



The Effect of the Project-Based Learning Model on the Creative Thinking Skills of Students at Darma Patra Private High School

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Abstract

This study aimed to analyze the effect of the Project-Based Learning (PjBL) model on the creative thinking skills of Grade XI students at SMA S Dharma Patra Pangkalan Brandan on the topic of the human excretory system. The study employed a quasi-experimental method with a non-equivalent control group design. The population consisted of all Grade XI students, totaling 171 students. The sample comprised two classes, namely XI A as the control class with 33 students and XI B as the experimental class with 35 students. Data were collected using a creative thinking skills test administered before and after the treatment. The data were analyzed using descriptive and inferential statistics, including normality, homogeneity, and independent-samples t-tests. The results showed that the mean pretest scores of the control and experimental classes were 58.48 and 58.34, respectively. After the treatment, the mean posttest scores increased to 62.82 in the control class and 79.43 in the experimental class. The experimental class showed an increase of 21.09 points, whereas the control class increased by 4.34 points. The hypothesis test yielded $t_{count} = 26.11$, which was greater than $t_{table} = 1.997$ at $\alpha = 0.05$. Therefore, H_0 was rejected and H_a was accepted. The findings reveal that the implementation of Project-Based Learning significantly enhanced the creative thinking skills of Grade XI students in learning about the human excretory system.

Keywords: *Project-Based Learning (PjBL), Creative thinking skills, Excretory system, Biology learning*

Abstrak

Penelitian ini bertujuan untuk menganalisis pengaruh model Project-Based Learning (PjBL) terhadap keterampilan berpikir kreatif siswa kelas XI di SMA S Dharma Patra Pangkalan Brandan pada materi sistem ekskresi manusia. Penelitian ini menggunakan metode kuasi-eksperimen dengan desain non-equivalent control group. Populasi penelitian mencakup seluruh siswa kelas XI yang berjumlah 171 orang. Sampel terdiri dari dua kelas, yaitu kelas XI A sebagai kelas kontrol dengan 33 siswa dan kelas XI B sebagai kelas eksperimen dengan 35 siswa. Data dikumpulkan menggunakan tes keterampilan berpikir kreatif yang diberikan sebelum dan sesudah perlakuan. Data dianalisis menggunakan statistik deskriptif dan inferensial, meliputi uji normalitas, homogenitas, dan uji-t sampel independen (independent-samples t-test). Hasil penelitian menunjukkan bahwa nilai rata-rata pretest kelas kontrol dan kelas eksperimen masing-masing adalah 58,48 dan 58,34. Setelah perlakuan, nilai rata-rata posttest meningkat menjadi 62,82 pada kelas kontrol dan 79,43 pada kelas eksperimen. Kelas eksperimen menunjukkan peningkatan sebesar 21,09 poin, sedangkan kelas kontrol meningkat sebesar 4,34 poin. Uji hipotesis menghasilkan nilai t-hitung sebesar 26,11, yang lebih besar daripada t-tabel sebesar 1,997 pada taraf signifikansi $\alpha = 0,05$. Dengan demikian, H_0 ditolak dan H_a diterima. Temuan ini menunjukkan bahwa penerapan Model Pembelajaran Berbasis Proyek (PjBL) secara signifikan meningkatkan keterampilan berpikir kreatif siswa kelas XI dalam mempelajari sistem ekskresi manusia.

Kata Kunci: *Project-Based Learning (PjBL), Keterampilan berpikir kreatif, Sistem ekskresi, Pembelajaran biologi*

1. INTRODUCTION

Twenty-first-century education emphasizes a shift from the acquisition of theoretical knowledge toward the development of higher-order thinking skills. Among these skills, creative thinking is particularly important, as it enables students to generate diverse, original, and well-developed ideas when addressing problems (Siswati *et al.*, 2024). In biology education, creative thinking plays a crucial role in enabling students not only to understand biological concepts but also to relate those concepts to real-life phenomena and formulate alternative solutions to problems encountered in everyday life (Fahmi & Jumadi, 2023).

