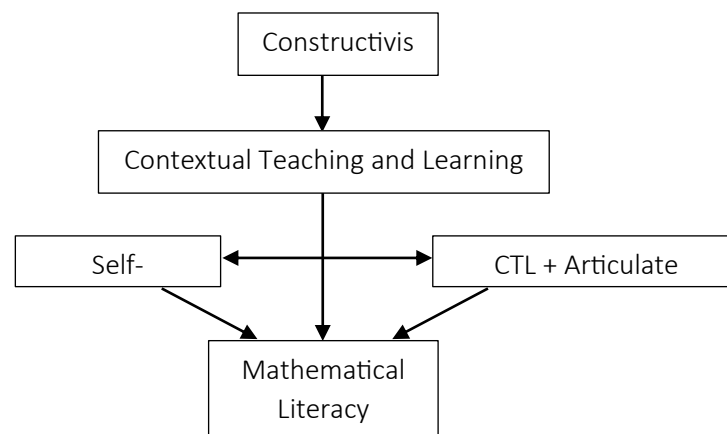


Figure 1. Theory Model Schema

The theoretical model in Figure 1 illustrates that the constructivist approach, implemented through Contextual Teaching and Learning (CTL) and supported by interactive media such as Articulate Storyline, provides an active, meaningful, and contextual learning experience. This learning environment can enhance students' self-confidence by offering opportunities to explore, experiment, and construct their own understanding. High self-confidence acts as an internal factor that encourages active participation in the learning process and strengthens students' belief in their ability to solve mathematical problems, thereby directly contributing to the development of mathematical literacy.

3. Methodology

3.1. Research Design

This study employed a mixed-methods research approach with a sequential explanatory design because it aims to achieve two main objectives. First, to quantitatively examine the effectiveness of the CTL model assisted by Articulate Storyline. Second, to qualitatively explore the mathematical literacy of students with high self-confidence. This approach was chosen to ensure that the study not only provides statistical evidence of the effectiveness of the learning model but also offers a deeper understanding of students' experiences and thought processes. The quantitative component used a true experimental design with a pretest-posttest control group. In this design, two groups were formed: the experimental group, which received instruction using the CTL model supported by Articulate Storyline (X), and the control group, which was taught using the Problem-Based Learning (PBL) model (Y). The pretest-posttest control group used in this study follows Sugiyono (2019) and is presented in Table 3.

Table 3. Pretest-Posttest Control Group Design

Group	Pretest	Treatment	Posttest
Experimental	O_1	X	O_2
Control	O_3	Y	O_4

Where:

X : Treatment in the form of a CTL model assisted by Articulate Storyline

Y : Treatment in the form of a PBL model

O_1 : Pretest scores of the experimental group

O_2 : Posttest scores of the experimental group

O_3 : Pretest scores of the control group

O_4 : Posttest scores of the control group

Meanwhile, the qualitative methods aim to describe students' mathematical literacy with high self-confidence in the CTL model assisted by Articulate Storyline.

3.2. Samples

The sample was drawn from the population of all 8th-grade students at a junior high school in Semarang, comprising 272 students. The sample was selected using a multistage random sampling technique, which is straightforward and involves several stages. This process resulted in the selection of two 8th-grade classes: Class VIII D and Class VIII C, each containing 34 students. Class VIII D served as the experimental group, while Class VIII C was the control group. Additionally, two students with high self-confidence in the experimental class were selected using the purposive sampling technique based on the results of the self-confidence questionnaire.

3.3. Data Collection

3.3.1. Test

The test technique was used to collect data on students' mathematical literacy levels in both the experimental and control groups before and after receiving their respective treatments. The experimental group received the CTL model treatment supported by Articulate Storyline, while the control group received the PBL model treatment. The test administered was a written exam consisting of three essay questions, which were designed based on the mathematical literacy

indicators in this study: (1) communication, (2) mathematizing, (3) using mathematical tools, and (4) interpretation and evaluation. These questions underwent validity tests, reliability tests, discriminatory power analysis, and difficulty level analysis.

The question items are considered valid if $r_{xy} > r_{table}$. The validity scores are obtained in Table 4 below based on the calculation.

Table 4. Validity Scores of Questions

Number of Question	Validity Score (r_{xy})	Value of r_{table}	Category of Validity
1	0,819	0,349	Very High
2	0,848		
3	0,838		

The question items are considered reliable if $r_{11} > r_{table}$. Based on the calculation, the value of $r_{11}=1,164$, where $r_{table}=0,349$. Therefore, it can be concluded that all questions were highly reliable.

The discriminatory power scores and difficulty level of the questions are shown in Table 5.

Table 5. Discriminatory Power and Difficulty Level of Questions

Number of Questions	Discriminatory Power Score	Category of Discriminatory Power	Difficulty Level Score	Category of Difficulty Level
1	0,467	Good	0,622	Medium
2	0,422		0,706	
3	0,411		0,691	

Based on the validity, reliability, discriminatory power, and difficulty level scores, it can be concluded that the three questions are suitable for measuring students' mathematical literacy.

3.3.2. Questionnaire

The questionnaire was used to collect data on the self-confidence levels of students in the experimental class. It was developed based on the self-confidence indicators in this study, namely: (1) believing in one's abilities, not feeling anxious, feeling free and being responsible for one's actions; (2) being able to make decisions independently; (3) displaying a positive, warm, and polite attitude, while being able to appreciate and accept others' opinions during interaction; (4) having the motivation to improve achievement and the courage to express arguments and opinions; and (5) understanding one's strengths and weaknesses to foster better self-awareness. The questionnaire also underwent a validation test and was compiled using a Likert scale.

