RADIAN Journal: Research and Review
in Mathematics Education
Volume 05, No. 01, 2026, pp. 01-16

e-ISSN: 2961 - 7049

The Effect of Scratch-Assisted Problem-Based Learning on Students' Mathematical Computational Thinking Skills

Rona Mentari[1*], Dedi Nurjamil[2], Sinta Verawati Dewi[3], Asanre Akorede Ayoola[4]

[1*,2,3]Department of Mathematics Education, Universitas Siliwangi, Indonesia
[4]Mathematics Education, Tai Solarin University of Education, South Africa
*Correspondence: mentarirona30@gmail.com

Received: 30 January 2026 | Revised: 21 February 2026 | Accepted: 11 March 2026 | Published Online: 30 March 2026

Abstract

Computational thinking in mathematics is important to develop through learning, but students are not accustomed to activities involving decomposition, pattern recognition, abstraction, and algorithmic thinking. This study aims to determine whether students' mathematical computational thinking abilities after learning through PBL assisted by Scratch are better than those of students who learn without it. This study uses a quantitative approach with a quasi-experimental method. The sample consists of class VIII D as the experimental class with 35 students, and VIII G as the control class with 33 students, at SMPN 4 Tasikmalaya. The instrument was a computational thinking ability test validated by expert lecturers and tried out on class IX J students. Data were analysed using descriptive statistics, the Shapiro-Wilk normality test, the Levene homogeneity test, and the one-tailed Independent Sample T-Test at a 5% significance level. Results showed that the experimental class obtained an average score of 75.51, while the control class obtained 69.55. The one-tailed p-value was $0.001 < 0.05$, so H_0 was rejected. Thus, students taught through Scratch-assisted PBL had better mathematical computational thinking abilities than those taught through PBL without Scratch. These findings indicate that Scratch can support PBL as an interactive medium that helps students solve mathematical problems in a more systematic, logical, and structured manner.

Keywords: Linear Equations and Inequalities; Mathematical Computational Thinking; Mathematics Learning; Problem-Based Learning, Scratch

How to Cite: Mentari, R., Nurjamil, D., Dewi, S. V., & Ayoola, A. A. (2026). The effect of scratch media in problem-based learning on students' mathematical computational thinking skills. *RADIAN Journal: Research and Review in Mathematics Education, 5*(1), 01-16. http://doi.org/10.35706/radian.v5i1.13473

http://doi.org/10.35706/radian.v5i1.13473

INTRODUCTION

Mathematics education plays an important role in developing students' abilities to think logically, critically, and systematically and their problem-solving skills. Through mathematics learning, students are expected not only to understand mathematical concepts but also to apply them in solving various problems, both in the context of learning and everyday life. Gusteti & Neviyarni, (2022) state that mathematics learning can help students understand mathematical concepts according to their abilities. However, in reality, mathematics is still often considered a difficult and challenging subject. Many students feel scared and anxious when participating in mathematics lessons due to the numerous formulas that must be understood and the belief that mathematics can only be mastered by certain students (Nunut et al., 2016; Efwan et al., 2024; Suwanto et al., 2025). That negative opinion can lead to low student confidence and difficulties in solving math problems. Computational thinking is one of the abilities that can help students solve math problems more effectively (Junaeti et al., 2023). Computational thinking enables students to understand problems systematically, break them down into simpler parts, recognize patterns, outline solution steps, and determine appropriate and efficient strategies (Gunawan et al., 2023). In the context of mathematics learning, this ability is important because it aligns with the problem-solving process that requires students to think logically, sequentially, and structurally. Thus, the development of computational thinking in mathematics education can be one of the efforts to help students build conceptual understanding while also enhancing their ability to solve mathematical problems.

Various countries are giving significant attention to developing computational thinking skills in their educational curricula, highlighting its importance. Since about 2014, a number of countries, including England, the United States, and Australia, have added computational thinking to their national curricula. In Indonesia, computational thinking has started to be officially accommodated through the Informatics subject in the 2013 curriculum, especially after the issuance of Minister of Education and Culture Regulation Numbers 35, 36, and 37 of 2018 (Kemdikbud, 2019). In the Informatics implementation guidelines, computational thinking is positioned as the foundation and principle in problem-solving. In addition, in the Merdeka Curriculum, this skill becomes an important part of the informatics subject and, at the elementary school level, is integrated with other subjects such as Pancasila education, language, mathematics, and science. This shows that computational thinking plays an important role in the learning process, including in mathematics education.

In mathematics learning, computational thinking can be developed by thinking mathematically and applying computational concepts. According to Veronica et al. (2022), mathematical computational thinking is an approach that integrates computational concepts, such as decomposition, pattern recognition, abstraction, and algorithms, into the process of solving mathematical problems. This ability enables learners to formulate problems, organise solution steps systematically, and discover efficient solutions. In other words, mathematical computational thinking is not only related to the use of computers but also a way of thinking that organises the process of solving mathematical problems logically and algorithmically. In line with this, Lestari & Roesdiana (2023) state that the indicators of computational thinking skills include problem decomposition, pattern recognition, abstraction, and algorithmic thinking. Nurohman et al. (2022) also support this view, stating that these four aspects form the fundamentals of computational thinking.