Challenges related to students' creative thinking skills have also been identified among Grade 11 students at SMA S Dharma Patra Pangkalan Brandan, particularly in the learning of the Excretory System. Preliminary observations, as reported in the research manuscript, indicated that students experienced difficulties in understanding abstract biological concepts and tended to be passive when responding to open-ended questions related to disorders of the excretory system (Simorangkir *et al.*, 2020). Furthermore, students demonstrated difficulties in generating original ideas and establishing connections between factual phenomena and relevant biological concepts. These findings highlight the need for a learning approach that provides students with greater opportunities to explore ideas, engage in collaborative activities, and develop meaningful products.

One instructional approach that may address these challenges is *Project-Based Learning* (PjBL). PjBL is a student-centered learning model that engages students in investigating authentic problems through a series of activities involving project planning, implementation and completion (Megawati, 2024). Such learning experiences can provide opportunities for students to generate and elaborate ideas, consider multiple alternatives, solve problems creatively, and collaborate with their peers. Previous studies have reported that the implementation of PjBL can contribute positively to students' creativity, learning engagement, collaboration and conceptual understanding (Cahyani, 2021; Ningsih *et al.*, 2021).

The Excretory System is a relatively complex topic because it involves physiological processes that are not directly observable, including filtration in the nephron and the formation of urine. Consequently, learning experiences that incorporate contextual situations and provide opportunities for students to create tangible products may facilitate a deeper and more meaningful understanding of the concepts. Through project-based activities, students can actively explore biological phenomena, connect theoretical concepts with real-world situations and develop creative responses to relevant problems (Sirih *et al.*, 2025).

Based on this background, the present study aims to investigate the effect of the *Project-Based Learning* model on the creative thinking skills of Grade 11 students at SMA S Dharma Patra Pangkalan Brandan in learning the Excretory System. The findings of this study are expected to provide empirical evidence regarding the potential of PjBL as an instructional approach for fostering students' creative thinking skills in biology education.

2. METHOD

2.1. Research Design

This study employs a quantitative approach using a quasi-experimental method. The research design utilized is the non-equivalent control group design, involving an experimental class and a control class without individual randomization of subjects. Both classes were administered a pretest prior to instruction and a posttest following instruction to assess changes in students' creative thinking abilities (Gopalan *et al.*, 2020).

Tabel 1. Research Design

Kelas	Pretest	Treatment	Posstest
Eksperimen	O ₁	X	O ₂
Kontrol	O ₁	-	O ₂

2.2. Population and Sample

The study population consisted of all Grade XI students at SMA S Dharma Patra Pangkalan Brandan, totaling 171 students. The research sample comprised two classes: Class XI A (33 students) serving as the control group and Class XI B (35 students) serving as the experimental group. The sample was selected by choosing two classes to act as the research groups, as specified in the source document. The use of selected intact classes is consistent with the characteristics of quasi-experimental research, in which individual random assignment is not necessarily conducted ([Gopalan et al., 2020](#)).

2.3. Research Procedure

The research procedure involved administering a pretest to both classes, conducting the instructional sessions, and administering a posttest. In the experimental class, instruction utilized the *Project-Based Learning* model focused on the Excretory System topic. Learning activities centered on solving contextual problems and creating educational posters regarding excretory system health. Meanwhile, the control class underwent conventional instruction, serving as the comparison group for the study. Upon completion of all instructional activities, both classes took a posttest to measure creative thinking skills following the intervention.

2.4. Instrument Research

The research instrument consisted of a creative thinking ability test used to measure students' abilities before and after instruction. Creative thinking ability was analyzed based on four indicators: fluency, flexibility, originality, and elaboration. The test was administered as a pretest and posttest to both the experimental and control groups ([Saragih et al., 2026](#)).

