



Effect of Canva-Assisted Project-Based Learning on Students' Conceptual Understanding and Mathematical Problem-Solving Skills

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ABSTRACT

Effective techniques must be applied in the design of mathematics instruction to ensure that learning objectives are achieved. Conceptual understanding and mathematical problem-solving skills are considered the primary learning objectives for students. However, in reality, many students still struggle to fully understand concepts or solve mathematical problems systematically. This study aims to determine the effect of using a Project-Based Learning (PjBL) approach supported by Canva on students' conceptual understanding and mathematical problem-solving skills. A quasi-experimental pretest–posttest non-equivalent control group design involved 50 students, with 25 in each group. During three 40-minute sessions, the experimental group used Canva to create scaled house floor plans on the topic of ratios and scale, while the control group received traditional instruction. Data were collected using validated essay tests scored with a predetermined rubric and analyzed using independent-samples t-tests. Significant between-group differences were found in conceptual understanding, $t(48) = -2.135, p = 0.038$, Cohen's $d = 0.60$, and problem-solving skills, $t(48) = -2.254, p = 0.029$, Cohen's $d = 0.64$. These findings suggest that Canva-supported PjBL offers promise for supporting both learning outcomes, although the intervention was limited to three sessions.



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Introduction

Mathematics learning is a series of activities that emphasize students' understanding of concepts, principles, and procedures for solving mathematical problems (Lestari et al., 2018). This type of learning prioritizes students' cognitive processes in assimilating information and solving problems, rather than final grades (Rahayu & Soleha, 2023). To help students apply concepts in their daily lives, the mathematics learning process should be designed to be interactive and contextual. This approach makes the mathematical material students learn feel

more relevant to them, rather than abstract (Rahayu et al., 2025). Based on this, the thought process in learning is also given attention from both scientific and religious perspectives.

Islam emphasizes the importance of using reason to acquire knowledge. This principle is in line with Surah Al-Baqarah, verse 269:

يُؤْتِي الْحِكْمَةَ مَنْ يَشَاءُ ۚ وَمَنْ يُؤْتَ الْحِكْمَةَ فَقَدْ أُوتِيَ خَيْرًا كَثِيرًا ۚ وَمَا يَذَّكَّرُ إِلَّا أُولُو الْأَلْبَابِ

This means, “He grants wisdom to whomever He wills. Whoever is given wisdom has indeed been given a great blessing. And none can take heed except those of understanding.” This passage makes it clear that thinking is an essential human ability for learning. Therefore, when students work on projects related to real-world issues, Project-Based Learning (PjBL) serves as a learning paradigm that actively develops their critical thinking skills.

According to Thomas (2000), Project-Based Learning (PjBL) is an educational approach that centers the learning process on projects, enabling students to acquire knowledge and skills through research on specific issues. By involving students in planning, implementing, and completing projects related to real-world problems, this approach actively engages students in their education and ultimately produces tangible outcomes (Amriani et al., 2024). PjBL is implemented through a series of stages that help students identify problems, create solutions, complete projects, and evaluate the results of those projects. Throughout the learning process, these stages foster students’ active participation, motivation, and sense of responsibility (Djeni dan Nasikhah, 2022). Digital learning tools such as Canva can be integrated with PjBL to enhance the presentation of project outcomes.

Canva is a visual learning tool that allows teachers and students to create engaging infographics, diagrams, and presentation materials (Janah et al., 2023). This tool helps make abstract mathematical concepts more tangible, making them easier for students to understand (Rubiyaniti & Novianti, 2025). Additionally, Canva’s dynamic presentation of content can encourage students to participate more actively in their education (Sirait et al., 2024). When Project-Based Learning (PjBL) is used, Canva serves as a tool for designing and presenting project outcomes in visual form. Students can use Canva to create visual representations of mathematical concepts, organize information, and present their problem-solving results visually. Students can connect mathematical ideas to the work they create using Canva during project activities, which supports conceptual understanding and problem-solving.

Project activities that utilize visualizations of mathematical concepts can be used to implement Project-Based Learning (PjBL) with the help of Canva (Kusuma et al., 2023). Through these activities, students organize information and represent the relationships between concepts through the products they create, thereby gaining a deeper understanding of the concepts. Guiding questions, project planning, scheduling, project implementation, presentation of results, assessment, and reflection are the six stages of the Project-Based Learning (PjBL) paradigm. When students are able to create graphical representations that effectively convey the relationships or correlations between mathematical ideas, they can gain a better understanding of the material (Lestari et al., 2021). This activity helps students understand concepts and develop their ability to solve mathematical problems, while also fostering their creativity and critical thinking skills.

Kilpatrick (2001) defines conceptual understanding as students’ ability to understand concepts, mathematical processes, and the interconnections between concepts in an integrated manner, thereby enabling them to establish meaningful relationships among various mathematical ideas. This ability reflects students’ proficiency in understanding mathematical content and applying these ideas appropriately in diverse contexts (Yulianah et al., 2020). These

skills go beyond simply memorizing formulas; they also involve understanding the connections between concepts (Soleha et al., 2024). Students with a solid grasp of concepts are able to retell the material coherently in their own words (Blouin & Lestari, 2024). In this study, conceptual understanding was assessed based on the following indicators: articulating concepts, grouping objects, distinguishing between examples and non-examples, and applying concepts. However, the reality on the ground shows that students' inability to understand mathematical concepts remains a fundamental problem in mathematics education. Therefore, an educational method is needed to improve mathematical understanding.

According to Polya (1973), problem-solving skills can be described as a process involving four key steps: understanding the problem, formulating a plan, implementing that approach, and drawing conclusions. Given its relevance to the application of concepts in everyday life, this skill is a primary goal in mathematics education (Khusna & Ulfah, 2021). However, students still face challenges in formulating a logical sequence of steps to solve mathematical problems, which can affect their learning outcomes (Rofi'ah et al., 2019). These challenges may include difficulties in understanding the information in a problem, formulating a mathematical model, determining a solution strategy, carrying out calculation procedures, and verifying the accuracy of the results obtained. Given these conditions, education must be designed in such a way as to enhance students' conceptual understanding and mathematical problem-solving skills.