3.3.3. Interview

The interview technique was employed to gain deeper insights into the mathematical literacy of students with high self-confidence in the CTL model supported by Articulate Storyline. A structured interview was utilized, in which the interviewer prepared a set of written questions for the interviewees (Sugiyono, 2018). In this study, the researcher acted as the interviewer, and the two students with high self-confidence served as interviewees.

3.4. Data Analysis

3.4.1. Classical Assumption Test of Initial Data

Before analysis, the data were tested for classical assumptions. The initial data tested were the mathematical literacy pretest scores from the experimental and the control groups. Initial data analysis involved a normality test, a homogeneity test, and a two-sample equality test.

- Normality Test

The initial data's normality test was conducted using the Shapiro-Wilk test with SPSS, and the results are presented in Table 6 below.

Table 6. Normality Test of Initial Data

Test of Normality						
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest_8C	.107	34	.200*	.960	34	.240
Pretest_8D	.150	34	.049	.948	34	.109
*. This is a lower bound of the true significance.						
a. Lilliefors Significance Correction						

Based on the Shapiro-Wilk normality test output, Class VIII C obtained the Sig. = 0.240 > 0.05, and Class VIII D obtained the Sig. = 0.109 > 0.05. Therefore, it can be concluded that H_0 is accepted and H_1 is rejected, indicating that both samples come from normally distributed populations.

- Homogeneity Test

The homogeneity test of the initial data was conducted using the Levene test with the assistance of SPSS, and the results are presented in Table 7 below.

Table 7. Homogeneity Test of Initial Data

Test of Homogeneity of Variances					
		Levene Statistic	df1	df2	Sig.
Hasil_Pretest	Based on Mean	.808	1	66	.372
	Based on Median	.786	1	66	.379
	Based on Median and with adjusted df	.786	1	65.997	.379
	Based on trimmed mean	.782	1	66	.380

Based on the Levene homogeneity test output, the Sig. = 0.372 > 0.5. Therefore, it can be concluded that H_0 is accepted and H_1 is rejected, indicating that both samples come from homogeneous populations.

- Equality of Two Means Test

The equality of two means test of initial data was conducted using the independent samples t-test with the assistance of SPSS, and the results are presented in Table 8 below.

Table 8. Equality of Two Means Test of Initial Data

Independent Samples Test						
		Levene's Test for Equality of Variances		t	df	Sig. (2-tailed)
		F	Sig.			
Hasil_Pretest	Equal variances assumed	.808	.372	.252	66	.801
	Equal variances not assumed			.252	64.666	.801

Based on the independent samples t-test output, it obtained the Sig. (2-tailed) = 0.372 > 0.5. Therefore, it can be concluded that H_0 is accepted and H_1 is rejected, indicating that both samples have the same initial mean.

3.4.2. Quantitative and Qualitative Data Analysis

The data from the mathematical literacy pretest and posttest were analyzed quantitatively and qualitatively. The quantitative analysis included the mean completeness test, classical completeness test, two-mean difference test, proportion difference test, right-tailed mean equality test, and N-gain test. The qualitative analysis followed three stages as stated by Sukestiyarno (2021): data reduction, data display, and conclusion drawing. Data reduction was done by simplifying, classifying, and removing unnecessary data. Data display was conducted through descriptions, narratives, tables, pictures, charts, and other representations based on the results of research that had been carried out to address existing problems. Conclusions were drawn by formulating answers to research questions based on the results of the analysis.

During the data reduction process, the researcher manually coded the interview transcripts using an open coding approach to identify meaning units from the transcripts and the subjects' test results. The initial codes found were then grouped through axial coding into several main categories representing mathematical literacy and self-confidence indicators. This process helped the researcher construct in-depth central themes related to the subjects' mathematical literacy skills.

3.4.3. Data Validity Techniques

In this study, triangulation was conducted to ensure the accuracy of the research findings. This technique was carried out by comparing the results of the mathematical literacy test and the self-confidence questionnaire in the experimental class with the interview results from the six research subjects. The findings from the tests were confirmed through interviews to assess the consistency of students' mathematical literacy skills. Additionally, the questionnaire results were used to evaluate whether students' self-confidence aligned with their responses to questions and explanations during the interviews. The results from each instrument were used to complement and verify each other to obtain a more comprehensive picture of the mathematical literacy skills of students with high self-confidence.

Furthermore, to reduce researcher bias, member checking was conducted by confirming the interpretation of the interview results with the subjects to ensure that the intended meanings were accurately captured. The researcher also engaged in peer debriefing, discussing the coding process and findings with colleagues to enhance the objectivity and trustworthiness of the analysis.

4. Results

4.1. How Effective is the CTL Model Assisted by Articulate Storyline is in Improving Students' Mathematical Literacy

- Results of the Mean Completeness Test:

The mean completion test of students' mathematical literacy posttest results was conducted using the t-statistic test, with the results presented in Table 9 below.

Table 9. Results of the Mathematical Literacy Mean Completeness Test

Statistic	Calculation
n	34
t_{count}	15,146
t_{table}	1,692

Based on the mean completeness test, it was found that $t_{count} \geq t_{table}$. Therefore, it can be concluded that H_0 is rejected and H_1 is accepted, indicating that the average posttest score for mathematical literacy is more than BTA (actual completion limit) or meets KKM (minimum completion criteria).

