BIOEDUSCIENCE
ISSN: 2614-1558
http://journal.uhamka.ac.id/index.php/bioeduscience

The Influence of the Project-Based Learning Model on Student Learning Outcomes and Creativity in the Excretory System Material in High School

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Abstract

Background: Education today requires learning that goes beyond focusing solely on material, as students must also be able to think critically, collaborate, be creative, and communicate effectively. That can be achieved by implementing the project-based learning model, which involves students actively in the problem-solving process through project-based learning. This study aims to determine the effect of the project-based learning model on student learning outcomes and creativity in the excretory system material in 11th-grade high school students. **Methods:** The study employed experimental research using a posttest-*only control group* design. The sample for this research consists of Class 11-3, with 32 students, and Class 11-4, with 31 students. The sample was taken using the population sampling technique, which involves sampling the entire population. During the research, descriptive statistical analysis techniques were employed. **Result:** The findings obtained from the research conducted indicate that the implementation of the project-based learning model on student creativity falls into the wildly creative category with an average score of 89.00, and for learning outcomes, it shows a significant difference with an average score of 76.09 obtained from the control class, while the experimental class obtained an average score of 90.32. **Discussion:** The project-based learning model has an impact on students' learning outcomes and creativity because it provides guidance for students to discover learning concepts, helps them solve problems, and applies knowledge from everyday life to learning, enabling students to develop their abilities and making the learning process less monotonous.

Keywords: *Project-Based Learning*; Creativity; Learning Outcomes

Article history
Received: 18 Feb 2025
Accepted: 14 Jun 2025
Published: 31 Aug 2025

Publisher's Note:
BIOEDUSCIENCE stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Citation: Rahmadani, A.P. and Agustina, L. (2025). The Influence of the Project-Based Learning Model on Student Learning Outcomes and Creativity in the Excretory System Material in High School. *BIOEDUSCIENCE, 9*(2), 192-198, doi: 10.22236/jbes/18373

Introduction

Education is a vital component of a person's life. Education can be considered a long-term investment that is crucial for the sustainability of human civilization worldwide. Education itself can be used as a benchmark or goal for humanity in the future. National education aims to motivate future generations of the nation to be competitive in today's educational world (Darmayanti et al., 2022).

Currently, education plays a crucial role in enhancing human resources and promoting educational advancement in every nation, aiming to produce an excellent generation that meets the needs of the times. Learning in the 21st century unites several aspects, namely skills and knowledge (Elitasari, 2022). According to Mariyanti (2023), students in the 21st century exhibit several characteristics, including the ability to take control, a preference for multiple learning options, a tendency to collaborate, and a reliance on digital technology. Hadayani et al. (2020), state that 21st-century learning must be able to

implement the 4C, namely critical thinking, creativity, collaboration, and communication, and possess high-level thinking skills (higher-order thinking skills).

One of the current trends is that many subjects are considered too difficult to understand, namely, biology. The topic of biology contains many foreign terms, making it challenging due to its dense material and reputation as a subject that requires extensive memorization. That limits students to taking notes only on the material explained by the teacher (Jayawardana & Gita, 2020). Biology is related to discovering and understanding nature, as well as conducting systematic processes of scientific inquiry. To facilitate the biology learning process, strategies are needed to make students interested in the subject of biology (Harefa et al., 2022).

Through the learning process, students can develop creative thinking skills to generate new ideas or tangible works. Biology learning enables students to memorize and repeat the material presented by the teacher, without fully utilizing the creativity they possess. In this issue, the expected solution is to implement a learning model that can support students in harnessing their creativity, specifically through the project-based learning model (Fadiyah Andirasdini & Fuadiyah, 2024).

The need to research the project-based learning model is to enhance students' creativity and learning outcomes in biology, particularly in the context of the excretory system. The project-based learning model aims for students to engage in innovative learning opportunities to discover their creativity through student-centered learning, where the teacher acts only as a motivator or facilitator (Anggraini et al., 2022). Project-based learning can develop students' skills to learn independently and think creatively, enabling them to achieve good results (Nugraha et al., 2023). The project-based learning model can train self-confidence, teamwork, and develop an understanding of material that has not been comprehended, thereby positively impacting students' creativity and learning outcomes (Natty & Kristin, 2019).

