



APPLICATION OF THE CANVA-ASSISTED PROBLEM-BASED LEARNING MODEL TO IMPROVE STUDENTS' MATHEMATICAL CREATIVE THINKING ABILITY

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Abstract

The purpose of this study was to analyze the effectiveness of the Problem-Based Learning (PBL) model combined with the Canva platform in improving students' mathematical creative thinking skills. This study also aimed to determine differences in learning outcomes between students taught using Canva-assisted PBL and those taught using conventional methods. The research employed a quasi-experimental method with a nonequivalent control group design. Subjects were eighth-grade students of SMP Negeri 1 Puspahiang in the 2025/2026 academic year, consisting of 33 students in the experimental class and 34 students in the control class ($n=67$), selected through purposive sampling. Before use, the research instrument was validated by two mathematics education lecturers and one junior high school mathematics teacher using expert judgment content validity analysis. Reliability was tested using Cronbach's Alpha with a coefficient of 0.84, indicating high reliability. The instrument assessed three creative thinking indicators: fluency, flexibility, and originality. Data were analyzed using the Shapiro-Wilk normality test and an independent-samples t -test. N-Gain categorization followed Hake (1999): high (≥ 0.70), medium ($0.30-0.70$), and low (≤ 0.30). Results showed that the experimental class achieved an average N-Gain of 0.65 (medium category), significantly higher than the control class at 0.48 (medium category). These findings confirm that Canva-assisted PBL effectively enhances students' mathematical creative thinking skills compared to conventional learning..

Keywords: Canva, Creative Thinking Skills, Problem-Based Learning

Abstrak

Tujuan penelitian ini adalah untuk mengevaluasi efektivitas model Problem-Based Learning (PBL) yang dikombinasikan dengan platform Canva dalam meningkatkan kemampuan berpikir kreatif matematis siswa, sekaligus mengetahui perbedaan hasil belajar antara kelas eksperimen dan kelas kontrol. Penelitian menggunakan metode kuasi-eksperimen dengan desain nonequivalent control group. Subjek penelitian adalah siswa kelas VIII SMP Negeri 1 Puspahiang tahun ajaran 2025/2026 sebanyak 67 siswa (33 kelas eksperimen, 34 kelas kontrol) yang dipilih melalui purposive sampling. Sebelum digunakan, instrumen penelitian divalidasi oleh dua dosen pendidikan matematika dan satu guru matematika SMP menggunakan analisis validitas isi melalui expert judgment. Reliabilitas instrumen diuji dengan Alpha Cronbach dan menghasilkan koefisien sebesar 0,84 (kategori tinggi). Analisis data dilakukan dengan uji normalitas Shapiro-Wilk dan uji-t sampel independen. Pengkategorian N-Gain mengacu pada Hake (1999): tinggi ($\geq 0,70$), sedang ($0,30-0,70$), dan rendah ($\leq 0,30$). Hasil penelitian menunjukkan rata-rata N-Gain kelas eksperimen sebesar 0,65 (kategori sedang), lebih tinggi dibandingkan kelas kontrol sebesar 0,48 (kategori sedang). Temuan ini mengindikasikan bahwa penerapan PBL berbantuan Canva terbukti efektif dalam meningkatkan kemampuan berpikir kreatif matematis siswa dibandingkan dengan metode konvensional.

Kata kunci: Canva, Kemampuan Berpikir Kreatif, Pembelajaran Berbasis Masalah

INTRODUCTION

Mathematics plays a crucial role in developing students' thinking skills in the twenty-first century. Recent developments in mathematics education require students to cultivate a wide range of mathematical competencies, including representation, logical reasoning, problem-solving, and innovation, to support their success in mathematics (Syaputri & Yulia, 2023). Therefore, mathematics education should not merely emphasize basic arithmetic skills but should also foster higher-order thinking skills to prepare students for the challenges of an ever-changing world.