Previous research has demonstrated the benefits of using Canva and implementing Project-Based Learning (PjBL) in mathematics education. According to Farhin et al. (2023), Project-Based Learning (PjBL) can improve student learning outcomes through student-centered learning activities. Research Amriani et al. (2024) also shows that student engagement in project completion has a positive impact on the development of mathematical problem-solving skills. Meanwhile, Janah et al. (2023) suggest that Canva supports the visual presentation of material, thereby making it easier for students to understand mathematical concepts and increasing their engagement during learning. Furthermore, Rahmawati (2025) suggest that integrating Project-Based Learning (PjBL) with Canva helps develop students' capacity for creative thinking while improving learning outcomes.

Currently, there is still very little research on the implementation of Project-Based Learning (PjBL) supported by Canva in mathematics instruction. Previous research has tended to focus on learning outcomes or specific mathematical skills in isolation, while there are still very few studies that examine conceptual knowledge and problem-solving skills simultaneously. In addition, some studies still apply learning models and media separately, so the operational use of Canva in the Project-Based Learning (PjBL) process has not been extensively explained. Previous research has also been conducted at different educational levels or on different mathematical topics. Given these circumstances, a study is needed that integrates Project-Based Learning (PjBL) and specifically Canva to enhance students' conceptual understanding and mathematical problem-solving skills. Therefore, Canva-assisted Project-Based Learning (PjBL) was used in this study to examine its impact on students' conceptual understanding and mathematical problem-solving skills.

Method

Types and Designs of Research

This study employed a quantitative approach with a quasi-experimental design, specifically a pretest-posttest design with a non-equivalent control group. Both groups took a pretest to assess the students' initial abilities prior to the intervention. The Project-Based Learning (PjBL) approach, supported by Canva, was then implemented in the experimental class, while conventional teaching methods were used in the control class. Both classes took a posttest to assess their conceptual understanding and mathematical problem-solving skills following the intervention. Table 1 shows the research design used in this study.

Table 1. Research Design

Group	Pretest	Treatment	Posttest
Experiment	Y_1	X_1	Y_2
Control	Y_1	X_2	Y_2

Notes:

Y_1 = Pretest

Y_2 = Posttest

X_1 = *Project Based Learning* (PjBL) with Canva

X_2 = Conventional Learning

Population and Sample

The population of this study comprised all seventh-grade students at Darul Lughah Wal Karomah Junior High School for the 2025–2026 school year. The study sample consisted of two classes, each with 25 students: Class VII A as the experimental group and Class VII B as the control group. The sample was selected using a purposive sampling technique. This method was chosen based on input from mathematics teachers and the characteristics of the two classes that aligned with the research objectives: they were at the same grade level, received equivalent instructional material, and had comparable class sizes. The experimental group (Class VII A) participated in Project-Based Learning (PjBL) facilitated by Canva, while the control group (Class VII B) participated in conventional instruction.

Research Instruments

An essay-type test was used as a research instrument to measure students' conceptual understanding and mathematical problem-solving skills. The test consisted of ten items: Five items measure conceptual understanding, and the other five items measure mathematical problem-solving ability. The development of this instrument was based on indicators for each variable under study. Indicators covering conceptual expression, grouping of objects, distinguishing between examples and non-examples, and application of concepts were used to measure conceptual knowledge. Meanwhile, the indicators for mathematical problem-solving skills include topic comprehension, strategy planning, strategy implementation, and drawing conclusions. Table 2 presents the test design for this instrument, which illustrates the relationship between each test item and the established indicators.

Table 2. Test Instrument Outline

Variable	Indicator	Question Indicators	Question Number
Conceptual Understanding	Stating the concept	Explain the concepts of ratio and scale, and write down the formula for scale	1
	Grouping objects	Group equivalent comparisons and provide reasons	2
	Distinguishing examples	Identify examples and non-examples of direct comparisons and explain why	3
	Applying the concept	Using the concept of scale or ratio to solve problems	4, 5
Problem Solving	Understanding the problem	Stating the information provided and the terms of the matter	6
	Planning a strategy	Outline the strategies or steps that will be taken to resolve the problem	7
	Implementing a strategy	Performing calculations and outlining procedures in a logical manner	8, 9
	Drawing conclusions	Write a final answer that fits the context of the problem	10

The test instruments were developed based on established indicators of conceptual understanding and mathematical problem-solving skills. Each test item was designed to measure students' abilities in accordance with the indicators for each variable. Table 3 presents the ten test items used in this study.

Table 3. Test Item Questions

Variable	Number	Test Item
Conceptual Understanding	1	Explain the concepts of ratio and scale in your own words, and then write down the general formula for scale used in calculating distances on maps or floor plans!
	2	Consider the following ratios: a. 2 : 3, b. 4 : 6, c. 6 : 9, d. 3 : 5, e. 8 : 12. Group the ratios that are equivalent to 2 : 3 and explain your reasoning!
	3	Determine which of the following are direct comparisons and which are not. Give a simple reason for each answer! a. The amount of gasoline and the distance traveled by a vehicle (at a constant speed). b. The number of workers and the time taken to complete the same task. c. The number of items and the total price to be paid. d. The length of a square's side and the area of the square.
	4	A map has a scale of 1 : 250,000. The distance between two cities on the map is 4 cm. Determine the actual distance between the two cities using the concept of scale, and explain your steps systematically!
	5	The ratio of Andi's age to Rudi's is 2 : 3, and their combined age is 40 years. Determine each of their ages and explain how you calculated them!
Problem Solving	6	A house plan is drawn to a scale of 1:100. The length of the room on the plan is 5 cm, and its width is 3 cm. List what is given and what is being asked in this problem?
	7	A vehicle travels a distance of 150 km in 3 hours. If the speed remains constant, determine the distance traveled in 5 hours, explaining your solution strategy first!
	8	A map with a scale of 1:500,000 shows the distance between two cities as 6 cm. Calculate the actual distance between the two cities and write down the steps to solve the problem!