2.5. Data Analysis

The data were analyzed using both descriptive and inferential statistical methods. Descriptive analysis was employed to determine the mean, maximum score, minimum score, and standard deviation, providing an overview of students' performance in both the experimental and control groups ([Rochon et al., 2012](#)). Before conducting inferential analysis, prerequisite tests were performed, including normality and homogeneity tests, to ensure that the data met the assumptions required for parametric statistical analysis ([Kim et al., 2019](#)). Based on the research protocol, the normality test involved comparing the calculated Z-value (Z-count) with the critical Z-value (Z-table) at a significance level of $\alpha = 0.05$, while homogeneity was assessed using the F-test. These tests were conducted to determine whether the data were normally distributed and whether the variances between the groups were homogeneous. Subsequently, hypothesis testing was conducted using an independent-samples t-test at a significance level of $\alpha = 0.05$ to determine whether there was a significant difference between the mean scores of the experimental and control groups. The null hypothesis (H_0) was rejected when the calculated t-value (t-count) exceeded the critical t-value (t-table), indicating a statistically significant difference between the two groups ([Rochon et al., 2012](#)). Statistical analysis was performed using the statistical software employed in the study.

3. RESULT AND DISCUSSION

Research data were obtained from the pretest and posttest results regarding students' creative thinking skills in the control class (XI A) and the experimental class (XI B). The results of the descriptive analysis of the pretest are presented in Table 2.

Table 2. Descriptive Statistics for Pretest Scores

Class	N	Average	Highest Score	Lowest Score	Standard Deviation
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Control (XI A)	33	58,48	63	54	2,57
Experiment (XI B)	35	58,34	62	54	2,25

Based on Table 2, the average pretest score for the control class was 58.48, while that of the experimental class was 58.34. The difference in the mean scores between the two classes was only 0.14 points. These results indicate that the initial proficiency levels of both groups were relatively similar prior to the intervention.

Table 3. Descriptive Statistics of Posttest Scores

Class	N	Mean	Highest Score	Lowest Score	Standard Deviation
Control (XI A)	33	62.82	66	59	2.05
Experimental (XI B)	35	79.43	84	74	3.12

The posttest results indicate a difference in the mean scores between the two groups. The experimental class achieved a mean posttest score of 79.43, whereas the control class obtained a mean score of 62.82. Thus, the difference in the mean posttest scores between the two classes was 16.61 points. Compared with the pretest scores, the experimental class showed an increase of 21.09 points, while the control class increased by 4.34 points.

3.1 Analysis of Prerequisite Tests

A normality test was conducted to determine whether the posttest data for both groups followed a normal distribution. Based on the analysis presented in the research manuscript, the calculated Z value ($Z_{\text{calculated}}$) for the control class was 0.87, while that of the experimental class was 1.12. Both values were lower than the critical Z value (Z_{critical}) of 1.96 at $\alpha = 0.05$. Therefore, the posttest data for both groups were considered to be normally distributed. A homogeneity test was conducted using the F-test to determine whether the variances of the two groups were homogeneous. The analysis yielded an F value ($F_{\text{calculated}}$) of 2.31, compared with a critical F value (F_{critical}) of 1.84. Since $F_{\text{calculated}}$ was greater than F_{critical} , the variances of the two groups were considered heterogeneous. Therefore, the hypothesis testing was conducted by taking into account the unequal variances between the groups.

3.2 Hypothesis Testing

The hypothesis was tested using an independent-samples t -test at a significance level of $\alpha = 0.05$. The analysis resulted in a calculated t value ($t_{\text{calculated}}$) of 26.11, while the critical t value (t_{critical}) at 66 degrees of freedom was 1.997. Since $t_{\text{calculated}} > t_{\text{critical}}$ ($26.11 > 1.997$), the null hypothesis (H_0) was rejected and the alternative hypothesis (H_a) was accepted. Therefore, the implementation of the Project-Based Learning model had a statistically significant effect on students' creative thinking skills in learning the Excretory System.

