



The Effect of Problem-Based Learning Assisted by Interactive PowerPoint on High School Students' Creativity: A Quasi-Experimental Study

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Abstract

Science learning at the senior high school level, which remains teacher-centered, has resulted in suboptimal development of students' creativity. This study aims to examine the effect of Problem-Based Learning (PBL) assisted by interactive PowerPoint on the creativity of tenth-grade students at SMAN 1 Labuapi in science learning. This study employed a quantitative quasi-experimental design with a nonequivalent control group. The sample consisted of 40 students, divided into an experimental class (XA) and a control class (XB), using a saturated sampling technique. Creativity data were collected using essay test instruments covering indicators of fluency, flexibility, and originality, and were analyzed using ANCOVA with pretest scores as the covariate. The results showed $F = 5.577$ with a significance value of $0.024 < 0.05$, and the adjusted mean of the experimental class, 81.265, was higher than that of the control class, 77.472. Therefore, it can be concluded that PBL assisted by interactive PowerPoint significantly affects the creativity of tenth-grade students in science learning. These findings suggest that integrating PBL with interactive media can be an innovative alternative for science teachers to design more authentic, contextual learning experiences that foster students' creativity in alignment with the Merdeka Curriculum.

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INTRODUCTION

Problem-Based Learning (PBL) is a learning model Problem-Based Learning (PBL) is a learning model that places real-world, contextual problems as the starting point of the learning process, where students actively investigate, discuss, and construct their own knowledge to find solutions (Darwati & Purana, 2021). This model is crucial because it transforms students from passive recipients of information to active thinkers in the learning process (Afni, 2020). Through the problem-solving process at the core of learning, students are trained to develop higher-order thinking skills, foster curiosity, and generate original ideas (Maskur, 2020). This aligns with constructivist theory, which asserts that knowledge is built through active engagement in authentic learning experiences rather than simply through the transfer of information from a teacher (Ardianti, 2021). Therefore, PBL serves not only as a variation in methods but as a fundamental approach capable of transforming the quality of students' thinking processes and outcomes, making it relevant for application in science learning, which is still dominated by conventional approaches.

In line with this, PBL is recognized as an effective learning model for developing 21st-century skills, particularly critical thinking, computational thinking, and creativity (Fonna & Nufus, 2024). PBL's contribution to creativity is reflected through several mechanisms: the presentation of open-ended problems that encourage the emergence of various alternative solutions (fluency and flexibility), freedom of investigation that stimulates original ideas, and the development and presentation stages that require in-depth elaboration of ideas (Munandar, 2012; Nurhayati & Rahman, 2021). Thus, creativity in PBL is not simply viewed as an end result but as a process that develops continuously throughout learning, in line with the principles of constructivism (Ardianti, 2021).

However, the success of PBL implementation is inseparable from the support of learning media that can facilitate active student engagement. One potential medium is interactive PowerPoint, which not only presents material visually with audio and animation but also uses hyperlinks between slides, enabling students to explore the material independently and interactively (Syafei, 2025). Through this medium, students are encouraged to be more active in

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understanding and solving problems, thus making the learning process more meaningful (Nursanti et al., 2025). Furthermore, the use of interactive media can also create a dynamic and enjoyable learning environment, reduce boredom, and provide space for students to express their innovative ideas (Ayshara & Kamil, 2025).

Several previous studies have shown that PBL positively affects student creativity. Ishlahul'Adiilah and Haryanti (2023) stated that PBL can develop creative thinking skills through student-centered problem-based learning. This finding is supported by Hastawan et al. (2023), who demonstrated a significant increase in creativity, and Rahmawati et al. (2024), who found improvements in creativity and learning outcomes after implementing PBL. However, most of these studies have focused on conventional PBL implementations and have not yet thoroughly examined its integration with interactive learning media, particularly in the context of science learning.