Creative thinking is one of the most essential competencies that should be developed through mathematics education (Dalilan & Sofyan, 2022). This ability encompasses students' capacity to generate new ideas, employ multiple solution strategies, and develop unique solutions to mathematical problems (Silver & Edward, 1997). Within the framework of twenty-first-century skills proposed by the Partnership for 21st Century Learning (P21), creative thinking is recognized alongside critical thinking, communication, and collaboration as one of the four core competencies that students must master to compete successfully in a global society (Greenstein, 2012).

Creative thinking refers to an individual's ability to generate innovative ideas through the process of analyzing and transforming information to produce various possible solutions (Siregar et al., 2020). According to Jayanti and Julianingsih (2021), in mathematics education, creative thinking is defined as students' ability to employ novel and original ideas in solving mathematical problems. This ability is reflected through characteristics such as fluency, flexibility, and originality.

However, empirical evidence indicates that Indonesian students' mathematical creative thinking ability remains relatively low. The results of the Trends in International Mathematics and Science Study (TIMSS) 2023 ranked Indonesia 48th out of 58 participating countries in mathematics, with particularly weak performance in reasoning and creative problem-solving tasks (Mullis et al., 2023). At the national level, Buyung (2021) found that the majority of junior high school students failed to achieve satisfactory levels of fluency, flexibility, and originality in solving open-ended mathematical problems. Similarly, Dalilan and Sofyan (2022) reported that junior high school students' mathematical creative thinking skills remained in the low category, as many students were only able to solve problems using a single strategy without exploring alternative approaches. This condition is closely associated with the continued dominance of conventional teacher-centered instructional approaches, which limit students' opportunities to independently develop their mathematical creativity (Zhang & Star, 2025).

One instructional model that has demonstrated considerable potential for fostering creative thinking is Problem-Based Learning (PBL). PBL is a learning approach that uses authentic real-world problems as the starting point of the learning process, encouraging students to actively seek information, collaborate with peers, and construct solutions independently (Susino Anggraini et al., 2023). Through the structured stages of PBL, students are trained to identify problems, analyze relevant information, and formulate multiple possible solutions rather than relying on a single correct answer. Consequently, PBL directly stimulates key indicators of creativity, including fluency, flexibility, and novelty (Nurmala et al., 2021). Abdullah and Munawwaroh (2024) demonstrated that PBL significantly enhances students' higher-order thinking skills, including both critical and creative thinking, compared with traditional direct instruction.

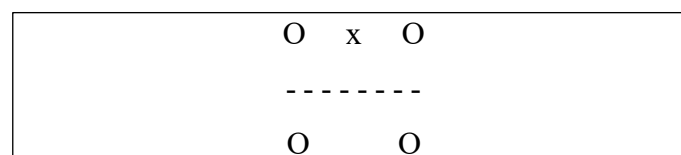
The effectiveness of PBL can be further enhanced when integrated with interactive visual learning media. Canva is a web-based graphic design platform that enables teachers and students to collaboratively create presentations, infographics, worksheets, and mind maps in an engaging visual format (Triningsih, 2021). Canva's primary advantage lies in its ability to transform abstract concepts into attractive visual representations, thereby supporting visual learning preferences and increasing students' active engagement in the learning process (Syahrir et al., 2019). Within the context of PBL, Canva serves not only as a medium for presenting authentic and contextualized problems but also as a platform through which students can organize, visualize, and communicate their creative ideas.

Several previous studies have examined the effectiveness of either PBL or Canva independently. Azzahra et al. (2023) demonstrated that PBL assisted by Canva significantly improved senior high school students' mathematical understanding compared with conventional instruction. Abdullah and Munawwaroh (2024) found that PBL was effective in improving students' critical thinking skills. Hasibuan and Syahlan (2025) developed a PBL-based mathematics instructional module assisted by Canva and reported that the module improved senior high school students' critical thinking abilities. Anwar and Jurotun (2019) found that PBL enhanced students' learning activities and learning outcomes, although the study did not incorporate digital visual media. Meanwhile, Oktavian (2025) confirmed that the use of Canva-based student worksheets (LKPD) within the PBL model positively affected vocational high school students' mathematical understanding.