Variable	Number	Test Item
	9	A job can be completed by 5 people in 12 days. If the job is done by 8 people with the same skills, determine the time required to complete the job using a systematic approach!
	10	The scale of a model car is 1:25, and the actual length of the car is 5 meters. Determine the length of the model car and write a conclusion that fits the context of the problem!

A validator, lecturer specializing in mathematics education, assessed the content validity of the instrument before it was used in the study. The validation procedure utilized a validation sheet with a rating scale of 1–4 (1: poor, 2: fair, 3: good, and 4: excellent). The factors assessed included the appropriateness of the test items for the students' ability level, the alignment of the test items with the indicators, language use, clarity of sentences, absence of ambiguity, alignment with the research objectives, and the alignment between the answer key and the skills being measured. Based on the validation results and after making several minor adjustments according to the validator's feedback, the instrument was deemed suitable for use.

After the instrument was approved by the validator, IBM SPSS Statistics 22 software was used for empirical testing. The calculated R value $R_{calculate}$ for each test item was compared with the R_{table} value of 0,279 at a 5% significance level ($\alpha = 0,05$) to evaluate empirical validity. If $R_{calculate} > R_{table}$, then the test item is deemed valid. Table 4 presents the validity test results for the mathematical concept comprehension and problem-solving skills tests.

Table 4. Instrument Validity Test Results

Test Item	Variable	$R_{calculate}$	R_{table}	Description
1	Conceptual	0.719	0.279	Valid
2	Understanding	0.658	0.279	Valid
3		0.550	0.279	Valid
4		0.771	0.279	Valid
5		0.428	0.279	Valid
6	Problem	0.655	0.279	Valid
7	Solving	0.698	0.279	Valid
8		0.658	0.279	Valid
9		0.282	0.279	Valid
10		0.580	0.279	Valid

Based on Table 4, each test item yielded a calculated R value higher than the R_{table} value (0,279); thus, each test item is considered valid and suitable for use in this study. These findings indicate that each test item has a correlation coefficient that meets the established validity requirements. Consequently, students' abilities can be measured using all test items in the instrument, which assesses conceptual understanding and mathematical problem-solving skills in accordance with the predetermined indicators. Following the validity test, the instrument was then tested for reliability to determine the consistency of measurement results for each research variable.

Table 5. Instrument Reliability Test Results

Variable	Cronbach's Alpha	N of Items
Conceptual Understanding	0,624	5
Problem Solving	0,638	5

Based on Table 5, the Cronbach's alpha value for the conceptual understanding instrument was 0.624, and for the mathematical problem-solving ability instrument, it was 0.638. Both instruments consisted of five items and had Cronbach's alpha values greater than 0.60. Thus, both instruments met the reliability criteria used in this study.

Research Procedure

Three methods were used to collect data in this study: tests, documentation, and observation. At Darul Lughah Wal Karomah Junior High School, the observation technique was used to monitor student activities during class. Students' conceptual understanding and mathematical problem-solving skills were assessed using an essay-based test designed according to indicators for each variable. Meanwhile, supporting data obtained through the documentation method included activity logs, recordings of the learning process, and the results of projects completed by the students.



Figure 1. Observation



Figure 2. Pretest



Figure 3. Canva-Assisted Project-Based Learning (PjBL)



Figure 4. Posttest

Figures 1–4 present the observation, pretest, PjBL assisted by Canva, and posttest activities, respectively. These figures illustrate the main activities conducted during the data collection process. Figure 5 presents the research stages for both the experimental and control groups.

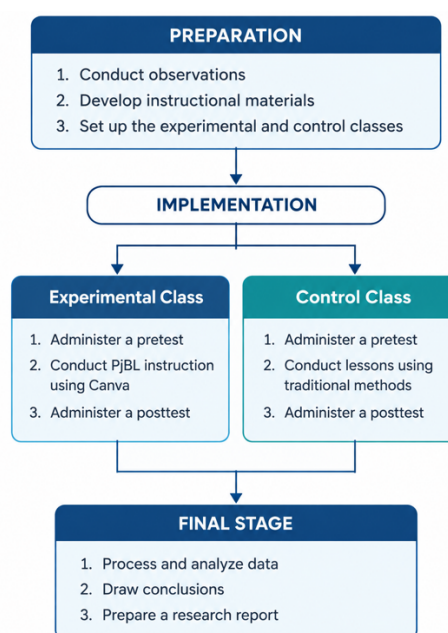


Figure 5. Research Phases

Six steps were implemented in the application of the Project-Based Learning (PjBL) paradigm in the experimental classroom: defining the central question, planning the project, creating a schedule, carrying out the project, presenting the results, and assessment and reflection. The instructor introduced a contextual challenge related to the concepts of ratio and scale during the formulation of the fundamental question. During the project planning stage, students designed the product they would create using Canva. Next, during the schedule development stage, students determine the division of tasks and the timeline for completing the project. During the project implementation stage, students create and develop their products using Canva under the teacher's guidance. During the presentation of results stage, students present the products they have created using Canva. The final stage—evaluation and reflection—involves evaluating the project outcomes and reflecting on the learning process and the use of Canva.

Data Analysis

IBM SPSS Statistics was used to analyze the research data. To determine whether the data were normally distributed, the Shapiro-Wilk test was used to evaluate the normality of the data at a significance level of 0.05. Next, Levene's test was used to test for homogeneity, and the significance value (Sig.) in the "Based on Mean" section at the 0.05 level was used as a basis for decision-making. The independent samples t-test is used for hypothesis testing at a significance level of 0.05 (two-tailed test) after the data meet the requirements for homogeneity and normality. This test is used to evaluate the post-test results of the experimental and control groups regarding conceptual understanding and mathematical problem-solving skills.