However, the reality on the ground reveals that students still need to develop their computational mathematical thinking skills. Based on interviews with mathematics teachers at SMPN 4 Tasikmalaya, it was found that students still have difficulty understanding the material on linear equations and inequalities in one variable. These difficulties are evident when students are unable to break down complex problems into simpler parts, logically arrange the steps to solve them, and determine solutions that can be applied to similar problems. This condition indicates that students are still facing obstacles, particularly in the aspects of decomposition and algorithmic thinking. These findings are in line with the research by Kresnadi et al. (2023), which indicates that students are not yet able to solve problems logically and systematically. Additionally, Solehudin et al. (2024) found that the ability to decompose, as one of the indicators of computational thinking, received an average score of 29.80, which is considered low. Therefore, we need a learning strategy that helps students grasp mathematical concepts while also training their logical, systematic, and structured thinking processes.

The low ability of students to think computationally in mathematics is related to both their difficulty in solving problems and the learning process, which has only partially encouraged active student involvement in building conceptual understanding. In fact, the ability to think computationally is important to develop in mathematics learning because it can train students to think logically, sequentially, and critically and to use appropriate and efficient strategies in problem-solving (Cahdriyana & Richardo, 2020; Mukhibin et al., 2024). Moreover, the integration of computational thinking in mathematics learning can help students connect mathematical thinking processes with systematic and structured problem-solving steps (Ye et al., 2023). Therefore, there is a need for innovative mathematics learning that integrates technology with learning models, encouraging students to actively explore concepts, break down problems, formulate solution steps, and determine solutions accurately.

One of the technology-based learning media that can be used to support this process is Scratch. Scratch is an interactive learning media that allows students to learn through visual, engaging, and structured activities. The use of Scratch can help students understand concepts more concretely and support a systematic and logical thinking process (Rosita et al., 2026). Papatga & Ersoy (2016) state that Scratch can be used effectively in education because it can help direct students' attention to learning, increase motivation, and develop their skills in using technology. In mathematics education, Scratch has the potential to help students visualise concepts, organise steps for problem-solving, and understand the relationships between processes in problem-solving. To make the use of Scratch media more effective, a learning model that aligns with problem-solving characteristics is needed. One relevant learning model is problem-based learning. The problem-based learning model is a teaching model that guides students to engage directly in solving problems presented as the basis for learning activities

(Rinaldi & Afriansyah, 2019; Putri et al., 2023). This model also helps students work on real problems by having them talk about them in groups or do them on their own (Nalman et al., 2023). By integrating Scratch media into the problem-based learning model, students are expected to be more active in learning, understand mathematical concepts through problem-solving, and develop computational mathematical thinking skills systematically.

Several previous studies have indicated that the use of Scratch media and the problem-based learning model have a positive impact on learning. Agung et al. (2023) showed that the problem-based learning model assisted by Scratch media with an ethnomathematics approach focusing on the cultural heritage of Semarang is effective in enhancing students' critical thinking skills. In line with that, Anwar et al. (2025) demonstrate that technology-based media are effectively used to support innovative mathematics learning and can enhance computational thinking skills among teachers and students. In addition, learning using the Problem-Based Learning model supported by Scratch media can encourage students to be more active and engaged in the learning process (Supriatin & Putra, 2023).

Although previous research has shown the effectiveness of using Scratch and the Problem-Based Learning (PBL) model in enhancing various student abilities, studies specifically examining the impact of integrating Scratch into PBL on students' mathematical computational thinking skills in the context of linear equations and inequalities in one variable are still limited. Therefore, this research was conducted to determine whether the mathematical computational thinking skills of students who learn through Scratch-assisted PBL are higher compared to students who learn without Scratch. The novelty of this research lies in the integration of Scratch with PBL regarding linear equations and inequalities in one variable, as well as the use of computational thinking indicators, namely decomposition, pattern recognition, abstraction, and algorithmic thinking, as the main framework in evaluating students' abilities.

METHODS

This research uses a quantitative approach with a quasi-experimental method and a posttest-only nonequivalent control group design. This design was chosen because the research focuses on comparing the computational thinking ability of students who participate in problem-based learning assisted by Scratch and those who participate in problem-based learning without Scratch assistance after the treatment is given. A pretest was not given because this study does not measure changes in ability before and after learning but rather compares the posttest results of both classes. Instead, a diagnostic test was given at the beginning of the study to determine that the initial abilities of students in the experimental and control classes were relatively equivalent. Thus, the differences in posttest results can be attributed to the treatment involving the use of Scratch media in the problem-based learning model. This study aims to determine whether the mathematical computational thinking abilities of students who participate in learning using the Scratch-assisted problem-based learning model are better than those of students who participate in learning using the problem-based learning model without Scratch assistance.

The research was conducted at SMPN 4 Tasikmalaya. The research sample consisted of two classes, namely class VIII D as the experimental class with 35 students and class VIII G as the control class with 33 students. The experimental class received instruction using the problem-based learning model assisted by Scratch, while the control class followed instruction using the problem-based learning model without Scratch media assistance. The material used in this research is linear equations and inequalities in one variable. This study was conducted in several stages: determining the research sample; implementing instructions in the experimental and control classes according to the specified treatment; administering a posttest to both classes; and processing and analyzing the research data. The following Figure 1 illustrates the flow of the research implementation.