Based on the review of previous studies, most research has focused on the effectiveness of Problem-Based Learning in improving critical thinking or mathematical understanding, as well as on the use of Canva as a learning medium. Studies specifically investigating the integration of Problem-Based Learning with Canva to enhance junior high school students' mathematical creative thinking remain limited. Therefore, this study makes a novel contribution by implementing a Canva-assisted Problem-Based Learning model in junior high school mathematics instruction, with a particular focus on improving students' mathematical creative thinking, as measured by the indicators of fluency, flexibility, and originality. Based on the foregoing discussion, this study aims to: (1) determine whether the implementation of a Canva-assisted Problem-Based Learning model can improve students' mathematical creative thinking ability; and (2) examine whether there is a statistically significant difference in mathematical creative thinking ability between students in the experimental class and those in the control class.

METHOD

This study employed a quantitative quasi-experimental design to examine the effect of implementing Problem-Based Learning (PBL) assisted by Canva on students' mathematical creative thinking ability. Figure 1 illustrates the nonequivalent control group design used in this study.



(Source: Ruseffendi, 2005)

Figure 1. Nonequivalent Control Group Design

Note:

- O = Pretest and posttest.
- = No random assignment
- X = Treatment

This study involved two main variables. The independent variable was the implementation of Problem-Based Learning (PBL) integrated with the use of the Canva application. The PBL model refers to an instructional approach that begins with contextual real-world problems, in which students actively identify problems, gather relevant information, and collaborate to develop solutions through a structured sequence of learning activities (Susino Anggraini et al., 2023). In this study, Canva functioned as a digital tool for presenting problem scenarios and visualizing students' mathematical ideas, thereby making the learning process more interactive and engaging.

The dependent variable in this study was students' mathematical creative thinking ability. This ability is defined as students' capacity to generate novel and diverse ideas when solving mathematical problems (Jayanti & Julianingsih, 2021). Mathematical creative thinking was assessed using the three indicators proposed by Silver and Edward (1997): (1) fluency, defined as students' ability to generate multiple ideas or solutions to mathematical problems; (2) flexibility, referring to the ability to apply various strategies to solve similar mathematical problems; and (3) novelty, which represents students' ability to produce unique and original answers or solution strategies that differ from conventional approaches. These three indicators were measured using an essay-based test administered during both the pretest and posttest.

The study was conducted at SMP Negeri 1 Puspahiang, located on Puspahiang Road, Puspahiang District, Tasikmalaya Regency, during the second semester of the 2025/2026 academic year. The study population consisted of eighth-grade students. A purposive sampling technique was employed based on criteria established by the researchers, including comparable average academic achievement across classes and recommendations from the mathematics teacher. The sample consisted of two classes: Class VIII-A, comprising 33 students, served as the experimental group, while Class VIII-B, comprising 34 students, served as the control group, resulting in a total sample of 67 students.

The research data were collected using an essay test designed to assess students' mathematical creative thinking ability. The test was administered twice: before the implementation of the treatment (pretest) and after the treatment (posttest). Essay items were selected because they are considered the most appropriate instrument for evaluating students' mathematical communication through written explanations and the expression of mathematical ideas (Warnawati et al., 2023). Before being administered in the study, the mathematical creative thinking test instrument was validated by two mathematics education lecturers and one junior high school mathematics teacher. Content validity was established through an expert judgment procedure, in which the validators evaluated each test item based on its alignment with the targeted creative thinking indicators, level of difficulty, and language appropriateness. The validation results indicated that all test items were considered valid and appropriate for use after revisions were made in accordance with the experts' recommendations.