- Results of the Classical Completeness Test:

The classical completeness test of students' mathematical literacy posttest results was conducted using the z-statistic test, with the results presented in Table 10 below.

Table 10. Results of the Mathematical Literacy Classical Completion Test

Statistic	Calculation
n	34
z_{count}	3,367
z_{table}	1,645

Based on the classical completeness test, it was found that $z_{count} \geq z_{table}$. Therefore, it can be concluded that H_0 is rejected and H_1 is accepted, indicating that more than 75% of the students completed the mathematical literacy posttest successfully, achieving classical completeness.

- Results of the Two-Mean Difference Test:

The two-mean difference test of students' mathematical literacy posttest results was conducted using the t-statistic test, with the results in Table 11 below.

Table 11. Results of the Mathematical Literacy Two-Mean Difference Test

Statistic	Calculation
n_1	34
n_2	34
t_{count}	3,384
t_{table}	1,668

Based on the two-mean difference test, $t_{count} \geq t_{table}$ was found. Therefore, H_0 is rejected, and H_1 is accepted, indicating that the average posttest results of mathematical literacy in the experimental group are higher than those in the control group.

In addition to the independent samples t-test, the effect size was also calculated using Cohen's d formula to determine the magnitude of the impact of CTL learning assisted by Articulate Storyline on students' mathematical literacy. Based on the calculation results, the value of d was 0.821, which falls into the large category. This indicates that the difference in learning outcomes between the experimental and control groups is statistically significant and has a substantial practical impact.

- Results of the Proportion Difference Test:

The proportion difference test of students' mathematical literacy posttest results was conducted using the z-statistic test, with the results presented in Table 12 below.

Table 12. Results of the Mathematical Literacy Proportion Difference Test

Statistic	Calculation
n_1	34
n_2	34
z_{count}	1,774
z_{table}	1,645

Based on the proportion difference test, it was found that $z_{count} \geq z_{table}$. Therefore, it can be concluded that H_0 is rejected and H_1 is accepted, indicating that the proportion of students' mathematical literacy completion in the experimental group is greater than that in the control group. The proportion of completion in both groups is illustrated in Figure 2.

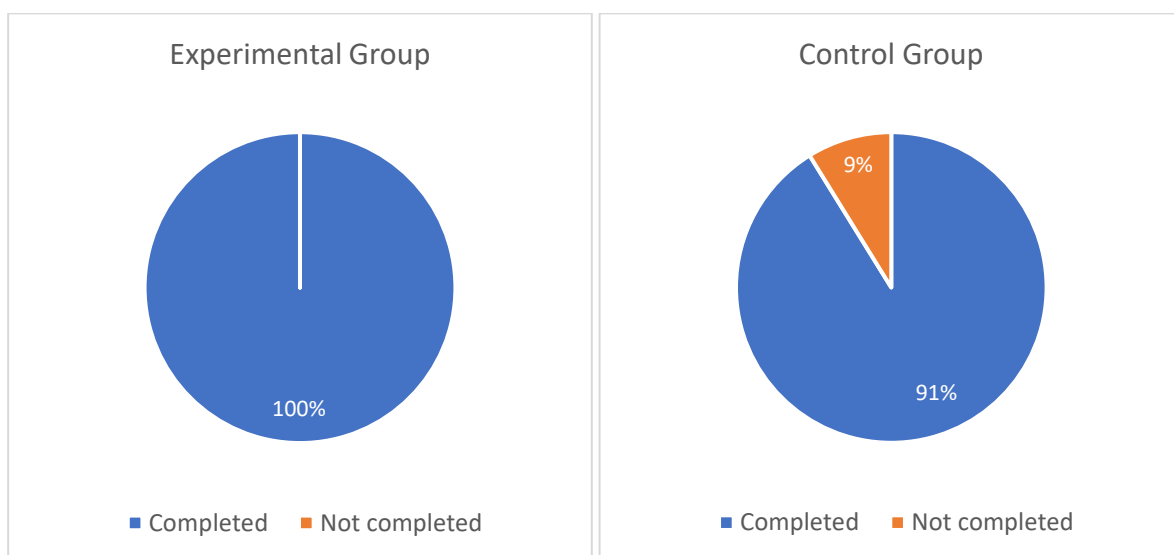


Figure 2. Proportion of Completion

- Results of the Right-Tailed Mean Equality Test and N-Gain Test

The right-tailed mean equality test of students' mathematical literacy was conducted using the t-statistic test, with the results presented in Table 13 below.