Results

The Project-Based Learning (PjBL) methodology, supported by Canva, was used to teach the concepts of ratio and scale in the experimental class. The implementation of PjBL consisted of six stages: fundamental questions, project planning, scheduling, project execution, presentation of results, assessment, and reflection. In the fundamental question stage, the researcher presented a contextual problem related to ratios and scales as the foundation for the project. Then, during the project planning stage, students worked together in groups to create a specific product: a floor plan of a house drawn to a reduced scale. At this stage, Canva was introduced as a tool for designing and visualizing the product.

For the topic of ratios and scale, the experimental class used a Project-Based Learning (PjBL) paradigm supported by Canva. The implementation of this model consisted of six stages: fundamental questions, project planning, scheduling, project execution, presentation of results, assessment, and reflection. To provide a foundation for the project, the researcher presented a contextual problem related to ratios and scales during the fundamental questions stage. Next, during the planning stage, students worked in groups to design a scaled house plan. At this stage, Canva was introduced as a tool to help design and visualize the product they would create.

During the scheduling phase, students determined the division of tasks and the time required to complete the project. Next, during the project implementation phase, students created scaled house floor plans using Canva under the researcher's guidance. Students applied the concepts of proportion and scale to determine dimensions, then presented the floor plans visually through Canva. During the presentation phase, each group presented the product they had created and explained the process of its completion. The final phase consisted of an

evaluation and reflection session conducted by the researcher together with the students to assess the project outcomes and reflect on the students' learning process and experiences while completing the project. Documentation of the learning activities is presented in Figures 6–9.



Figure 6. The researcher raised a fundamental question



Figure 7. Students discuss and design projects



Figure 8. Students are working on a project using Canva



Figure 9. Students present their project results

Documentation of the learning process shows the involvement of the researcher and students in each key stage of Canva-assisted PjBL. The activity began with the presentation of a contextual problem, followed by discussion and project planning, the creation of a scaled house floor plan using Canva, and a presentation of the results. Throughout the learning process, students were involved in determining the design, dividing tasks, applying the concepts of proportion and scale, and communicating the project results. The documentation shows that the implementation of Canva-assisted PjBL provided students with the opportunity to actively participate from the planning stage through to the presentation of project results. Documentation of the scaled house floor plan project results created by each group using Canva is presented in Figures 10–14.



Figure 10. Canva Media Project – Group 1



Figure 11. Canva Media Project – Group 2

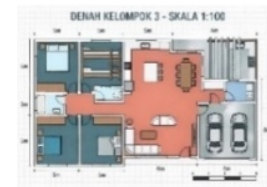


Figure 12. Canva Media Project – Group 3



Figure 13. Canva Media Project – Group 4



Figure 14. Canva Media Project – Group 5

Based on the results of the project, each group produced a scaled house plan with distinct presentation characteristics. These differences were evident in the layout, the completeness of the information, and the way each group presented dimensions on the plan. The final products were then analyzed based on the students' achievement levels regarding the indicators of conceptual understanding and mathematical problem-solving skills, as shown in Table 6.

Table 6. Summary of Student Achievement by Competency Indicators

Variable	Indicator	K1	K2	K3	K4	K5
Conceptual Understanding	State a concept	✓	✓	✓	✓	✓
	Group objects	✓	×	✓	✓	×
	Distinguish examples	✓	✓	✓	✓	✓
	Apply a concept	✓	✓	×	✓	×
Problem Solving	Understand a problem	✓	✓	✓	✓	✓
	Plan a strategy	✓	✓	✓	✓	✓
	Implement a strategy	✓	✓	✓	✓	✓
	Draw conclusions	✓	✓	✓	✓	✓

Most groups met the indicators for conceptual knowledge and mathematical problem-solving skills, as shown in Table 6. All groups were able to effectively communicate ideas and distinguish examples related to conceptual knowledge; however, some groups did not meet the indicators for object classification and concept application. Each group met all the criteria for problem-solving skills, which include understanding the problem, formulating a plan, implementing the plan, and drawing conclusions.

Descriptive statistics based on pretest and posttest data from the experimental and control classes were used to analyze student learning outcomes at the beginning and end of the study. This analysis aims to determine the minimum, maximum, mean, and dispersion of the data (expressed as standard deviation) for each group. The results of the analysis provide an initial overview of changes in students' skills following the instructional intervention. Table 7 presents the results of data analysis using IBM SPSS Statistics.

Table 7. Descriptive Statistics of Pretest and Posttest Results on Conceptual Understanding

Value	N	Minimum	Maximum	Mean	Std. Deviation
Pretest Experiment	25	0	60	20.80	18.912
Posttest Experiment	25	20	100	81.60	23.395
Pretest Control	25	0	40	14.40	13.565
Posttest Control	25	20	100	73.20	21.548

Based on the information in Table 7, the average post-test score for conceptual understanding in the experimental class was 81.60, while the control group's score was 73.20. These results indicate that after the training, students in the experimental class demonstrated better conceptual knowledge than students in the control class.

To determine whether the research data follow a distribution that approximates a normal distribution, the first step in data analysis is to conduct a normality test. The variables of

conceptual understanding and mathematical problem-solving were tested using both pre-test and post-test data from the experimental and control groups. The Shapiro-Wilk test criteria state that if the significance value (Sig.) is greater than 0.05, the data are considered to be normally distributed; conversely, if the Sig. value is less than 0.05, the data are not normally distributed. Table 8 presents the results of these tests.

Table 8. Results of the Normality Test for the Conceptual Understanding Test

Value	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
Pretest Control	.121	25	.200	.948	25	.227
Posttest Control	.090	25	.200	.965	25	.523
Pretest Experiment	.101	25	.200	.941	25	.158
Posttest Experiment	.107	25	.200	.936	25	.117

Based on the summary in Table 8, the Shapiro-Wilk values for the pretest and posttest data on conceptual understanding ability—in both the experimental and control classes—were all greater than 0.05. Thus, one of the requirements for parametric analysis was met because the data on conceptual understanding ability were normally distributed. Next, Levene's test was used to test for homogeneity to determine whether the variances of the two groups were equal. If the significance value (Sig.) is greater than 0.05, the data are considered homogeneous. Table 9 presents the results of this homogeneity test.