Following the content validation process, the instrument was pilot-tested to determine its reliability. Instrument reliability was evaluated using Cronbach's Alpha, yielding a reliability coefficient of 0.84. Based on Guilford's classification criteria, this coefficient falls within the high reliability category (0.80–0.90), indicating that the instrument was sufficiently reliable and internally consistent for use in this study. To determine the magnitude of the improvement in students' mathematical creative thinking ability following the implementation of the treatment, this study employed Normalized Gain (N-Gain) analysis, with the interpretation criteria presented in Table 1.

Table 1. Modified N-Gain Interpretation Criteria

Average N-Gain (GT)	Category
$-1,00 \leq GT < 0,00$	Decrease
$GT = 0,00$	No Change
$0,00 < GT < 0,30$	Low
$0,30 \leq GT < 0,70$	Moderate
$0,70 \leq GT \leq 1,00$	High

(Source: Hakke, 1999, adapted from Sundayana, 2025)

RESULTS AND DISCUSSION

Different instructional approaches were implemented in the two groups. The control group

received conventional instruction, whereas the experimental group was taught using the Problem-Based Learning (PBL) model assisted by the interactive Canva platform. The results of the descriptive statistical analysis are presented in Table 2

Table 2. Descriptive Statistics for the Pretest, Posttest and N-Gain Scores

Data	Class	N	Mean	Std.Deviation	Min.	Max.
Pretest	Experimental	33	40,12	13,84	20	75
	Control	34	38,56	14,10	15	73
Posttest	Experimental	33	78,94	10,27	35	87
	Control	34	68,32	11,85	25	80
N-Gain	Experimental	33	0,65	0,143	0,20	0,89
	Control	34	0,48	0,157	0,08	0,76

Based on Table 2, the pretest results show that the experimental group obtained a mean score of 40.12, while the control group achieved a mean score of 38.56. This indicates that the initial performance of both groups was relatively comparable before the treatment was implemented. After the implementation of the Canva-assisted Problem-Based Learning (PBL) model, the experimental group's mean posttest score increased to 78.94, exceeding the established minimum mastery criterion (MMC) of 75. Meanwhile, the control group only achieved a mean posttest score of 68.32, which remained below the MMC.

The N-Gain calculation was conducted to measure the proportional improvement in students' mathematical creative thinking ability after the treatment. Based on Hake's (1999) classification, the experimental group obtained a mean N-Gain score of 0.65, which falls into the moderate category (0.30–0.70), while the control group obtained a mean N-Gain score of 0.48, which was also categorized as moderate but with a lower value. Although both groups were within the same category, the difference of 0.17 points indicates a meaningful difference in the level of improvement between the two groups. Furthermore, the distribution of N-Gain scores in the experimental group tended to approach the upper limit of the moderate category (0.70), suggesting that several students in the experimental group achieved improvement at the high category level.

This difference indicates that students in the experimental group demonstrated better mathematical creative thinking ability compared with students in the control group. This finding is consistent with Oktavian (2025), who reported that a problem-based learning model supported by Canva-based worksheets had a positive effect on students' mathematical understanding because it made the learning process more engaging and encouraged students' active involvement. Before conducting hypothesis testing, an initial analysis was performed through a normality test. The normality test was conducted to determine whether the research data followed a normal distribution or not (Sari et al., 2024).

Table 3. Results of the Normality Test for Mathematical Creative Thinking Ability Data

Kelas	Kolmogorov-Smirnov	Df	Sig	Keterangan
Pretest Experimental	0,117	33	0,2200	Normally distributed
Pretest Control	0,121	34	0,176	Normally distributed
Posttest Experimental	0,109	33	0,200	Normally distributed
Posttest Control	0,124	34	0,162	Normally distributed

Table 3 indicates that all significance values (Sig.) for the pretest and posttest data exceeded 0.05 in both the experimental and control classes. This indicates that the analyzed data followed a normal distribution. Since the normality assumption was fulfilled, hypothesis testing could be continued using parametric statistical analysis methods. The fulfillment of the normality assumption suggests that the research data have an appropriate distribution, allowing the application of suitable statistical tests and producing more accurate interpretations of the findings (Sonjaya et al., 2025).