Table 13. Results of the Mathematical Literacy Right-Tailed Mean Equality Test

Statistic	Calculation
n_1	34
n_2	34
t_{count}	3,948
t_{table}	1,668

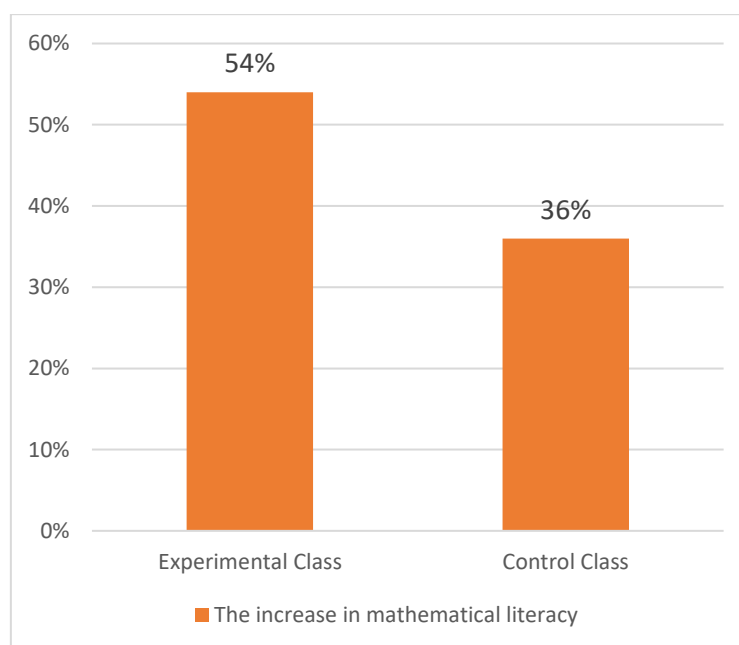
Based on the right-tailed mean equality test, $t_{count} \geq t_{table}$ was found. Therefore, H_0 is rejected, and H_1 is accepted, indicating that the increase in mathematical literacy in the experimental group is greater than that in the control group.

The next step was to conduct an N-gain test on the pretest and posttest results of mathematical literacy from the experimental and control groups. The results of the N-gain test are presented in Table 14 below.

Table 14. Results of the Mathematical Literacy N-Gain Test

Group	Average			Category of Increase
	Pretest	Posttest	N-gain	
Experimental	30,59	67,75	54%	Medium
Control	31,18	56,37	36%	Medium

Based on the N-gain test, it was found that the increase in mathematical literacy in the experimental and control groups falls into the medium category, as illustrated in Figure 3.

**Figure 3.** Increase in Mathematical Literacy

After conducting several statistical tests on students' mathematical literacy, the following conclusions can be drawn: (1) students' mathematical literacy in the CTL class supported by Articulate Storyline meets the minimum completion criteria (KKM); (2) students' mathematical literacy in the CTL class supported by Articulate Storyline achieves classical learning completion, with the proportion of students reaching completion being more than or equal to 75%; (3) the average mathematical

literacy score of students in the CTL class supported by Articulate Storyline is higher than that in the PBL class; (4) the proportion of students achieving mathematical literacy completion in the CTL class supported by Articulate Storyline is greater than that in the PBL class; and (5) the increase in students' mathematical literacy in the CTL class supported by Articulate Storyline is greater than that in the PBL class. Therefore, the CTL model supported by Articulate Storyline is effective in improving students' mathematical literacy.

4.1. The description of mathematical literacy of students with high self-confidence in the CTL model supported by Articulate Storyline

In this study, two research subjects were selected through purposive sampling, specifically two students with high self-confidence, as indicated by their results of the student self-confidence questionnaire. Both subjects had posttest scores for mathematical literacy and self-confidence scores, as shown in Table 15 below.

Table 15. Subjects' Mathematical Literacy and Self-Confidence Scores

Subject Code	Category of Self-confidence	Score of Self-confidence	Score of Mathematical Literacy
S-1	High	79	90,00
S-2	High	76	83,33

The following sections provide an analysis of the test results and interview findings for each subject.

Test Results of Subject S-1

1) Question Number 1:

The results of Subject S-1's mathematical literacy test for question number 1 are presented in Figure 4.

1. Diketahui : Biaya parkir motor = Rp 3.000
 Biaya parkir mobil = Rp 5.000
 Penghasilan = Rp 110.000
 Ditanya : Buatlah 3 kemungkinan jumlah motor & mobil yang parkir pada hari itu!
 Jawab : Jumlah motor = x
 Jumlah mobil = y
 $3000x + 5000y = 110.000$
 Kemungkinan 1
 Motor = 20, Mobil = 10
 $3000(20) + 5000(10) = 110.000$
 $60.000 + 50.000 = 110.000$
 Kemungkinan 2
 Motor = 15, Mobil = 13
 $3000(15) + 5000(13) = 110.000$
 $45.000 + 65.000 = 110.000$
 Kemungkinan 3
 Motor = 25, Mobil = 7
 $3000(25) + 5000(7) = 110.000$
 $75.000 + 35.000 = 110.000$
 Jadi, kemungkinan jumlah Motor dan mobil yang parkir adalah
 1. motor = 20 dan mobil = 10
 2. motor = 15 dan mobil = 13
 3. motor = 25 dan mobil = 7

Translate:
 1. Given: Motorcycle parking fee = IDR 3.000
 Car parking fee = IDR 5.000
 Income = IDR 110.000
 Asked: Make 3 possible number of motorcycles and cars parked on the day!
 Answer: Number of motorcycles = x
 Number of cars = y
 $3000x + 5000y = 110.000$
 • Possibility 1
 Motorcycles = 20, cars = 10
 $3000(20) + 5000(10) = 110.000$
 $60.000 + 50.000 = 110.000$
 • Possibility 2
 Motorcycles = 15, cars = 13
 $3000(15) + 5000(13) = 110.000$
 $45.000 + 65.000 = 110.000$
 • Possibility 3
 Motorcycles = 25, cars = 7
 $3000(25) + 5000(7) = 110.000$
 $75.000 + 35.000 = 110.000$
 Therefore, the possible number of motorcycles and cars parked on the day are:
 1. Motorcycles = 20 and cars = 10
 2. Motorcycles = 15 and cars = 13
 3. Motorcycles = 25 and cars = 7

Figure 4. Answer of Subject S-1 to Question Number 1

Based on the results, Subject S-1 met indicators 1 and 2 by correctly identifying the known and requested information and creating appropriate mathematical examples and models of the presented problems. Subject S-1 also fulfilled indicator 3 by effectively using mathematical techniques to support the problem-solving process. Furthermore, Subject S-1 met indicator 4 by drawing mathematical conclusions to interpret the resolution process.