Based on observations at a school in West Lombok, learning tends to be teacher-centered, with less interactive media, and low student engagement in expressing creative ideas. This situation results in less-than-optimal development of creativity indicators, such as fluency, flexibility, originality, and elaboration. Therefore, learning innovations are needed that not only implement the PBL model but also support interactive media to increase active student participation. In this context, this study introduces a novel approach by integrating PBL with interactive PowerPoint and a comprehensive creativity measurement that includes indicators of fluency, flexibility, and originality. It also integrates a deep learning perspective to better meet the demands of the Independent Curriculum (Isnayanti et al., 2025). This study focused on 10th-grade high school students because they are at a strategic stage of cognitive development that can be leveraged to stimulate their creativity through problem-based learning (Putri et al., 2023).

MATERIALS AND METHODS

Time and Place

This research was conducted in the odd semester of the 2025/2026 academic year at SMAN 1 Labuapi, located on Jalan Gunung Pengsong, Telaga Waru, Labuapi District, West Lombok Regency, West Nusa Tenggara. The research lasted for approximately 4 weeks, with a total of 8 meetings adjusted to the time allocation for science subjects. This school was selected for its suburban location and the scarcity of science education research sites, thereby contributing to the equitable development of educational quality outside the city center. Class selection also accounted for teacher similarity, lesson hours, and learning facilities to control for external variables. In addition, class X was chosen because this phase is a crucial stage in stimulating students' creative thinking skills.

Research Design

This study used a quantitative approach with a quasi-experimental type. The design applied was a non-equivalent control group design involving two groups: an experimental class and a control class (Abraham & Supriyati, 2022). Both groups were given pretests and posttests to determine initial conditions and changes after treatment. The experimental class received treatment in the

form of Problem-Based Learning (PBL) using an interactive PowerPoint presentation, while the control class used conventional learning. The initial equivalence of the two groups was assessed using their final semester exam scores, which indicated that students' abilities were relatively comparable before the treatment was administered. Thus, this design allowed researchers to compare the treatment effects between the two groups more objectively, even without full randomization (Fitriani et al., 2019).

Population and Sample

The population in this study was all tenth-grade students at SMAN 1 Labuapi, consisting of two classes with a total of 40 students. The sampling technique used was saturated sampling, in which all members of the population were sampled because the population size was relatively small (Sari & Silalahi, 2022). The experimental and control classes were determined through simple random assignment using a systematic, controlled procedure, resulting in class XA as the experimental class and class XB as the control class (Purba et al., 2024). The independent variable in this study was the Problem-Based Learning (PBL) learning model, assisted by interactive PowerPoint, while the dependent variable was student creativity, operationalized as indicators of fluency, flexibility, and originality. Data collection was carried out using a test instrument consisting of essay questions compiled based on these three indicators to measure student creativity in a directed and comprehensive manner, and supported by interactive PowerPoint media as a tool in the learning process.

Research Procedure

The research procedure began with a preparation phase, which included the development of learning materials and research instruments. The learning materials included lesson plans (RPP), student worksheets (LKPD), and interactive PowerPoint presentations that integrated animated videos, articles, books, hyperlinks, and quizzes tailored to creativity indicators. These learning materials were then validated by expert lecturers for appearance, ease of use, suitability of the material, and content quality. The research instrument, a creativity test consisting of 10 essay questions covering indicators of fluency, flexibility, and originality, was also validated by expert lecturers, considering indicator suitability, item clarity, and content appropriateness. Next, the instrument was piloted on eleventh-grade students at SMAN 10 Mataram to obtain empirical data on the validity and quality of the questions (Melsita & Erita, 2023). Based on the pilot test results, an item analysis was conducted, including validity, difficulty, and discriminatory power. Items that did not meet the criteria were then revised to obtain an instrument suitable for use in the research.

The research implementation stage was conducted over 8 meetings. In the experimental class, learning applied the Problem-Based Learning (PBL) methodology, which included: (1) student orientation to problems, (2) student organization in learning, (3) individual and group investigations, (4) development and presentation of work results, and (5) analysis and evaluation of the problem-solving process. Interactive PowerPoint media was used at each stage, including presenting contextual problems through video/animation, providing access to materials via

hyperlinks, and using interactive quizzes to strengthen understanding and stimulate students' creative ideas (Nabila et al., 2026). Meanwhile, in the control class, conventional learning was used, dominated by lecture, question-and-answer, and assignment methods, with little use of interactive media. The final stage of the research involved collecting, processing, and analyzing data from student creativity test results to determine the effect of the treatment.