Learning outcomes are achieved through an individual's development of skills and knowledge in a process that involves cognitive, affective, and psychomotor abilities, as well as experiences spanning a considerable period, resulting in changes and knowledge development that can be observed through grades and evaluation processes (Yogi Fernando et al., 2024). To achieve good learning outcomes, students are required to think creatively to generate new ideas. Creative ability is the ability that facilitates a person's learning by developing their imagination to enhance their creativity (Wahyuni & Kurniawan, 2018).

Creativity is a skill that enables individuals to create innovations that are better than before and become more beneficial (Merpati et al., 2018). Some indicators of creativity include fluency, flexibility, originality, and elaboration (Setiawan et al., 2023). This study aims to demonstrate the influence of the project-based learning model on students' learning outcomes and creativity in the excretory system material in high school

Methods

The approach in this research is quantitative because the data collected in the study are in the form of numbers, which are analyzed using statistical methods. Included in the type of experimental research is *the posttest-only control group* design. The two variables used are the project-based learning model as the independent variable, student learning outcomes, and creativity as the dependent variables.

In the research conducted, the data used must be complete. To obtain and analyze the data, several instruments were used, namely teaching modules, Student Worksheets, and 20 multiple-choice questions (*post-test*). Data analysis utilizes the t-test to evaluate learning outcomes, while descriptive analysis measures student creativity with the aid of SPSS.

The research was conducted at a high school located in the Solo area for the 2024/2025 academic year. This research was conducted in January. The population in this study consists of all the eleventh-grade IPA classes, which are divided into two classes: eleven three and eleven 4. The sample used consists of the eleventh-grade class 3 as the control class, with 32 students, and the eleventh-grade class 4 as the experimental class, with 31 students.

A validity and reliability test was conducted before the research to determine whether the questions used were valid. This test was administered to class XI-2, comprising a total of 24 students. The results of the validity test showed that out of the 20 questions given, three questions were invalid because they had a calculated r value of 0.404, while the three invalid questions had values of 0.09, 0.272, and 0.065. In the reliability test, the Cronbach's alpha value was 0.60. Of the 20 questions presented, they are classified as reliable because they have a Cronbach's Alpha value of 0.606.

In this study, the sample was taken using the population sampling technique, specifically using all eleventh-grade classes that chose the science major. The experimental class that received treatment used the project-based learning model. Students were shown a video for understanding, then asked to create a project in the form of a poster to be presented, and afterward, they took a *post-test*. For the control class that received no treatment, they were given an explanation through PowerPoint and then completed a *post-test.*

Result

Student learning outcomes can be measured using a post-test administered through a 20-item multiple-choice questionnaire to the control and experimental classes, specifically class eleven 3 and class eleven 4, as shown in Table 1 below. The *post-test* scores were calculated using the t-test to compare two independent groups and determine significant results (Soeprajogo, Purnama, & Ratnaningsih, 2020), as shown in Table 2 below.

Table 1. T-Test Results Data

Class	Mean	N	Std. Deviation	Sig	Information
Experiment Class	90,3226	31	8,10559		
				0,016	H_0 is rejected
Control Class	76,0938	32	5,15356		

Table 2. Data on the Learning Outcomes of 11th Grade High School Students on the Excretory System Material

Value	Control Class	Experimental Class
Lowest Value	60	80
Highest Value	90	95
Average Value	76,09	90,32

From the data (Table 2), a significant difference was observed, with the control class having an average score of 76.09, ranging from a low of 60 to a high of 90. The experimental class received an average score of 90.32, with the lowest score being 80 and the highest score being 95. This suggests that there is an influence on students' learning outcomes, as supported by t-test data with a probability of 0.016 < 0.05; thus, H0 is rejected.

Showing the results of student creativity data in the biology subject on the excretory system material provided by the researcher to the experimental class for the 2024/2025 academic year, categorized based on the research criteria for creativity, which can be seen in Table 3 below.

Table 3. Data on the Assessment of Creativity 11th Grade High School Students on the Excretory System Material.

Category	Value	Category
Fluency	87,75	
Flexibility	84,50	
Originality	83,75	
Elaboration	100	
Average	**89,00**	**Very creative**

In assessing student creativity, it is divided into four categories: fluency, flexibility, originality, and elaboration. This assessment is derived from the learning process conducted in the classroom, which includes discussions and group presentations. The research results show that data analysis techniques, including descriptive analysis, were employed to analyze the data, yielding an average student creativity score of 89.00. This indicates that the students fall into the very creative category (Yuniharto & Rochmiyati, 2022). This demonstrates that the learning conducted using the Project-Based Learning model on excretory system material in the 11th-grade 4 SMA class yields good results in terms of student creativity.