2) Question Number 2:

The results of Subject S-1's mathematical literacy test for question number 2 are presented in Figure 5.

2. Diketahui: 1. Sebuah buku gambar dan 6 Spidol = 20.000 - 2.000 = Rp 18.000 * Harga Sebuah buku gambar = 3x harga Spidol Ditanya = Hitunglah harga sebuah buku gambar dan sebuah Spidol Jawab = harga buku gambar = x, harga Spidol = y SPLDV = $x + 6y = 18.000$ dan $x = 3y$ $x + 6y = 18.000$ $3y + 6y = 18.000$ $9y = 18.000$ $y = \frac{18.000}{9} = 2.000$ (Spidol) $x = 3y$ $x = 3(2.000)$ $x = 6.000$ (buku gambar) Jadi, harga sebuah buku gambar adalah Rp 6.000 dan harga sebuah Spidol adalah Rp 2.000.	Translate: 2. Given: A drawing book and 6 markers = 20.000 - 2.000 = IDR 18.000 The price of a drawing book = 3 times of the price of a marker Asked: Calculate the price of a drawing book and a marker. Answer: The price of drawing book = x The price of marker = y SPLDV = $x + 6y = 18.000$ dan $x = 3y$ $x + 6y = 18.000$ $3y + 6y = 18.000$ $9y = 18.000$ $y = \frac{18.000}{9} = 2.000$ (marker) $x = 3y$ $x = 3(2.000)$ $x = 6.000$ (drawing book) Therefore, the price of a drawing book is IDR 6.000 And the price of a marker is IDR 2.000.
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Figure 5. Answer of Subject S-1 to Question Number 2

Based on the results, Subject S-1 met indicators 1 and 2 by identifying the known and requested information and creating accurate analogies from the presented problems. However, there was a slight inaccuracy in constructing the SPLDV model. The model created was $x + 6x = 18000$, whereas based on the assumptions made, the correct model should be $x + 6y = 18000$. Subject S-1 fulfilled indicator 3 by correctly using mathematical techniques to support the problem-solving process. Additionally, Subject S-1 met indicator 4 by drawing mathematical conclusions to interpret the problem-solving process.

3) Question Number 3:

The results of Subject S-1's mathematical literacy test for question number 3 are presented in Figure 6.

3. Diketahui: 1. Hari Kamis → 7 pekerja laki-laki dan 5 pekerja perempuan = 98 gerabah Hari Jumat → 5 pekerja laki-laki dan 4 pekerja perempuan = 73 gerabah Ditanya = Gerabah yang dihasilkan seorang pekerja laki-laki dan perempuan Jawab = Laki-laki = x Perempuan = y SPLDV $7x + 5y = 98$ dan $5x + 4y = 73$ * Eliminasi $7x + 5y = 98$ $\times 5$ $35x + 25y = 490$ $5x + 4y = 73$ $\times 7$ $35x + 28y = 511$ $-3y = -21$ $y = \frac{-21}{-3} = 7$ (perempuan) * Substitusi $7x + 5y = 98$ $7x + 5(7) = 98$ $7x + 35 = 98$ $7x = 98 - 35$ $7x = 63$ $x = \frac{63}{7} = 9$ (laki-laki) Jadi, seorang pekerja laki-laki menghasilkan 9 gerabah dan seorang pekerja perempuan menghasilkan 7 gerabah.	Translate: 3. Given: Thursday → 7 male workers and 5 female workers = 98 potteries Friday → 5 male workers and 4 female workers = 73 potteries Asked: The potteries were made by one male worker and one female worker. Answer: Men = x Women = y SPLDV $7x + 5y = 98$ and $5x + 4y = 73$ • Elimination $7x + 5y = 98$ $\times 5$ $35x + 25y = 490$ $5x + 4y = 73$ $\times 7$ $35x + 28y = 511$ $-3y = -21$ $y = \frac{-21}{-3} = 7$ (female) • Substitution $7x + 5y = 98$ $7x + 5(7) = 98$ $7x + 35 = 98$ $7x = 98 - 35$ $7x = 63$ $x = \frac{63}{7} = 9$ (male) Therefore, one male worker can make 9 potteries and one female worker can make 7 potteries.
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Figure 6. Answer of Subject S-1 to Question Number 3

Based on the results of number 3, Subject S-1 fulfilled indicators 1 and 2 by correctly identifying the known and requested information and creating a mathematical model of the presented problems. However, there were a few inaccuracies in formulating the suppositions. Subject S-1 only used the examples of “male” and “female”, whereas the appropriate suppositions should have been “the number of pottery produced by a male worker” and “the number of pottery produced by a female worker.” Subject S-1 also fulfilled indicator 3 by correctly using mathematical techniques to support the problem-solving process. Additionally, Subject S-1 fulfilled indicator 4 by drawing mathematical conclusions to interpret the problem-solving process.

Interview Results of Subject S-1

Subject S-1 explained his reasoning fluently and thoroughly during the interview based on each indicator for every question item. He appeared confident and showed no signs of nervousness when answering questions. Although subject S-1 expressed some hesitation when constructing a mathematical model of the given problem (mathematizing indicator), he continued to make a strong effort through the subsequent stages until reaching a final result that addressed the problem. An excerpt from the interview with Subject S-1 regarding question number 3 is presented in Figure 7.