Data Analysis Techniques

Data analysis began with classical assumption tests, including normality and homogeneity tests. Normality tests were performed using the Shapiro–Wilk test, which is recommended for small sample sizes ($n < 50$) because it has higher test power than the Kolmogorov–Smirnov test (Sianturi, 2025). Homogeneity of variance tests were performed using Levene's Test to ensure equality of variance between groups (Amalia et al., 2021). Hypothesis testing was conducted using Analysis of Covariance (ANCOVA), with pretest scores as a covariate to control for students' initial abilities, thereby allowing the treatment effect on the posttest to be measured more accurately (Anantasia & Rindrayani, 2025). Decision-making criteria were based on a 5% significance level ($\alpha = 0.05$), meaning the null hypothesis is rejected if the p-value is < 0.05 (Field, 2018). Furthermore, the strength of the treatment's influence was interpreted through the F value and partial eta squared (η^2) to determine the magnitude of the treatment's effect on the dependent variable.

The instrument's reliability was tested using the Cronbach's Alpha coefficient, using the formula: $\alpha = (k / (k-1)) \times (1 - \sum \sigma_i^2 / \sigma_t^2)$, where k is the number of items, $\sum \sigma_i^2$ is the total item variance, and σ_t^2 is the total variance. An instrument is considered reliable if the Cronbach's Alpha coefficient is ≥ 0.70 (Nunnally & Bernstein, 1994). Based on the test results, the creativity test instrument had a reliability coefficient of ≥ 0.921 , making it reliable and suitable for use in research (Kusuma, 2023). The entire data analysis process was conducted using IBM SPSS Statistics version 22 software.

RESULTS AND DISCUSSION

Result

Normality Test Results

The normality test in this study used the Shapiro–Wilk test in SPSS version 22. The basis for decision-making in this test is that if the significance value obtained is > 0.05 , the data is normally distributed; otherwise, if the significance value obtained is < 0.05 , the data is not normally distributed. The test results show that the significance value of creativity in the experimental class pretest was 0.894 (> 0.05), the experimental class posttest was 0.259 (> 0.05), the control class pretest was 0.167 (> 0.05), and the control class posttest was 0.060 (> 0.05). Thus, the pretest and posttest data on student creativity in both the experimental and control classes were normally distributed (Table 1). In addition to statistical tests, verification of normality is also supported by visual inspection using histograms and Q–Q plots, which show that the data distribution follows a diagonal line with no significant deviations, further strengthening the conclusion that the data is normally distributed (Muliana et al., 2025).

Table 1. Results of the creativity normality test

Class	Shapiro-Wilk		
	Statistic	df	Sig.
Control Creativity Pretest	.929	19	.167
Control Creativity Posttest	.905	19	.060
Experimental Creativity Pretest	.976	19	.894
Experimental Creativity Posttest	.940	19	.259

Homogeneity Test Results

The homogeneity test was conducted using Levene's Test of Equality of Error Variances. According to Oktavianti et al. (2022), data are considered inhomogeneous if the p-value of Levene's test is < 0.05 . The analysis results showed that the significance values for the creativity pretest and posttest were 0.876 (> 0.05) and 0.772 (> 0.05), respectively, indicating that the variance between groups is homogeneous (Table 2). Thus, the homogeneity assumption has been met, and ANCOVA can be appropriately used to test the research hypothesis.

Table 2. Results of creativity homogeneity test.