3.3 Creative Thinking Skills by Indicator

Table 4. Comparison of Creative Thinking Skills by Indicator

Indicator	Control	Category	Experimental	Category	Difference
Fluency	15.82	Moderate	20.45	Very High	4.63
Flexibility	15.37	Moderate	19.88	High	4.51
Originality	15.05	Moderate	19.34	High	4.29
Elaboration	16.58	High	19.76	High	3.18

As presented in Table 4, the largest difference in scores was observed in the fluency indicator, with a difference of 4.63 points, followed by flexibility (4.51 points), originality (4.29 points), and elaboration (3.18 points). These findings indicate that the experimental group achieved higher scores across all indicators of creative thinking skills compared with

the control group. The results suggest that the implementation of Project-Based Learning contributed positively to the development of students' abilities to generate ideas, consider multiple perspectives, produce original ideas, and elaborate their ideas in greater detail ([Rukoyah et al., 2025](#); [Oktafiani et al., 2026](#)).

The research results indicate that the implementation of the Project-Based Learning (PjBL) model has a positive and significant impact on students' creative thinking skills regarding the Excretory System topic. This difference is evident in the experimental class's average score increase of 21.09 points—rising from 58.34 in the pretest to 79.43 in the posttest—whereas the control class saw an increase of only 4.34 points. This disparity in achievement is corroborated by t-test results showing a calculated t-value of 26.11, which exceeds the critical t-value of 1.997. These findings align with previous research indicating that the Project-Based Learning (PjBL) model has a positive and significant impact on students' creative thinking skills ([Astuti et al., 2022](#); [Ilahi et al., 2022](#); [Winarni, 2023](#); [Lavli & Efendi, 2024](#); [Wulandari et al., 2024](#); [Ramadan et al., 2025](#); [Safitri, 2025](#)).

The improvement in creative thinking skills within the experimental class is linked to the characteristics of PjBL, which positions students as active participants in the learning process. Through problem-solving activities and the creation of educational posters on excretory system health, students have the opportunity to generate ideas, select alternative solutions, organize information, and present their thoughts. These activities align with four indicators of creative thinking: fluency, flexibility, originality, and elaboration. The greatest improvement was observed in the fluency indicator, with a score difference of 4.63. This suggests that project-based learning activities provide students with the scope to generate a larger number of ideas in response to the problems presented. Furthermore, the flexibility and originality indicators also showed significant differences; discussions and product development enabled students to consider various perspectives and cultivate a more diverse range of ideas. Regarding the elaboration indicator, a score difference of 3.18 indicates that students in the experimental class also progressed in developing and detailing their ideas. This can be attributed to the project development phase, which requires students to organize information and present it in a structured manner. These findings align with previous research stating that PjBL fosters creativity, engagement, collaboration, and conceptual mastery in science education ([Cahyani, 2021](#); [Megawati, 2024](#); [Ningsih et al., 2021](#)).

Nevertheless, implementing PjBL requires adequate time and effective classroom management. Variations in students' initial abilities, levels of engagement, and active participation within groups can influence the outcomes achieved. Therefore, teachers need to provide clear task allocation, guidance throughout the project process, and planned time management so that all students have an equal opportunity to engage in the learning.

4. CONCLUSION

Based on the research findings and discussion, it can be concluded that the Project-Based Learning (PjBL) model has a significant effect on the creative thinking skills of Grade XI students at SMA S Dharma Patra Pangkalan Brandan regarding the Excretory System topic. This is evidenced by the increase in the experimental class's average score from 58.34 to 79.43, whereas the control class's average rose from 58.48 to 62.82. Hypothesis testing results show that t-calculated (26.11) is greater than t-table (1.997) at a significance level of 0.05. Furthermore, the experimental class demonstrated higher achievement across all indicators of creative thinking skills: fluency, flexibility, originality, and elaboration. Thus, PjBL serves as a viable alternative biology learning model to support the development of students' creative thinking skills regarding the Excretory System.

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