P	: What information do you know from the question?
S-1	: On Thursday, there were 7 male and 5 female workers in the factory who produced 98 crafts. Then, on Friday, there were 5 male and 4 female workers who produced 73 pottery crafts.
P	: What is being asked in the question?
S-1	: How many potteries are produced by one male worker and one female worker.
P	: Do you understand the intent and purpose of the question or not?
S-1	: I do.
P	: How do you transform or model the question into mathematical form?
S-1	: I made a supposition. For example, I assumed male workers as x and female workers as y . Then, I created a SPLDV model. However, it seems that I made a mistake because I didn't add the phrase “the number of” in the model. After all, I continued working until the end.

Figure 7. Interview Excerpts of Subject S-1

Test Results of Subject S-2

1) Question Number 1:

The results of Subject S-2's mathematical literacy test for question number 1 are presented in Figure 8.

1. Diketahui: harga parkir motor = Rp 3.000
 harga parkir mobil = Rp 5.000
 penghasilan parkir = Rp 110.000

Ditanya = berikan 3 kemungkinan banyaknya motor dan mobil?

Jawab = misalkan: x = motor
 y = mobil

model SPLDV: $3.000x + 5.000y = 110.000$

kemungkinan 1: $x = 10$ dan $y = 16$
 $3000(10) + 5.000(16) = 110.000$

kemungkinan 2: $x = 20$ dan $y = 10$
 $3.000(20) + 5.000(10) = 110.000$

kemungkinan 3: $x = 30$ dan $y = 4$
 $3.000(30) + 5.000(4) = 110.000$

Jadi, 3 kemungkinan banyaknya motor dan mobil adalah - 10 motor dan 16 mobil.
 - 20 motor dan 10 mobil.
 - 30 motor dan 4 mobil //

Figure 8. Answer of Subject S-2 to Question Number 1

Based on the results, Subject S-2 fulfilled indicators 1 and 2 by correctly identifying the known and requested information and creating a mathematical model of the presented problems. However, there were a few inaccuracies in formulating the supposition. Subject S-2 only used suppositions “motorcycles” and “cars,” whereas the correct suppositions should have been “the number of parked motorbikes” and “the number of parked cars.” Subject S-2 also fulfilled indicator 3 by using mathematical techniques to support the problem-solving process correctly. In addition, Subject S-2 also fulfilled indicator 4 by drawing mathematical conclusions to interpret the problem-solving process.

2) Question Number 2:

The results of Subject S-2's mathematical literacy test for question number 2 are presented in Figure 9.

2. diketahui = kiran membeli buku gambar dan 6 spidol dengan uang Rp 20.000
uang kembalinya = Rp 2.000
harga buku gambar = 3 kali lipat harga spidol.
Ditanya = berapa harga buku gambar dan spidol?
Jawab: harga buku dan spidol: $20.000 - 2.000 = 18.000$
Misalkan: $x =$ harga spidol
 $y =$ harga buku gambar
Model SPLDV: $3x + 6y = 18.000$, ~~3x~~ $y = 3x$
Sederhanakan persamaan: $y = 3x$
Harga spidol: $x = \frac{18.000}{3} = 2.000$
 y
Harga buku gambar: $3x = 3 \times 2.000 = 6.000$
Jadi harga buku gambar adalah 6.000 dan harga spidol adalah 2.000

Figure 9. Answer of Subject S-2 to Question Number 2

Based on the results, Subject S-2 fulfilled indicators 1 and 2 by correctly identifying the known and requested information and formulating an appropriate supposition for the presented problems. However, there were some inaccuracies in constructing the SPLDV model. The model created was $3x + 6y = 18000$, whereas based on the analogies made, the correct model should have been $6x + y = 18000$. Subject S-2 fulfilled indicator 3 by using mathematical techniques to support the problem-solving process, although the process was not fully coherent. Additionally, Subject S-2 did not explain the method used when completing the SPLDV. Nevertheless, Subject S-2 fulfilled indicator 4 by drawing mathematical conclusions to interpret the problem-solving process.

3) Question Number 3:

The results of Subject S-2's mathematical literacy test for question number 3 are presented in Figure 10.