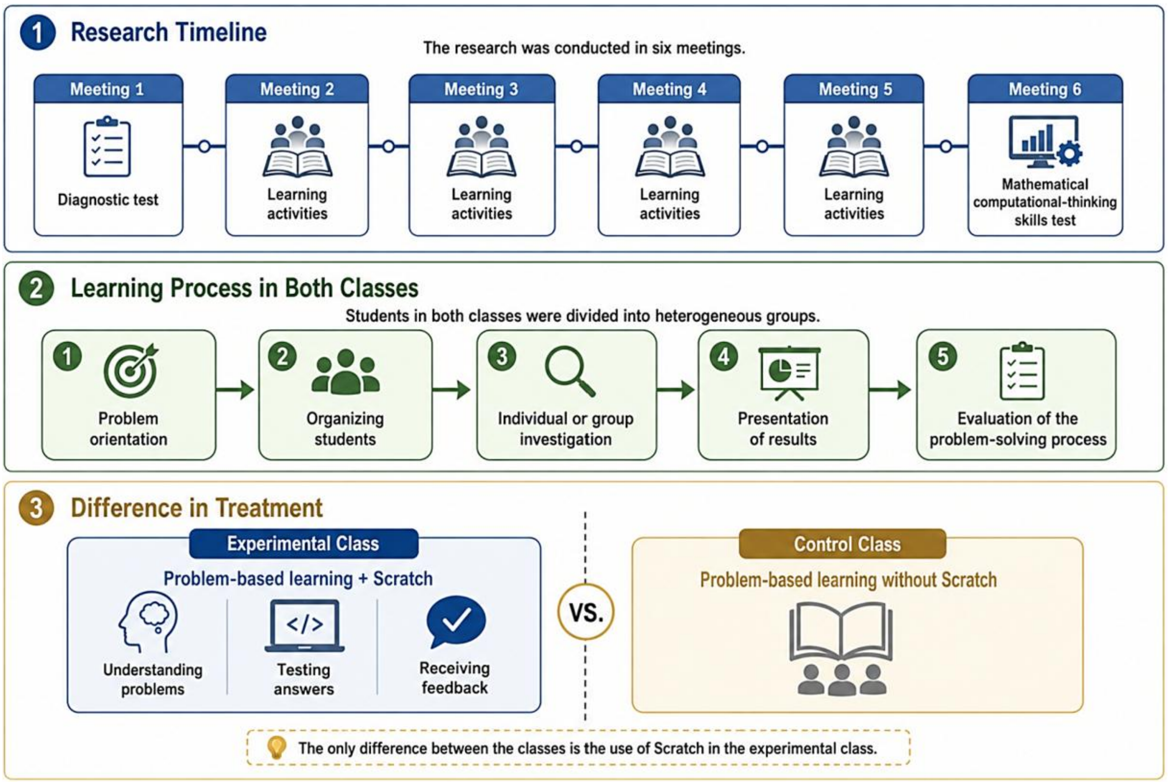

Figure 1. Research Implementation Flow

The research instrument used is a descriptive test of mathematical computational thinking ability, which consists of two questions about the material of linear equations and inequalities in one variable (LEIM and LIOM). This instrument is built based on four indicators, namely problem decomposition, pattern recognition, abstraction, and algorithmic thinking. Before being used in the research, the instrument was first validated by expert validators and tested on students outside the research sample (9th-grade students) who had studied linear equations and inequalities in one variable to ensure its validity and reliability. The empirical validity test was conducted using the Pearson Product Moment correlation, which involves correlating the score of each item with the total score. The results of the validity test show that the correlation coefficient for item number 1 is 0.884 and for item number 2 is 0.738. Both values are greater than the r-table value of 0.374 at the 5% significance level; therefore, both items are declared valid. Next, the reliability test was conducted using Cronbach's Alpha because the instrument used was an essay test with a tiered scoring system; therefore, it is necessary to determine the internal consistency between the items in measuring the same construct, namely computational and mathematical thinking abilities. The reliability test results obtained a Cronbach's alpha value of 0.840. This value is greater than the r-table value of 0.374 and falls into the high category. Therefore, the instrument for the mathematical computational thinking ability test is declared valid and reliable, making it suitable for use as a research data collection tool.

The collected data were analyzed using descriptive statistics and inferential statistics. Descriptive statistics were used to describe the data from the computational mathematical thinking ability test, including minimum scores, maximum scores, averages, ability categories, and achievement percentages in each indicator of computational mathematical thinking. Next, inferential statistics are used to test the research hypothesis. Before conducting the hypothesis test, prerequisite tests were first carried out, including the normality test using Shapiro-Wilk because the sample size was less than 50 and the homogeneity test using Levene's test. The testing criteria were that if the significance value was greater than 0.05, the data were declared normally distributed and the variances of the two groups were declared homogeneous. After the prerequisite tests are met, the hypothesis test is conducted using a one-tailed independent sample t-test at a 5% significance level to determine whether the average computational mathematical thinking ability of the experimental class students is better than that of the control class.

RESULTS AND DISCUSSION

This study compared the mathematical computational thinking ability of students who participated in problem-based learning assisted by Scratch and students who participated in problem-based learning without Scratch assistance. Before the treatment was implemented, a diagnostic test was administered to both classes to describe students' initial ability. The summary of the diagnostic test scores is presented in Table 1.

Table 1. Descriptive Statistics of the Diagnostic Test Scores

Class	N	Minimum	Maximum	Mean	Standard Deviation
Experimental	35	0	12	6.09	4.08
Kontrol	33	0	12	5.55	4.05

As shown in Table 1, the mean diagnostic score of the experimental class was 6.09, while the mean score of the control class was 5.55. The difference between the two means was 0.54 points. After the treatment, a posttest was administered to both classes. The posttest measured students' mathematical computational thinking ability on the topic of linear equations and inequalities in one variable. The descriptive statistics of the posttest scores are presented in Table 2.