Discussion

Based on the calculated data and presented in the tables above, the influence of the project-based learning model on student learning outcomes and creativity at high school for the 2024/2025 academic year falls into the very creative category, and a significant difference in learning outcomes was observed, indicating that the project-based learning model has an impact. At the time the research was conducted, the learning outcomes were not very significant because the eleventh-grade classes 3 and 4 are science-based, making it relatively easy for students to understand the material that was explained, specifically the material related to the excretory system.

During the research, the teacher used video media as an explanation to prevent students from getting bored and to help them develop their imagination. This project-based learning model is designed according to the components of effective learning for students. With a learning strategy designed according to the conditions of classroom instruction, teachers can accommodate various student abilities (Malik et al., 2024). This aligns with Hamidah and Citra (2021), who suggest that the project-based learning model can create a learning atmosphere that is both engaging and enjoyable, thereby improving students' learning outcomes, which can be observed during the learning process. The *project-based learning* model has a significant impact on students' learning outcomes.

Project-based learning takes relatively longer than regular learning, allowing students to experience the impact of a more engaging learning model and better understand the material being taught. This learning is provided to students so that they can interpret concepts, create detailed insights into problems, and find their own solutions while working on the project, allowing them to expand their knowledge. In this project-based learning, students are trained to identify problems using their abilities to analyze, explore, and create, thereby producing learning outcomes based on real experiences. *Project-based learning* can provide students with the opportunity to create valuable works independently or in groups. Students engage in activities such as designing, making decisions, exploring to discover new things, solving problems, and providing opportunities for students to collaborate in groups or individually, thereby achieving the final output as the goal of the project task, which includes demonstrations and references as well as oral and written reports (Ovartadara et al., 2023).

The project-based learning (PBL) model can foster student engagement, encouraging them to think critically and develop intellectual skills. Project-based learning (PBL) is a strategy for developing competencies by using projects as a stimulus for focused learning activities. Students can explore their skills, think critically, and apply that knowledge to solve the presented problems (Nisah et al., 2021). In the 21st century, the goal of the project-based learning model is to enhance teamwork skills within groups. The learning process will be student-centered, with the material provided focusing on the daily lives of the students (Farhin et al., 2023). The *project-based learning* model can improve learning outcomes through several factors, including internal factors such as interest, talent, and students who already possess the ability themselves. External factors include the environment, school conditions, school location, and family (Ramadianti, 2021).

This project-based learning model is beneficial for developing students' creativity in their work. This provides learning through skills with principles. The project-based learning model offers students the opportunity to design, plan, research, and reflect on the projects

they create (Sari & Angreni, 2018). In line with Kusmiati (2022), the project-based learning model enhances students' creativity in school and also motivates them to be more active during the learning process. Teaching students to learn independently under the supervision of a teacher, then having them engage in project activities and be directly involved from the beginning to the end of the learning process. This aims to enable students to maximize their creativity. In the research conducted, the most significant result obtained was in one of the 4C skills, specifically elaboration, as students were able to explain the projects they had created in detail.

Conducting learning through project-based learning is a suitable learning model for the independent curriculum, as it can develop the potential possessed by students to enhance their creativity (Dewi et al., 2022). The *project-based learning* model impresses and excites students to engage in the teaching and learning process, as they are motivated to create a project that has never been done before, which increases their curiosity and drives them to produce a work (Saputro & Rayahub, 2020).

Conclusions

It can be concluded that the *project-based learning* model has a significant influence on students' creativity and learning outcomes in the excretory system material, yielding notable results. This can be seen in the average *post-test* score, which has been treated and is 90.32, and in creativity, which falls into the very creative category. For the teacher and other researchers to develop more creative project-based learning with other biological materials or other subjects. The teacher can create a comfortable learning environment that encourages students to be enthusiastic about engaging in the learning process.

Acknowledgments

The author would like to express sincere gratitude to the supervising lecturer, Mrs. Lina Agustina S.Pd., M.Pd., who guided, advised, and provided valuable input throughout the research process. The author expresses deep gratitude to parents, family, and friends who have accompanied and supported throughout the research process until the article was completed. The author would like to express heartfelt thanks to the principal who granted permission, the biology teacher who provided guidance, and the students who participated, helped, and showed enthusiasm during the research process.

Declaration statement

The authors report no potential conflict of interest.

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