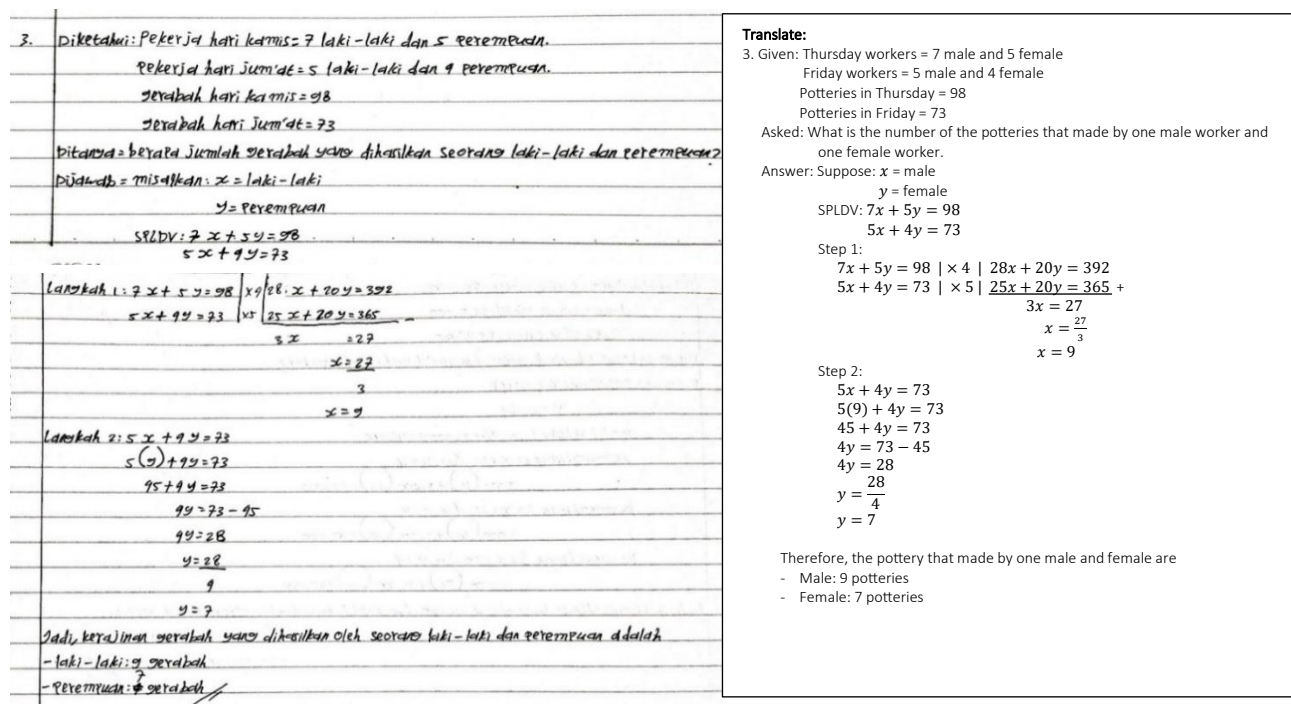


Figure 10. Answer of Subject S-2 to Question Number 3

Based on the results, Subject S-2 fulfilled indicators 1 and 2 by correctly identifying the known and requested information and creating a mathematical model of the presented problems. However, there were a few inaccuracies in formulating the supposition. Subject S-2 only used the suppositions of “male” and “female,” whereas the correct suppositions should have been “the number of pottery produced by a male worker” and “the number of pottery produced by a female worker.” Subject S-2 also fulfilled indicator 3 by using mathematical techniques to support the problem-solving process accurately. Additionally, Subject S-2 fulfilled indicator 4 by drawing mathematical conclusions to interpret the problem-solving process.

Interview Results of Subject S-2

Similar to Subject S-1, Subject S-2 provided fairly complete explanations for each indicator across all question items during the interview. Subject S-2 also answered each interview question fluently. Although he expressed some hesitation when constructing a mathematical model of the given problem (mathematizing indicator), Subject S-2 continued to make a strong effort through the subsequent stages. An excerpt from the interview with Subject S-2 regarding question number 1 is presented in Figure 11.

- P : How do you transform or model the problem into mathematical form?
- S-2 : I made a supposition. For example, I represented the number of motorbikes as x and the number of cars as y .
- P : Do you know the steps to solve the problem?
- S-2 : Yes.
- P : How did you do it?
- S-2 : First, I created a SPLDV equation, namely $3000x + 5000y = 110000$. Then, I substituted the values of the motorbike and car, ensuring that the total matched IDR 110,000.

Figure 11. Interview Excerpts of Subject S-2

Summary of Mathematical Literacy Subjects S-1 and S-2

Based on the test results and interviews from S-1 and S-2 subjects, a summary can be made regarding the mathematical literacy of the two subjects as in Table 16.

Table 16. Summary of Subjects' Mathematical Literacy

Indicators	Description of Mathematical Literacy	
	Subject S-1	Subject S-2
Communication	Able to write down the known and requested information correctly based on the problems presented.	Able to write down the known and requested information correctly based on the problems presented.
Mathematizing	Quite able to create mathematical models of the problems presented.	Quite able to create mathematical models of the problems presented.
Using mathematical tools	Able to use mathematical tools, both physical and electronic, language, and mathematical techniques to assist in the problem solving process.	Quite able to use mathematical tools, both physical and electronic, language, and mathematical techniques to assist in the problem solving process.
Interpret and evaluate	Able to draw mathematical conclusions to interpret the solution process.	Able to draw mathematical conclusions to interpret the solution process.

5. Discussion

5.1. How Effective Articulate Storyline Supports the CTL Model in Improving Students' Mathematical Literacy

Based on the research findings, the CTL model assisted by Articulate Storyline was found to be effective in improving students' mathematical literacy. These results are supported by several studies that reveal that mathematical literacy can be effectively enhanced through the CTL model (Afni & Hartono, 2020). This effectiveness is attributed to the CTL process, where students are encouraged to understand the material by connecting it to real-life contexts, thereby acquiring knowledge and skills applicable to their lives (Haryanto & Arty, 2019). Through this approach, students gradually develop an understanding of problem situations, aligning with one of the key components of the CTL model, namely constructivism. Another component of CTL that can support students' mathematical literacy is the learning community, where students are provided opportunities to discuss and use the mathematical concepts they have learned to solve mathematical problems (Rohimatunisa & Sudianto, 2022).

The use of interactive media, such as Articulate Storyline media, is also essential for enhancing mathematics learning (Simarmata et al., 2024). Learning mathematics through Android or smartphone-based media can boost students' motivation and foster independent learning, which in turn improves their mathematical abilities, including mathematical literacy (Nissa et al., 2021). In a study conducted by Nissa et al. (2021) on the use of Articulate Storyline in learning algebra material, it was found that students were able to develop their level of understanding, both from cognitive,

procedural, and conceptual aspects. Furthermore, the use of interactive media can significantly improve students' abilities in formulating problems, applying reasoning skills, drawing conclusions, and evaluating arguments (Pradana et al., 2020).