Table 2. Descriptive Statistics of Mathematical Computational Thinking Posttest Scores

Class	N	Range	Minimum	Maximum	Sum	Mean	Standard Deviation	Variance
Experimental	35	25	62	87	2643	75.51	7.318	53.551
Control	33	28	53	81	2295	69.55	8.174	66.818

Table 2 shows that the experimental class obtained a mean posttest score of 75.51, while the control class obtained a mean score of 69.55. The mean difference between the two classes was 5.96 points. The highest score in the experimental class was 87, whereas the highest score in the control class was 81. The lowest score in the experimental class was 62, while the lowest score in the control class was 53. To provide a clearer visual comparison of the posttest achievement between the two classes, the mean scores of the experimental and control classes are presented in Figure 2.

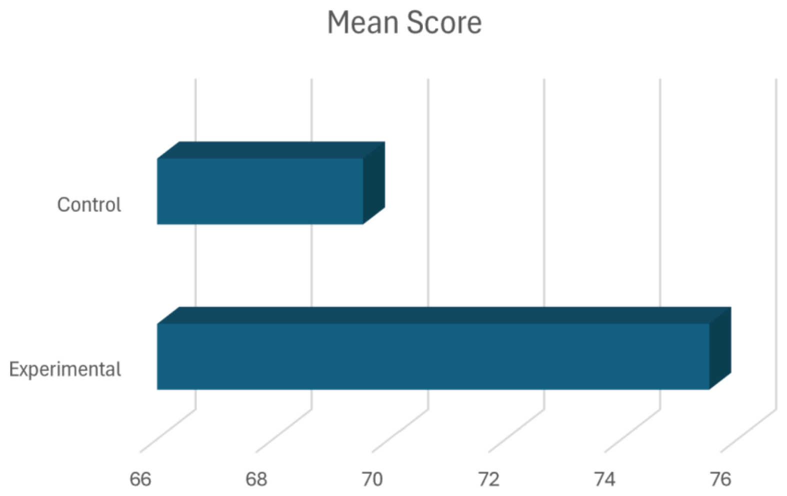

Figure 2. Mean Posttest Scores of the Experimental and Control Classes

In addition to comparing the posttest scores based on mean, highest, and lowest scores, the results were also examined by classifying students' mathematical computational thinking ability into several achievement categories. This categorization was conducted to provide a more detailed description of the distribution of students' abilities in both the experimental and control classes. The distribution of students' mathematical computational thinking ability categories is presented in Table 3.

Table 3. Distribution of Mathematical Computational Thinking Ability Categories

Score Interval	Category	Experimental F	Experimental %	Control F	Control %
$90 \leq$ Score ≤ 100	Very High	0	0.00%	0	0.00%
$80 \leq$ Score < 90	High	12	34.29%	5	15.15%
$70 \leq$ Score < 80	Moderate	14	40.00%	13	39.39%
$55 \leq$ Score < 70	Low	9	25.71%	13	39.39%
Score < 55	Very Low	0	0.00%	2	6.06%
Total		**35**	**100%**	**33**	**100%**

Table 3 shows that the largest proportion of students in the experimental class was in the moderate category, with 14 students or 40.00%. In the control class, the largest proportions were found in the moderate and low categories, each consisting of 13 students or 39.39%. No students in either class were in the very high category. The posttest was also analyzed based on the four indicators of mathematical computational thinking: decomposition, pattern recognition, abstraction, and algorithmic thinking. The achievement percentage of each indicator is presented in Table 4.

Table 4. Percentage of Students' Achievement in Each Indicators of Mathematical Computational Thinking

Class	Question	Decomposition	Pattern Recognition	Abstraction	Algorithmic Thinking
Experimental	1	92.14%	70.71%	82.86%	75.00%
Experimental	2	87.86%	62.14%	74.29%	60.00%
Experimental	Mean	90.00%	66.43%	78.58%	67.50%
Control	1	87.12%	60.61%	77.27%	64.39%
Control	2	84.09%	58.33%	71.97%	53.03%
Control	Mean	85.61%	59.47%	74.62%	58.71%

As shown in Table 4, decomposition had the highest achievement percentage in both classes, with 90.00% in the experimental class and 85.61% in the control class. Algorithmic thinking had an average achievement of 67.50% in the experimental class and 58.71% in the control class. The achievement percentage for each indicator of mathematical computational thinking is further illustrated in Figure 3. The figure provides a visual comparison between the experimental and control classes, making it easier to observe the differences in students' performance across the assessed indicators.