	Sig.	Information
The Prettest Creativity	.876	Homogen
Post-Test on Creativity	.772	Homogen

Data Description of Pretest and Posttest Creativity Question Scores

The student creativity data analysis showed that the average pretest and posttest scores in the experimental class were higher than those in the control class. The experimental class experienced an average increase of 33.1, while the control class experienced an average increase of 31.9. Based on the distribution of scores, the control class had a minimum score of 65 and a maximum of 88, while the experimental class had a minimum score of 68 and a maximum of 93. This indicates that student creativity achievement in the experimental class tended to be higher. Although the difference in average improvement between the two classes was relatively small (1.2 points), the ANCOVA test results showed that the difference was statistically significant. This is because the ANCOVA analysis not only compared the mean difference but also controlled for students' initial abilities using the pretest as a covariate, allowing the effect of the treatment to be measured more accurately (Sari et al., 2025). Thus, the increase observed in the experimental class can be attributed to the application of the Problem-Based Learning model, which is more effective than conventional learning. More complete data is presented in Figure 1.

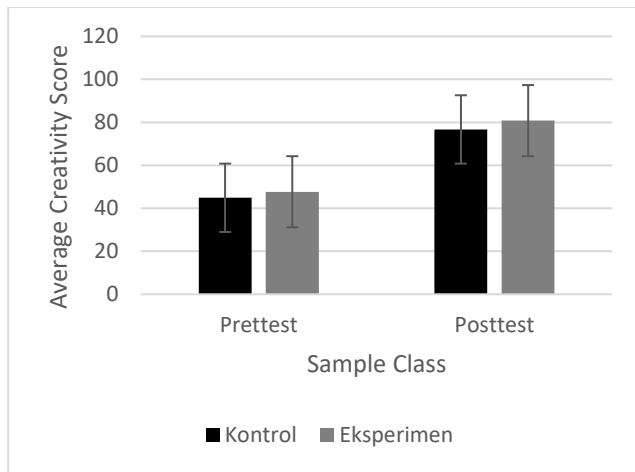


Figure 1. Average Score of Student Creativity

Hypothesis Test Results

Inferential statistics were used to test the hypothesis using ANCOVA. Hypothesis testing was conducted to determine whether the research hypothesis was accepted or rejected (Dewi & Wardani, 2021). The results of the covariance analysis of the hypothesis test for student creativity data yielded an F value of 5.577 and a significance value of 0.024, which is < 0.05 (Table 3). The effect size, based on an R-squared value of 0.58, indicates that the learning model has a moderate effect on student creativity, meaning that approximately 58% of the variance in student creativity can be explained by the learning model treatment (Rosya, 2022).

Table 3. Results of the creativity hypothesis test

Source	Sig.
Learning model	.024

The results of the hypothesis test in Table 3 show that H₀, which states that “There is no effect of the interactive PowerPoint-assisted problem-based learning model on the creativity of grade 10 students at SMAN 1 Labuapi,” is rejected, and H_a, which states that “There is an effect of the interactive PowerPoint-assisted problem-based learning model on the creativity of grade 10 students at SMAN 1 Labuapi,” is accepted. The results of the hypothesis test are supported by the corrected average scores for the experimental class (81.625) and the control class (77.472) (Table 5). These results indicate that the corrected average score for the experimental class using the problem-based learning model exceeds that of the control class.

Table 4. Corrected the average results of the creativity data

Class	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Control	77.472 ^a	1.111	75.217	79.727
Exspriment	81.265 ^a	1.111	79.010	83.520

Discussion

The results of the study showed that students’ creative abilities in the experimental class, which implemented a problem-based learning model assisted by an interactive PowerPoint, developed more effectively than

those of students in the control class using conventional learning. This difference not only reflects the final results but also indicates a change in the quality of the learning process, making it more student-centered. This finding aligns with Kumalasari and Pramono (2024), who stated that problem-based learning can enhance creativity by providing space for students to actively construct their knowledge. The problem-based learning model comprises stages that support the development of student creativity indicators, such as fluency, originality, and flexibility. Samura (2019) stated that problem-based learning places students in meaningful problem situations, encouraging them to gain a deeper understanding of the learning object. Through active involvement in the problem-solving process, students are trained to express their ideas critically and creatively to build new understanding.