5.1. The Description of the Mathematical Literacy of Students with High Self-Confidence in CTL Learning Assisted by Articulate Storyline

The research results showed that students with high self-confidence generally excel in fulfilling the four indicators of mathematical literacy, both when answering questions and during interviews. This finding is consistent with Pratama (2020), who found that higher self-confidence is associated with improved mathematical literacy. Self-confidence empowers students to be more courageous in demonstrating their abilities in various situations. Students with strong self-confidence will take appropriate and effective actions in different contexts, even when faced with challenges from themselves or others (Burton & Platts, 2006). As a result, they are more inclined to understand, identify, and attempt to solve the mathematical problems they encounter while effectively communicating their ideas to clarify their problem-solving approach (Novianti Fay et al., 2022; Pratama, 2020).

Students with high self-confidence also tend to learn mathematics effectively and quickly, demonstrate perseverance, trust in their mathematical abilities, and think realistically (Pratama, 2020). With strong self-confidence, students can solve mathematical problems. Therefore, self-confidence is considered one of the key determinants of mathematics achievement (Çiftçi & Yildiz, 2019).

The findings of this study are consistent with the findings of Afni & Hartono (2020) and Wahyuni et al. (2021), who found that the CTL model is effective in improving mathematical literacy. However, they differ from the findings of Widjajanti and Dewi (2022), which emphasize the influence of self-confidence in learning through a scientific approach. In contrast, this study highlights the importance of combining the CTL model with interactive media, such as Articulate Storyline, to enhance mathematical literacy among students with high self-confidence.

6. Conclusion

Based on the research results and discussions, it can be concluded that the CTL model assisted by Articulate Storyline is effective in improving mathematical literacy as shown by: (1) students' mathematical literacy in the CTL class assisted by Articulate Storyline met the minimum completion criteria (KKM); (2) students' mathematical literacy in the CTL class assisted by Articulate Storyline achieved classical learning completion, with the proportion of students reaching learning completion being greater than or equal to 75%; (3) the average mathematical literacy of students in the CTL class assisted by Articulate Storyline was higher than that of students in the PBL class; (4) the proportion of students' mathematical literacy completion in the CTL class assisted by Articulate Storyline was greater than that in the PBL class; and (5) the increase in students' mathematical literacy in the CTL class assisted by Articulate Storyline was greater than that in the PBL class. In addition, students with high self-confidence generally demonstrated excellent mathematical literacy, as indicated by their performance in fulfilling all mathematical literacy indicators.

Contribution to theory: This study strengthens the theory of constructivism and contextual learning by showing that the integration of interactive media such as Articulate Storyline in the CTL model is effective in enhancing mathematical literacy, especially for students with high self-confidence.

Contribution to practice: These results provide practical guidance for teachers and schools to consider using the CTL model assisted by interactive media such as Articulate Storyline, in learning as an effective innovation in improving mathematical literacy.

7. Limitation

Although the results of this study indicate the effectiveness of CTL-based learning assisted by Articulate Storyline in improving students' mathematical literacy with high self-confidence, several limitations should be acknowledged. First, there were environmental constraints, particularly related to the internet connectivity and the compatibility of technological devices used by students. During the Articulate Storyline-based learning process, not all students had adequate devices or stable internet connections, which hindered the optimal use of the learning media. Second, this study employed purposive sampling by selecting only students with high self-confidence as subjects in the qualitative analysis. This limits the generalizability of the findings to groups of students with varying levels of self-confidence.

8. Suggestion

Based on the findings showing that the CTL model assisted by Articulate Storyline is effective in improving mathematical literacy, the researchers suggest that this learning model be considered as an alternative approach to be applied in mathematics instruction, particularly for teaching the Two-Variable Linear Equation System (SPLDV) material. However, the study also shows technical constraints such as weak internet signals and limited access to student devices that hinder access to Articulate Storyline media. Therefore, it is recommended that schools provide a stable internet connection and facilitate access to devices, such as laptops or tablets, to ensure smooth learning activities. In addition, the results of interviews and tests showed that students with high levels of self-confidence could meet all indicators of mathematical literacy. Therefore, teachers are encouraged to foster students' self-confidence through learning strategies that promote active participation and create a supportive learning environment. To further enhance students' mathematical literacy, continuous support is essential to help students understand and master the key indicators of mathematical literacy.

Declarations

Author Contributions. Amidi: Literature review, conceptualization, and data collection. Kartono: Corresponding author, Methodology, data analysis, and supervision. Mulyono: Review, editing, and manuscript preparation. Emi Pudjiastuti: Validation, data visualization, and critical revisions. All authors have read and approved the final version of the article for publication.

Conflicts of Interest. The authors declare no conflict of interest.

Funding. The study received funding from DPA LPPM Universitas Negeri Semarang.

Ethical Approval. The research was conducted in accordance with ethical standards for research involving secondary school learners. Research authorization was obtained from the school. All participants provided informed consent prior to participation. Participants were assured that their answers would be confidential and anonymous, and that their participation was voluntary with no academic consequences.

Data Availability Statement. The data supporting the results reported in this study are available from the corresponding author upon reasonable request.

Acknowledgements. This study was supported by DPA LPPM Universitas Negeri Semarang.

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