Table 9. Homogeneity Test

Value	Levene Statistic	df1	df2	Sig.
Based on Mean	.051	1	48	.821
Based on Median	.000	1	48	1.000
Based on Median and with adjusted df	.000	1	46.343	1.000
Based on trimmed mean	.020	1	48	.889

Based on Table 9, the results of Levene's homogeneity test show a "Based on Mean" significance value of 0.821, which is greater than 0.05. Thus, one of the requirements for parametric analysis has been met because the variances of the data regarding conceptual understanding in the experimental and control classes are considered homogeneous.

An independent-samples t-test was used after the data met the criteria for homogeneity and normality. The purpose of this test was to compare mathematical conceptual knowledge between students in the experimental class, who were taught using the Canva-assisted PjBL paradigm, and students in the control class, who were taught using conventional methods. Table 10 presents the results of this test.

Table 10. Results of the Independent-Samples T-Test for Conceptual Understanding

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	Df	Sig. (2- tailed)	Mean Differen ce	Std. Error Differen ce	95% Confidence Interval of the Difference	
										Lower r
										Upper r
Value	Equal variances assumed	.278	.601	-2.135	48	.038	-12.800	5.994	-	-747
	Equal variances not assumed			-2.135	47.199	.038	-12.800	5.994	-	-742

The results of the independent samples t-test in Table 10 show a t-value (48) of -2.135 and a significance value (2-tailed) of 0.038 ($p < 0.05$). The 95% confidence interval for the difference in means is [-24.853, -0.747]. These findings indicate a significant difference in the understanding of mathematical concepts between students who received traditional instruction and those who were taught using a Project-Based Learning (PjBL) approach with the aid of Canva. Cohen's d was used to determine the effect size, and the result was 0.60, indicating a moderate effect size. In addition, Table 11 presents the average post-test scores for the experimental and control classes to clarify the differences in ability between the two groups.

Table 11. Results of the Independent-Samples t-Test for Conceptual Understanding Ability

		Kelas	N	Mean	Std. Deviation	Std. Error Mean
Value	Posttest Control		25	73,20	22.531	4.506
	Posttest Experiment		25	81,60	19.765	3.953

Table 11 shows that the average post-test score for conceptual knowledge in the experimental class was 81.60, while the control group's score was 73.20. These findings indicate that, compared to students who received conventional instruction, students who participated in Project-Based Learning (PjBL) supported by Canva achieved a higher level of conceptual knowledge. Thus, there is a difference in conceptual understanding of mathematics between the experimental class and the control class.

After identifying the differences in conceptual understanding of mathematics between the experimental and control groups, an analysis was conducted to determine how the application of various interventions affected students' ability to solve mathematical problems in both groups. Descriptive statistics were presented first to provide an overview of the pre-test and post-test results for the experimental and control groups. Next, the basis for hypothesis testing was established through the implementation of an independent samples t-test, a homogeneity test, and a normality test. Table 12 displays descriptive data related to mathematical problem-solving skills.

Table 12. Descriptive Statistics of Pretest and Posttest Results on Problem Solving

		N	Minimum	Maximum	Mean	Std. Deviation
Value	Pretest Experiment	25	0	70	27.60	24.712
	Posttest Experiment	25	40	100	76.40	19.765
	Pretest Control	25	0	60	28.40	19.933
	Posttest Control	25	10	100	57.60	28.908

Table 12 shows that the average post-test score for problem-solving skills in the experimental class was 76.40, while the score for the control group was 57.60. These findings indicate that after the instruction, students in the experimental class performed better at solving math problems than those in the control group.

As a prerequisite for parametric analysis, a normality test was conducted prior to hypothesis testing. The purpose of this test was to determine whether the problem-solving skills data from both groups were normally distributed. Table 13 presents the results of the normality test.

Table 13. Results of the Normality Test for the Problem-Solving Test

		Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Value	Pretest Control	.120	25	.200	.934	25	.109
	Posttest Control	.124	25	.200	.965	25	.524
	Pretest Experiment	.131	25	.200	.945	25	.192
	Posttest Experiment	.092	25	.200	.975	25	.781

Based on the results of the normality test in Table 13, the Shapiro-Wilk significance values for the pretest and posttest problem-solving ability data—in both the experimental and control classes—were all greater than 0.05. Thus, one of the requirements for parametric analysis was met because the problem-solving ability data were normally distributed. Next, Levene's test was used to assess homogeneity to determine whether the variances of the two groups were equal. If the significance value (Sig.) is greater than 0.05, the data are considered homogeneous. Table 14 presents the results of the homogeneity test for problem-solving skills.

Table 14. Results of the Homogeneity Test for the Problem-Solving Test

		Levene Statistic	df1	df2	Sig.
Value	Based on Mean	3.721	1	48	.060
	Based on Median	2.948	1	48	.092
	Based on Median and with adjusted df	2.948	1	40.335	.094
	Based on trimmed mean	3.790	1	48	.057

Based on Table 14, the results of Levene's homogeneity test show a significance value (based on the mean) of 0.060, which is greater than 0.05. Thus, one of the requirements for parametric analysis is met because the variances of the problem-solving ability data in the experimental and control groups are considered homogeneous. Next, the students' problem-solving abilities in the experimental and control groups were compared using an independent samples t-test. Table 15 presents the results of this test.