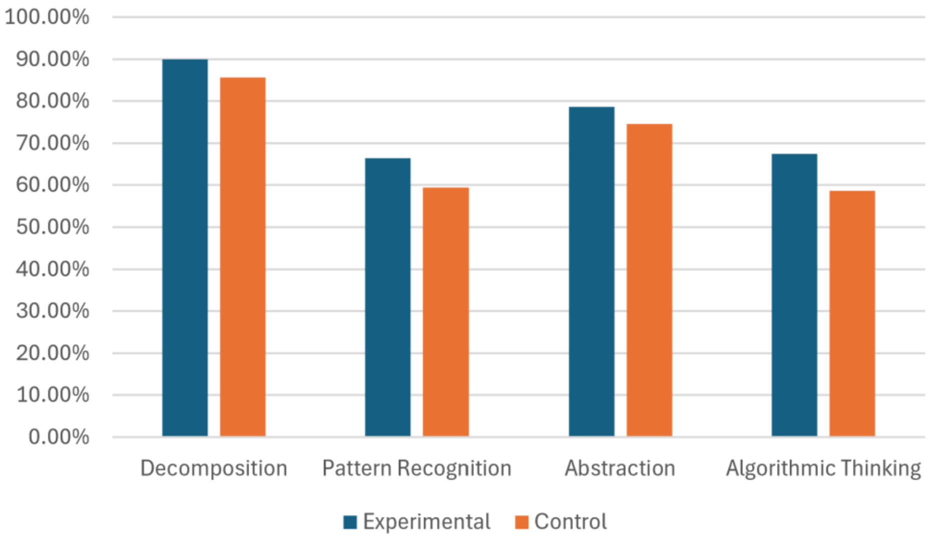

Figure 3. Mean Achievement Percentage in Each Indicator of Mathematical Computational Thinking

Figure 3 illustrates the average achievement percentages for each indicator of mathematical computational thinking in the experimental and control classes. Overall, the experimental class showed a higher percentage of achievement than the control class in each indicator. The highest achievement in both classes was found in decomposition, indicating that students in both groups were relatively able to break down mathematical problems into simpler parts. Abstraction also shows relatively high achievement compared to other indicators. Meanwhile, pattern recognition and algorithmic thinking have lower achievement percentages, with the control class showing lower percentages than the experimental class in both areas. These results offer a descriptive overview of students' achievements in computational mathematical thinking prior to conducting statistical analysis. Before testing the hypothesis, prerequisite tests were conducted. The normality test was carried out using the Shapiro-Wilk test because the sample size of each class was less than 50. The results are presented in Table 5.

Table 5. Results of the Shapiro-Wilk Normality Test

Class	Sig.	Decision
Experimental	0.134	Normally distributed
Control	0.061	Normally distributed

Table 5 shows that the significance values for both classes were greater than 0.05. Therefore, the posttest scores of the experimental and control classes were normally distributed. The homogeneity test was conducted using Levene's test. The results are presented in Table 6.

Table 6. Results of the Homogeneity Test

Levene Statistic	df1	df2	Sig.	Decision
0.683	1	66	0.527	Homogeneous

As shown in Table 6, the significance value of Levene's test was 0.527, which was greater than 0.05. Therefore, the variances of the two groups were homogeneous. After the prerequisite tests were fulfilled, the research hypothesis was tested using a one-tailed independent sample t-test. The hypothesis tested was whether the mean mathematical computational thinking ability of students in the experimental class was higher than that of students in the control class. The results of the independent sample t-test are presented in Table 7.

Table 7. Results of the One-Tailed Independent Sample t-Test

Assumption	t	df	Sig. (2-tailed)	Sig. (1-tailed)	Mean Difference	Std. Error Difference	95% CI Lower	95% CI Upper
Equal variances assumed	3.176	66	0.002	0.001	5.969	1.879	2.217	9.721

Table 7 shows that the value of Sig. (2-tailed) was 0.002. Since the hypothesis test was one-tailed, the significance value was divided by two, resulting in Sig. (1-tailed) $= 0.001$. Because $0.001 < 0.05$, H_0 was rejected. Thus, the posttest mean score of students who participated in problem-based learning assisted by Scratch was significantly higher than that of students who participated in problem-based learning without Scratch assistance.

The findings of this study show that problem-based learning assisted by Scratch produced better mathematical computational thinking abilities than problem-based learning without Scratch assistance. Although the diagnostic test showed that the initial mean scores of the two classes were relatively close, with only a 0.54-point difference, the posttest results showed a clearer difference after the treatment. The experimental class obtained a mean score of 75.51, while the control class obtained a mean score of 69.55, with a mean difference of 5.96 points. This difference was also supported by the independent sample t-test, which showed a one-tailed significance value of 0.001, indicating that the mean score of the experimental class was significantly higher than that of the control class. Therefore, the result does not only indicate a numerical difference but also provides statistical evidence that the use of Scratch in problem-based learning had a positive effect on students' mathematical computational thinking ability.

The meaning of this finding is important in the broader context of mathematics education. Mathematical computational thinking requires students to formulate problems, break them down into smaller parts, recognize patterns, select relevant information, and construct systematic solution steps. These processes are closely related to the demands of learning linear equations and inequalities in one variable, because students are required to translate contextual problems into mathematical models and solve them logically. The higher achievement of the experimental class suggests that Scratch helped students engage more actively with these processes, especially because the media provided visual, interactive, and structured learning experiences. This supports the theoretical view that computational thinking is not limited to programming activities but can be integrated into mathematics learning to strengthen logical, systematic, and problem-solving-oriented thinking.

The distribution of achievement categories also strengthens this interpretation. In the experimental class, 34.29% of students achieved the high category, whereas only 15.15% of students in the control class attained the same level. In contrast, the control class still had students in the very low category, whereas the experimental class had none. This indicates that Scratch-assisted learning did not merely increase the average score but also helped more students move toward a better level of achievement. However, the absence of students in the very high category in both classes shows that the intervention had not yet led students to maximum mastery. Thus, Scratch can be interpreted as an effective support, but not a complete solution; students still need repeated practice, stronger conceptual reinforcement, and more opportunities to construct algorithms independently.