Based on the research results, during the problem-oriented stage of PBL, students are confronted with contextual problems related to viral diseases, presented through an interactive PowerPoint presentation. The contextual presentation of problems at this stage has been proven to train students’ creativity, especially in the fluency indicator. This is evidenced by students’ ability to spontaneously express many ideas regarding the problems presented. The visual presentation of problems through interactive PowerPoint also supports this by making students more interested in paying attention to the problems presented. Zein et al. (2024) reinforce the use of interactive PPT at this stage, which helps present problems visually and attractively through images, animations, or short videos, thereby stimulating students’ imaginations and enriching the initial stimulus to generate creative ideas.

The second and third stages of PBL develop students’ flexibility in thinking. The group work activities undertaken by students at this stage encourage them to discuss problems and collaboratively devise solutions to problems related to the impacts and prevention of viral diseases. This fosters fluency in their thinking, as reflected in the diverse ideas and alternative solutions each student in the group presents. Interaction between students within the group also fosters flexibility in thinking, as students learn to respond to, compare, and consider different perspectives on the same problem. Furthermore, the use of interactive PowerPoint presentations as activity guides and as supporting information on the life cycle of viruses and how viruses infect their hosts helps students understand the assignment’s objectives and limitations without limiting their freedom to develop creative ideas (Utomo et al., 2014).

The presentation stage of the discussion results in PBL provides students with the opportunity to develop and present solutions to problems related to viral diseases. This stage fosters students’ creativity, particularly originality, as demonstrated by the uniqueness of the solutions and presentation methods presented by each group. The differences in opinion and the way they were expressed demonstrated that students were able to develop ideas independently and were not fixated on a single solution pattern. These results align with Nugraheni et al. (2024), who found that PBL helps students construct problems and subject matter into meaningful, interconnected experiences and knowledge. This process supports student communication and creative work.

The final stage of Problem-Based Learning (PBL) plays a role in enhancing student creativity, particularly in indicators of fluency and flexibility of thinking. This was evident in students' ability to express ideas, present arguments coherently, and respond to questions or responses from other groups from various perspectives. Furthermore, students were able to adjust their explanations based on feedback received during the presentation. This demonstrates that the presentation of results in the final stage of PBL not only serves as a means of communication but is also effective in training and optimally developing student creativity.

Based on the explanation above, implementing a problem-based learning model supported by an interactive PowerPoint can enhance students' creativity. Learning that emphasizes problem-solving and is supported by interactive media not only encourages student engagement and collaboration but also trains students to identify problems, develop strategies, and design solutions systematically. The right learning model and interesting learning media can create a meaningful learning process so that it can increase students' creative thinking.

CONCLUSION

Based on the research results, it can be concluded that implementing the Problem-Based Learning (PBL) model, supported by interactive PowerPoint media, significantly improved the creativity of seventh-grade junior high school students. This was demonstrated by the ANCOVA test results, which showed a significance value of $0.021 < 0.05$, thus accepting the alternative hypothesis. Furthermore, the average creativity score of students in the experimental class was higher than that of the control class. The implementation of PBL encouraged active student engagement in the learning process through contextual problem-solving, group discussions, and presentations of results, thereby directly developing creativity indicators such as fluency, flexibility, and originality.

Therefore, the PBL model, supported by interactive media, can be an effective learning alternative for developing student creativity in science learning. However, this study has limitations, including a relatively small sample size (only two classes) and a quasi-experimental design without full randomization. Therefore, further research involving a larger sample size and a variety of school contexts is recommended to strengthen the validity of the findings.

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AUTHOR'S CONTRIBUTION

Table of Author Contributions

Contribution Indicator	Author 4				
	1	2	3	4	5
Conceptualization	✓	✓			✓
Literature Review	✓		✓	✓	✓
Research Design / Methodology	✓	✓		✓	

Instrument Development	✓	✓	✓	✓
Data Collection	✓			
Data Curation	✓	✓	✓	
Formal Analysis	✓	✓		
Data Interpretation	✓		✓	✓
Writing – Original Draft	✓		✓	✓
Writing – Review & Editing	✓	✓	✓	✓
Visualization / Tables	✓		✓	
Supervision	✓	✓	✓	✓

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