Table 15. Results of the Independent-Samples T-Test for Problem Solving

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2- tailed)	Mean Differ- ence	Std. Error Differ- ence	95% Confidence Interval of the Difference	
									Lower	Upper
Value	Equal variances assumed	3.805	.057	-2.254	48	.029	-14.400	6.390	-27.274	-1.553
	Equal variances not assumed			-2.254	43.27 3	.029	-14.400	6.390	-27.283	-1.517

The results of the independent samples t-test in Table 15 show a t-value (48) of -2.254, with a significance level (2-tailed) of 0.029 (< 0.05). The 95% confidence interval for the difference in means is [-27.274, -1.553]. These findings indicate a significant difference in mathematical problem-solving skills between students who receive a conventional education and those taught using a Project-Based Learning (PjBL) approach with the aid of Canva. Cohen's d was used to determine the effect size, and the result was 0.64, indicating a moderate effect size. In addition, Table 16 presents the average post-test scores for the experimental and control classes to illustrate the differences in skills between the two groups.

Table 16. Results of the Independent Samples T-Test for Problem-Solving Ability

		Class	N	Mean	Std. Deviation	Std. Error Mean
Value	Posttest Kontrol		25	57,60	26.058	5.212
	Posttest Eksperimen		25	76,40	18.484	3.697

Table 16 shows that the average post-test score for mathematical problem-solving skills in the experimental class was 76.40, while the score in the control group was 57.60. These findings indicate that students who participated in Project-Based Learning (PjBL) using Canva had better mathematical problem-solving skills than students who participated in conventional instruction. Thus, there is a difference in mathematical problem-solving skills between the experimental class and the control class.

In addition, a study was conducted to examine how a Canva-assisted Project-Based Learning (PjBL) approach in that classroom could improve students' conceptual understanding and mathematical problem-solving skills. The results of the project, which demonstrated that students had met the competency indicators, supported this study, which compared pre-test and post-test results. Table 17 presents the results of this analysis.

Table 17. Comparison of the Average Pretest and Posttest Scores for the Experimental Class

Variable	Pretest	Posttest
Conceptual Understanding	20,80	81,60
Problem Solving	27,60	76,40

Table 17 shows that while problem-solving skills increased from 27.60 to 76.40, the average conceptual understanding score increased from 20.80 to 81.60. This increase indicates that students' understanding of arithmetic concepts and problem-solving skills improved after participating in instruction that utilized a Project-Based Learning (PjBL) approach with the aid of Canva.

Discussion

Research findings indicate differences in the understanding of mathematical concepts between students who receive conventional instruction and those taught using a Project-Based Learning (PjBL) paradigm supported by Canva. This is evidenced by the results of the independent samples t-test, with a t-value (48) of -2.135 , a 95% confidence interval of $[-24.853; -0.747]$, and a significance level (2-tailed) of $0.038 (< 0.05)$. The effect size of 0.60 , calculated using Cohen's d , indicates a moderate effect. Additionally, the average post-test score for the experimental class was higher than that of the control class (81.60 versus 73.20). These results indicate that after the instruction, students in the experimental class demonstrated a better conceptual understanding than students in the control group. These findings are consistent with a study [Farhin et al. \(2023\)](#) that explains how the Project-Based Learning (PjBL) approach can improve student learning outcomes.

Through hands-on learning activities, the Project-Based Learning (PjBL) paradigm provides students with the opportunity to construct their own understanding. In this learning process, students work on a project that involves using Canva to create a scaled floor plan of a house; thus, they not only learn the material conceptually but also apply it in practical situations. Through this method, students are able to better understand the relationships between various topics and develop a deeper understanding. This view is supported by [Khusna & Ulfah. \(2021\)](#) who state that contextual learning helps students achieve a deeper conceptual understanding.

In addition to the learning paradigm, the more engaging presentation of material through Canva also aids in the process of conceptual understanding. By using this application, students can organize material, compile project results, and build visual connections between mathematical ideas. These findings align with research [Janah et al. \(2023\)](#) which found that Canva facilitates the visualization of learning material. In line with this, [Ginting & Siregar. \(2025\)](#) state that the use of Canva makes learning more dynamic and engaging, while also making it easier for students to understand the subject matter. Furthermore, [Purba & Harahap. \(2022\)](#) emphasize that students' attention and concentration while learning can be enhanced through the use of digital media.

This study shows that there is a difference between the experimental group and the control group in their ability to solve mathematical problems, which goes beyond mere conceptual understanding. The results of the independent samples t-test showed a t-value (48) of -2.254 , with a 95% confidence interval of $[-27.274, -1.553]$ and a two-tailed significance level of $0.029 (p < 0.05)$. The effect size of 0.64 , calculated using Cohen's d formula, indicates a moderate effect. Furthermore, the mean post-test score in the experimental group was higher than that in the control group (76.40 versus 57.60). These results indicate that, following the learning process, students in the experimental class demonstrated better mathematical problem-solving skills than students in the control group. This is consistent with the findings of [Amriani et al., \(2024\)](#) who stated that students' active participation in project-based learning can foster critical thinking and problem-solving skills.

Student involvement at every stage of the project from understanding the problem, formulating and implementing a solution strategy, to presenting the final project results was a key factor in the difference in problem-solving skills between the two groups. Through this series of activities, students learned to think systematically, engage in dialogue, share ideas, and collaborate to find solutions. This learning experience helps students gradually improve their problem-solving skills. These findings align with the view [Rahmawati \(2025\)](#), that the

implementation of Project-Based Learning (PjBL) supported by Canva can enhance students' creative thinking skills and learning outcomes.

Students have the opportunity to demonstrate problem-solving techniques in a more organized visual format using Canva during the learning process. This presentation style allows students to better articulate the ideas and solutions they discover, while also making the concepts and procedures involved easier to understand. Our findings are supported by research [Sabrina et al. \(2023\)](#), which shows that digital visual media can increase student motivation to learn. Furthermore, according to [Janah et al. \(2023\)](#), Canva makes it easier to present information in a more systematic way.