The indicator-based results provide a deeper explanation of how Scratch contributed to students' computational thinking. Decomposition was the highest indicator in both classes, with 90.00% in the experimental class and 85.61% in the control class. This suggests that both groups benefited from the problem-based learning structure, because PBL naturally trains students to understand problems by identifying known information, asked information, and relevant mathematical relationships. However, the experimental class still outperformed the control class on all indicators. The largest differences appeared in algorithmic thinking and pattern recognition, where the experimental class achieved 67.50% and 66.43%, compared with 58.71% and 59.47% in the control class. This pattern suggests that Scratch particularly supported the aspects of computational thinking that require students to follow sequences, observe regularities, test procedures, and revise solution steps.

The higher mathematical computational thinking ability of students in the experimental class indicates that the integration of Scratch into problem-based learning provided a more meaningful learning experience than problem-based learning without Scratch. This finding is consistent with Papatga and Ersoy (2016), who emphasized that Scratch can be used effectively in education because it attracts students' attention and supports the development of technology-related skills. It also supports Nabilah et al. (2024), who argued that Scratch can serve as a mathematics learning medium that helps students solve complex problems and increases their learning motivation. Similarly, Agung et al. (2023) stated that the use of Scratch can increase students' involvement in the learning process. These studies suggest that Scratch does not only function as a digital tool but also as an interactive medium that encourages students to explore problems, represent mathematical ideas visually, and test possible solutions.

From the perspective of the learning model, this result is also in line with Putri et al. (2023), Nalman et al. (2023), and Widyastuti and Airlanda (2021), who emphasized that problem-based learning encourages students to be directly involved in solving real-world problems, work through discussion or individual tasks, and arrange solution strategies systematically. In this study, the combination of Scratch and problem-based learning may have strengthened students' computational thinking because students were required to understand the problem, decompose it into smaller parts, design steps to solve it, and evaluate the results through interactive activities. Therefore, the higher achievement of the experimental class can be understood as the result of the integration between Scratch as an interactive learning medium and problem-based learning as a problem-solving-oriented learning model.

Moreover, previous studies relevant to this research reinforce these findings. Agung et al. (2023) demonstrated the effectiveness of problem-based learning, aided by Scratch, in enhancing students' critical thinking skills. Anwar et al. (2025) demonstrated that Scratch is effective as a technology-based mathematics learning platform that improves computational thinking skills. Similarly, Muttaqin (2024) found that educational games such as Scratch contribute positively to computational thinking through interactive problem-solving activities involving analysis and algorithm construction. The present study strengthens these findings by showing that Scratch is not only useful as a programming or game-based platform but can also be integrated into problem-based mathematics learning at the junior high school level, particularly regarding linear equations and inequalities in one variable.

This study theoretically supports the idea that integrating problem-based pedagogy and interactive digital media can foster the development of mathematical computational thinking.

PBL provides the problem-solving framework, while Scratch functions as a cognitive scaffold that helps students visualize problems, test solutions, receive feedback, and reflect on their thinking process. Therefore, the use of technology in mathematics learning should not be viewed merely as an additional tool but as a learning environment that can guide students toward more structured reasoning.

Practically, the findings imply that mathematics teachers can use Scratch as an alternative medium to support problem-based learning, especially for topics that require step-by-step reasoning. Scratch can be used to present contextual problems, organize learning activities, display learning materials and worksheets, test students' solutions, and provide feedback. For schools, these findings indicate the importance of supporting teachers with adequate facilities, such as projectors, internet access, and student devices. For students, Scratch-assisted PBL can create a more engaging learning experience and help them become more active in exploring, discussing, and evaluating mathematical solutions.

Nevertheless, several limitations should be considered. First, this study used a quasi-experimental design with a posttest-only control group, so differences between groups before treatment cannot be completely controlled, even though the diagnostic test showed relatively similar initial ability. Second, the research was conducted in only one school, with two classes of grade VIII students, so the findings should be generalized carefully. Third, the study was limited to the topic of linear equations and inequalities in one variable, meaning that the effectiveness of Scratch-assisted PBL on other mathematical topics still needs further investigation. Fourth, the instrument consisted of essay questions that measured four indicators of computational thinking, but students' computational thinking processes during discussion, exploration, and media use were not measured in depth.

Based on the evidence, it can be concluded that problem-based learning assisted by Scratch was more effective than problem-based learning without Scratch assistance in improving students' mathematical computational thinking abilities. The conclusion is supported by the higher posttest mean score, the better distribution of achievement categories, higher performance across all computational thinking indicators, and the significant result of the one-tailed independent sample t-test. Thus, Scratch can be considered a meaningful interactive medium for strengthening students' ability to decompose problems, recognize patterns, abstract relevant information, and construct algorithmic solution steps in mathematics learning.

CONCLUSION

This study concludes that problem-based learning assisted by Scratch is more effective than problem-based learning without Scratch assistance in supporting students' mathematical computational thinking ability. The experimental class achieved a higher posttest mean score than the control class, and the one-tailed independent sample t-test showed a significant difference between the two groups. This indicates that the use of Scratch in problem-based learning provided a meaningful contribution to students' ability to decompose problems, recognize patterns, abstract relevant information, and construct algorithmic solution steps in mathematics learning.

Theoretically, the findings strengthen the view that computational thinking can be developed through mathematics learning when problem-solving activities are combined with interactive digital media. Problem-based learning provides a structured learning framework that encourages students to analyze problems and develop solution strategies, while Scratch acts as a visual and interactive scaffold that helps students test ideas, observe procedures, and revise their thinking. Therefore, technology integration in mathematics learning should not be seen merely as a supporting tool but as a learning environment that can promote logical, systematic, and reflective thinking.