The improvement in students' mathematical creative thinking ability in the experimental class cannot be separated from the characteristics of the implemented learning model, namely the fundamental characteristics of the Problem-Based Learning (PBL) model emphasize contextual problems as the stimulus for the learning process. In each PBL cycle, students are presented with problem situations that do not have a single predetermined answer, encouraging them to explore various solution strategies. This condition directly trains fluency, as students attempt to generate as many ideas as possible; flexibility, as they apply different approaches to solve problems; and novelty, as they are encouraged to develop unique solutions (Silver & Edward, 1997). The stages of PBL, including problem orientation, learning organization, investigation guidance, development of learning outcomes, and analysis and evaluation (Nurmala et al., 2021), systematically develop students' creative thinking capacity from one learning session to another.

The integration of Canva as a supporting medium in PBL provides an additional contribution to improving students' mathematical creativity. Canva enables students not only to solve problems procedurally but also to represent their thinking processes through engaging visual formats, such as infographics, flowcharts, and mind maps. These visual representations strongly support the novelty indicator because students are encouraged to present their ideas in original ways. Triningsih (2021) explained that the Canva application can increase students' enthusiasm and engagement in the learning process through more visual and interactive content delivery. This active involvement subsequently correlates positively with the productivity of creative ideas generated by students during learning activities (Kim et al., 2023).

The findings of this study are consistent with several previous studies. Azzahra et al. (2023) demonstrated that Canva-assisted PBL significantly improved senior high school students' mathematical understanding, which aligns with the present study's finding that the experimental group's posttest scores exceeded the minimum mastery criterion. Hasibuan and Syahlan (2025) confirmed that Canva-assisted PBL modules were effective in improving students' higher-order thinking skills. Oktavian (2025) also demonstrated that Canva-based student worksheets within a PBL context had a positive impact on students' mathematical understanding. Compared with the study by Anwar and Jurotun (2019), which implemented PBL without digital visual media, this study obtained a higher N-Gain score, indicating that Canva integration provides a meaningful added value in enhancing students' mathematical creative thinking ability.

The analysis of each indicator revealed that the highest improvement occurred in the fluency indicator, where students in the experimental class were able to generate more solution ideas after participating in Canva-assisted PBL learning. This finding is consistent with Siregar et al. (2020), who stated that problem-based learning stimulates students' idea productivity through intensive group discussions. The flexibility indicator also showed significant improvement because students became accustomed to exploring multiple solution methods during PBL discussion sessions (Piglioni & Presti, 2026). Meanwhile, the novelty indicator demonstrated the most notable improvement in the experimental class, presumably because Canva encouraged students to present solutions using diverse representations, which indirectly trained their originality of thinking. In the control class, all three indicators improved; however, the level of improvement was lower because conventional instructional approaches tend to encourage students to follow a uniform solution procedure.

CONCLUSION

The implementation of Canva-assisted Problem-Based Learning (PBL) was found to be effective in improving the mathematical creative thinking ability of eighth-grade students at SMP Negeri 1 Puspahiang. This finding is reflected in the experimental group's mean N-Gain score of 0.65 (moderate category), which was higher than that of the control group (0.48, moderate category). In addition, the

experimental group achieved a mean posttest score of 78.94, exceeding the school's Minimum Mastery Criterion (MMC) of 75. These results indicate that the use of Canva within the PBL approach provided students with greater opportunities to actively engage in problem-solving and express creative mathematical ideas throughout the learning process. Therefore, Canva-assisted Problem-Based Learning represents a more effective instructional alternative than conventional teaching for enhancing students' mathematical creative thinking ability.

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