This study demonstrates changes in the average scores for conceptual understanding and mathematical problem-solving skills in the experimental class following the implementation of a Canva-assisted Project-Based Learning (PjBL) model, and highlights the differences between the experimental and control classes. This improvement is evident from the increase in average scores from the pretest to the posttest and is supported by project assessment results showing that most groups met the indicators for conceptual understanding, and all groups met the indicators for mathematical problem-solving skills. These findings illustrate changes in student achievement in the experimental class during the study. However, these changes were not used as a basis for concluding the extent of the treatment's effectiveness.

Students can learn through project-based activities, which lead to this improvement. Students use Canva to create works during the learning process by applying the concepts they have learned theoretically. These exercises make the learning process more relevant by helping students discover connections between mathematical ideas and real-world situations. This conclusion is supported by [Farhin et al. \(2023\)](#), who state that Project-Based Learning (PjBL) increases student engagement during the learning process. Similarly, according to [Khusna & Ulfah. \(2021\)](#), contextual learning enhances students' conceptual understanding.

In practice, the use of Project-Based Learning (PjBL) supported by Canva impacts mathematics instruction because it provides students with the opportunity to connect concepts to real-world problems through the creation of visual products. While project-based activities encourage student participation, teamwork, and mathematical communication, Canva allows them to express their ideas and answers in a more organized manner. Therefore, the use of Project-Based Learning (PjBL) supported by Canva is worth considering as an alternative method in mathematics instruction, particularly for topics that allow students to produce visual works.

Overall, the findings of this study support previous research on the effectiveness of Project-Based Learning (PjBL) aided by Canva in mathematics instruction. According to [Rahayu & Soleha. \(2024\)](#), the use of creative learning models improves students' mathematics skills more effectively than traditional teaching methods. Furthermore, according to [Ginting & Siregar. \(2025\)](#), Canva facilitates more participatory learning, thereby helping students understand the material more easily. In line with this, [Purba & Harahap. \(2022\)](#) observed that the use of digital media can increase students' attention during learning. According to [Sabrina et al. \(2023\)](#), digital visual media can boost learning motivation, which in turn improves students' learning outcomes. Meanwhile, [Rahmawati \(2025\)](#) explain that integrating Canva with Project-Based Learning (PjBL) not only improves learning outcomes but also fosters the development of students' creative thinking skills. Therefore, in the context of this study, the findings indicate that the use of a Canva-assisted Project-Based Learning (PjBL) model is associated with higher levels of conceptual understanding and mathematical problem-solving skills in the experimental class compared to the control class.

Conclusion

Based on the research findings, there was a difference in the average scores for mathematical concept understanding between students taught using the Canva-assisted Project-Based Learning (PjBL) model and those who received conventional instruction, as indicated by the post-test data; the experimental class demonstrated superior results compared to the control group. Regarding mathematical problem-solving skills, the experimental class again recorded a higher average post-test score than the control group. Thus, it can be concluded from this research sample that students in the experimental and control classes achieved different levels of mathematical conceptual knowledge and problem-solving skills after the learning intervention was implemented. This study shows that classes using Project-Based Learning (PjBL) supported by Canva achieved better results than classes receiving traditional instruction in terms of subject knowledge and mathematical problem-solving skills. However, the findings of this study cannot be broadly generalized due to limitations, such as a very small sample size and a curriculum focus limited to a single topic. Furthermore, the analysis did not account for students' prior knowledge. To obtain a more comprehensive picture of the results, future research should use a more diverse sample, apply this model to various areas of mathematics, and employ methods that take students' prior knowledge into account.

Declarations

- Conflict of Interest** : The authors declare that there are no conflicts of interest.
- Auhor Contributions** : A.S.N.: Conceptualization, Methodology, Investigation, Formal analysis, Project administration, Writing – original draft.
E.T.W.: Conceptualization, Validation, Writing – review & editing.
E.R.: Conceptualization, Validation, Writing – review & editing.
- Data Availability Statement** : The authors declare that the data supporting the findings of this study will be made available by the corresponding author, [A.S.N.], upon reasonable request.
- AI Statement** : The authors states that generative AI tools were used solely to improve the clarity of the English language and Visualise in the manuscript.

References

- Amriani, S. D., Uzzakah, I., Prakoso, R. A., Sabela, P. A., Surur, M., & AgustiAgusti. (2024). Analisis Penerapan Model Pembelajaran Project Based Learning (PJBL) Untuk Meningkatkan Kreativitas Siswa. *Jurnal Kajian Penelitian Pendidikan Dan Kebudayaan(JKPPK)*, 2(2), 13–25. <https://doi.org/10.59031/jkppk.v2i2.316>
- Blouin, A., & Lestari, W. (2024). Analisis efektivitas model pembelajaran berbasis kompetensi (CBL) dalam meningkatkan kemampuan berhitung siswa SMA Negeri 1 Gending. *Al-Fikru: Jurnal Pendidikan Dan Sains*, 5(2), 262–266. <https://doi.org/10.55210/al-fikru.v5i2.1922>
- Rubiyanti, D., & Novianti, N. (2025). Peningkatan Pemahaman Konsep Matematika melalui Media Interaktif Berbasis Canva pada Siswa Sekolah Dasar. *JADIKA Jurnal Pendidikan Guru Sekolah Dasar*, 1(2), 44–51. <https://doi.org/10.66371/jadika.v1i2.35>
- Djeni, D., & Nasikhah, J. (2022). Efektifitas Pembelajaran Daring Dengan E-Modul