Practically, the results imply that mathematics teachers can use Scratch as an alternative medium to make problem-based learning more engaging and structured, particularly for topics that require sequential reasoning such as linear equations and inequalities in one variable. Scratch-assisted activities can help students participate more actively in exploring problems, discussing possible solutions, and evaluating their answers. However, the implementation of this approach requires adequate facilities, teacher readiness, and sufficient learning time so that students can use the media effectively.

This study also has several limitations. The research used a quasi-experimental design with a posttest-only control group, so initial differences between the two classes could not be fully controlled even though the diagnostic test showed relatively similar starting abilities. The study was also conducted in only one school with two grade VIII classes and was limited to the topic of linear equations and inequalities in one variable. In addition, the assessment focused on essay-test results, while students' computational thinking processes during discussion and Scratch-based exploration were not examined in depth. Therefore, future studies are recommended to involve broader samples, different mathematical topics, longer treatment periods, and additional qualitative data to obtain a more comprehensive understanding of how Scratch supports students' mathematical computational thinking.

Acknowledgments

The author would like to express gratitude to the Mathematics Education Study Program, Faculty of Teacher Training and Education, Siliwangi University, for its support throughout the conduct of this research. The author also extends gratitude to the Principal of SMP Negeri 4 Tasikmalaya, the mathematics teachers, and all eighth-grade students who participated and helped ensure the smooth progress of the research. Furthermore, the author thanks the academic advisor and all parties who provided guidance, advice, and support, enabling this research to be successfully completed.

Declarations

Author Contribution : Author 1: Conceptualization, Writing - Original Draft, Editing and Visualization; Author 2: Validation, Supervision, and Writing, Review & Editing; Author 3: Validation, Supervision, and Writing, Review & Editing; Author 4: Strengthening the theoretical framework, Recommending relevant international references, Enhancing the discussion and interpretation of the findings, and Offering constructive recommendations to increase its international quality and impact.

Funding Statement : This research received no external funding.

Conflict of Interest : The authors declare no conflict of interest.

Generative AI Statement : This paper is assisted by AI tools, namely Quillbot for translation and Grammarly for proofreading. These tools are used to improve readability and compliance with academic standards. The authors are fully responsible for the content and interpretation presented.

Additional Information :

REFERENCES

Agung, G. H., Amalia, I. R., Faizah, N. A., & Ardiansyah, A. S. (2023). Problem Based Learning Berbantuan Scratch Bernuansa Etnomatematika Cagar Budaya Kota Semarang Terhadap Kemampuan Berpikir Kritis Siswa. *PRISMA, Prosiding Seminar Nasional Matematika*, *6*(2022), 670–675. https://journal.unnes.ac.id/sju/index.php/prisma/

Anwar, K., Kamid, Kurniawan, W., Sofidar, & Alrizal. (2025). Peningkatan Ketrampilan Berfikir Computational Thinking Dalam Pembelajaran Berbasis Programming-Matematika Menggunakan Menggunakan Scratch Jurnal Pengabdian Masyarakat (JUPEMA). *Jurnal Pengabdian Masyarakat (JUPEMA)*, *04*(01), 50–60.

Cahdriyana, R. A., & Richardo, R. (2020). Berpikir komputasi dalam pembelajaran matematika. *LITERASI (Jurnal Ilmu Pendidikan),* *11*(1), 50–56. https://doi.org/10.21927/literasi.2020.11(1).50-56

Efwan, N. S., Afriansyah, E. A., Luritawaty, I. P., Arwadi, F., & Yadav, D. K. (2024). The Level of students' mathematical creative thinking skills as measured by their self-confidence. *International Journal of Didactic Mathematics in Distance Education*, *1*(2), 125-136.

Gunawan, Y., Putra, Z. H., Antosa, Z., Dahnilsyah, D., & Tjoe, H. (2023). The effect of gender on fifth-grade students’ computational thinking skills. *Mosharafa: Jurnal Pendidikan Matematika*, *12*(3), 465-476. https://doi.org/10.31980/mosharafa.v12i3.820

Gusteti, M. U., & Neviyarni. (2022). Pembelajaran Berderensiasi pada Pembelajaran Matematika di Kurikulum Merdeka. *Lebesgue: Jurnal Ilmiah Pendidikan Matematika,*

Matematika Dan Statistika, *3*(3), 170–184. https://doi.org/10.4324/9781003175735-15

Junaeti, E., Herman, T., Priatna, N., Dasari, D., & Juandi, D. (2023). Students' Computational Thinking Ability in Calculating an Area Using The Limit of Riemann Sum Approach. *Mosharafa: Jurnal Pendidikan Matematika*, *12*(2), 215-228. https://doi.org/10.31980/mosharafa.v12i2.778

Kementerian Pendidikan dan Kebudayaan. (2019). Pedoman implementasi muatan/mata pelajaran Informatika Kurikulum 2013: Jenjang pendidikan dasar dan menengah. Badan Penelitian dan Pengembangan, Pusat Kurikulum dan Pembelajaran.

Kresnadi, H., Ghasya, D. A. V., & Pranata, R. (2023). Analisis Kemampuan Computational Thinking Berdasarkan Tahap Dekomposisi Dan Pengenalan Pola Siswa Di Kelas Iii Sdn 03 Toho. *Jurnal Review Pendidikan Dan Pengajaran*, *Volume 6 N*, 1281–1285.

Lestari, S. & Roesdiana, L. (2023). Analisis Kemampuan Berpikir Komputasional Matematis Siswa Pada Materi Program Linear. Range: Jurnal Pendidikan Matematika, 4 (2), 178-188.

Mukhibin, A., Herman, T., Aulia, L. S., & Firdaus, H. (2024). Integrating computational thinking in STEM learning: An effort to improve students' problem-solving skills. *Mosharafa: Jurnal Pendidikan Matematika*, *13*(1), 49-62. https://doi.org/10.31980/mosharafa.v13i1.1975

Muttaqin, S. (2024). Pengaruh game edukatif dalam menunjang kemampuan berpikir komputasional. *Prosiding Seminar Nasional Pendidikan Biologi*, *10*(1), 165–170.

Nabilah, A. P., Alindra, A. L., Nurhikmah, I., Fauziyah, N. N., Herlina, P., Febriyanti, R., & Prayoga, R. (2024). Penggunaan media Scratch meningkatkan motivasi belajar dan kemampuan berpikir kreatif matematis siswa. *Jurnal Pendidikan Tambusai, 8*(1), 1975–1986. https://doi.org/10.31004/jptam.v8i1.12694.

Nalman, A. R., Susanta, A., & Hanifah, H. (2023). Pengaruh Model Pembelajaran Problem Based Learning (PBL) Terhadap Kemampuan Pemahaman Konsep dan Kemampuan Pemecahan Masalah Matematika Siswa Kelas VIII SMP Negeri 10 Kota Bengkulu. *Journal on Education*, *6*(1), 12–24. https://doi.org/10.31004/joe.v6i1.2909

Nunut, I., Kadir, & Asrul, S. (2016). Pengaruh Pembelajaran Berbasis Masalah Terhadap Kemampuan Berpikir Kritis Matematis Siswa SMA. *Pasundan Journal of Mathematics Education : Jurnal Pendidikan Matematika*, *Vol 6 No. 2*, 37–45. https://doi.org/10.23969/pjme.v6i2.2650

Nurohman, S., Purnomo, Y. W., Munzil, M., Prabawa, H. W., Wardani, R., & Utomo, B. (2022). *Computational thinking dalam pembelajaran*. Direktorat Pendidikan Profesi Guru, Direktorat Jenderal Guru dan Tenaga Kependidikan, Kementerian Pendidikan, Kebudayaan, Riset dan Teknologi.

Papatga, E., & Ersoy, A. (2016). Improving reading comprehension skills through the SCRATCH program. *International Electronic Journal of Elementary Education*, *9*(1), 124–150.

Putri, R. O., Nugroho, A. S., & Umam, N. K. (2023). Pengaruh Model *Problem Based Learning* Terhadap Kemampuan Berpikir Kritis Siswa Kelas V Sekolah Dasar Pada Pelajaran *IPS Corresponding author : 4*(2), 1–10.

Rinaldi, E., & Afriansyah, E. A. (2019). Perbandingan kemampuan pemecahan masalah matematis siswa antara problem centered learning dan problem based learning. *NUMERICAL: Jurnal Matematika dan Pendidikan Matematika*, 9-18.

Rosita, N. T., Putra, B. Y. G., & Suhendar, Y. (2026). Needs Analysis: Developing Scratch Media with Sumedang Local Wisdom to Enhance Students' Computational Thinking. *Mosharafa: Jurnal Pendidikan Matematika*, *15*(1), 182-199. https://doi.org/10.31980/mosharafa.v15i1.3623

Solehudin, S., Darhim, D., & Herman, T. (2024). Analisis Kemampuan Dekomposisi Computational Thinking Siswa Pada Materi Sistem Persamaan Linear Dua Variabel. *Jurnal Perspektif*, *8*(2), 218. https://doi.org/10.15575/jp.v8i2.304

Supriatin, C., & Putra, H. D. (2023). Pengembangan Bahan Ajar Materi Garis Singgung Lingkaran Menggunakan Model Problem Based Learning berbantuan Scratch. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, *6*(5), 1851–1864. https://doi.org/10.22460/jpmi.v6i5.20811.

Suwanto, S., Siagian, M. D., Purba, B. P., Siahaan, C. K. M. S., Tambunan, C., Amanda, D., & Perangin-angin, T. D. (2025). Analisis computational thinking pada pembelajaran matematika dengan mengintegrasikan algoritma pemrograman. *Jurnal Inovasi Pembelajaran Matematika: PowerMathEdu*, *4*(1), 175-186. https://doi.org/10.31980/pme.v4i1.2648

Veronica, A. R., Siswono, T. Y. E., & Wiryanto. (2022). Hubungan berpikir komputasi dan pemecahan masalah Polya pada pembelajaran matematika di sekolah dasar. ANARGYA: Jurnal Ilmiah Pendidikan Matematika, 5(1), 115–126. https://doi.org/10.24176/anargya.v5i1.7977

Widyastuti, R. T., & Airlanda, G. S. (2021). Efektivitas model *Problem Based Learning* terhadap kemampuan pemecahan masalah matematika siswa sekolah dasar. *Jurnal Basicedu, 5*(3), 1120–1129. https://doi.org/10.31004/basicedu.v5i3.896.

Ye, H., Liang, B., Ng, O.-L., & Chai, C. S. (2023). Integration of computational thinking in K-12 mathematics education: A systematic review on CT-based mathematics instruction and student learning. *International Journal of STEM Education, 10*, Article 3. https://doi.org/10.1186/s40594-023-00396-w