- Terintegrasi Google Education Pada Mata Pelajaran Matematika Kelas Viii. *Al-Fikru : Jurnal Pendidikan Dan Sains*, 3(1), 44–56. <https://doi.org/10.55210/al-fikru.v3i1.794>
- Farhin, N., Setiawan, D., & Waluyo, E. (2023). Meningkatkan Hasil Belajar Siswa SD melalui Pembelajaran Berbasis Proyek. *Jurnal Penelitian Tindakan Kelas*, 1(2), 132–136. <https://doi.org/10.61650/jptk.v1i2.144>
- Ginting, B. W. B., & Siregar, N. (2025). Pengembangan Media Pembelajaran Interaktif Berbasis Canva Untuk Meningkatkan Minat Belajar Siswa. *AL_IRSYAD Journal of Mathematics Education*, 4(2), 391–404. <https://doi.org/10.58917/ijme.v4i2.351>
- Janah, F. N. M., Nuroso, H., Mudzanatun, & Isnuryantono, E. (2023). Penggunaan Aplikasi Canva dalam Media Pembelajaran Matematika di Sekolah Dasar. *Jurnal Pendidikan Dasar*, 11(1), 138–146. <https://doi.org/10.20961/jpd.v11i1.72716>
- Khusna, H., & Ulfah, S. (2021). Kemampuan Pemodelan Matematis dalam Menyelesaikan Soal Matematika Kontekstual. *Mosharafa: Jurnal Pendidikan Matematika*, 10(1), 153–164. <https://doi.org/10.31980/mosharafa.v10i1.649>
- Kilpatrick, J., Swafford, J., & Findell, B. (2001). *Adding it up: Helping children learn mathematics*. In National Academy Press.
- Kusuma, K. P., Untari, M. F. A., & Purnamasari, V. (2023). Penerapan Model Pembelajaran Project Based Learning Dalam Pembelajaran Matematika Kelas IV di Kelas IV Sekolah Dasar. *Didaktik : Jurnal Ilmiah PGSD FKIP Universitas Mandiri*, 9(2), 4845–4854. <https://doi.org/10.36989/didaktik.v9i2.1129>
- Lestari, W., Pratama, L. D., & Sulistiowati, L. (2021). Efektifitas Pembelajaran Berbasis m-PBL Dalam Menunjang Pembelajaran Matematika Secara Daring. *Jurnal Magister Pendidikan Matematika (Jumadika)*, 3(1), 35–44. <https://doi.org/10.30598/jumadikavol3iss1year2021page35-44>
- Lestari, W., Pratama, L. D., & Jailani. (2018). Implementasi Pendekatan Saintifik Setting Kooperatif Tipe STAD Terhadap Motivasi Belajar dan Prestasi Belajar Matematika. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 9(1), 29–39. <https://doi.org/10.26877/aks.v9i1.2332>
- Polya, G. (1973). *How to Solve It 2nd edition*. In Princeton University Press.
- Purba, Y. A., & Harahap, A. (2022). Pemanfaatan Aplikasi Canva Sebagai Media Pembelajaran Matematika Di SMPN 1 NA IX-X Aek Kota Batu. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, 6(2), 1325–1334. <https://doi.org/10.31004/cendekia.v6i2.1335>
- Rahayu, C., Setiani, W. R., Yulindra, D., & Azzahra, L. (2025). Pendidikan Matematika Realistik Indonesia dalam Pembelajaran Mendalam (Deep Learning): Tinjauan Literatur. *Jurnal Pendidikan Matematika*, 2(3), 41–60. <https://doi.org/10.23960/mtk/v13i1.pp9-25>
- Rahayu, E., & Soleha, D. (2023). Penggunaan Konsep Penjumlahan Dan Pengurangan Bilangan Bulat Dalam Pembelajaran Matematika Madrasah Ibtidaiyah (Mi). *Jurnal Ilmiah Mandala Education*, 9(1), 8–14. <https://doi.org/10.58258/jime.v9i1.4070>
- Rahayu, E., & Soleha, D. (2024). Literasi numerasi dalam pembelajaran matematika berbantuan media baambozle berbasis kearifan lokal. *Jurnal Karya Pendidikan Matematika*, 11(1), 116–126. <https://doi.org/10.26714/jkpm.12.1.2025.97-107>
- Rahmawati, A. (2025). Pengaruh Model Pembelajaran Project Based Learning(PjBL) Dalam Meningkatkan Keterampilan Berpikir Kreatif. *JUPEIS: Jurnal Pendidikan Dan Ilmu Sosial*, 4(1), 30–33. <https://doi.org/10.57218/jupeis.Vol4.Iss1.1346>
- Rofi'ah, N., Ansori, H., & Mawaddah, S. (2019). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Cerita Matematika Berdasarkan Langkah Penyelesaian Polya. *EDU-MAT: Jurnal Pendidikan Matematika*, 7(2), 120.

<https://doi.org/10.20527/edumat.v7i2.7379>

Sabrina, N. A., Maharaja, L. R., Naingglan, M. M., & Gaol, M. L. (2023). Pengaruh Pengembangan Media Ajar Visual Terhadap Siswa Sekolah Dasar dalam Memahami Konsep Matematika Secara Visual. *Jurnal Pendidikan Matematika*, 1(1), 11. <https://doi.org/10.47134/ppm.v1i1.113>

Sirait, E., Usman, H., & Wardhani, P. A. (2024). Pengembangan Media Pembelajaran Smart Apps Creator 3 Berbasis STEAM pada Muatan Matematika Sekolah Dasar. *Kognitif: Jurnal Riset HOTS Pendidikan Matematika*, 4(1), 368–376. [10.51574/kognitif.v4i1.1453](https://doi.org/10.51574/kognitif.v4i1.1453)

Soleha, D., Farid, E. K., & Rahayu, E. (2024). Pemahaman Konsep Siswa Dalam Pembelajaran Matematika Berbantuan Media Baambozle Berbasis Kearifan Lokal. *Jurnal Karya Pendidikan Matematika*, 11(1), 116. <https://doi.org/10.26714/jkpm.11.1.2024.116-126>

Thomas, & John W. (2000). *A Review of Research on Project-Based Learning*. The Autodesk Foundation.

Yulianah, L., Ni'mah, K., & Rahayu, D. V. (2020). Analisis Kemampuan Pemahaman Konsep Matematika Siswa Berbantuan Media Schoology. *Jurnal Derivat*, 7(1), 39–45. <https://doi.org/10.31316/j.derivat.v7i1.863>

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