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The Effect of the Project Based Learning Model on the Students Creative Thinking Ability in Fluid Materials

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Abstract: This research set out to see whether the Project Based Learning approach actually makes a difference to Year 11 students' creative thinking when tackling fluid topics. A quasi-experimental method was applied, using a nonequivalent control group setup. The population covered 126 students from the science stream at SMAN 9 Mataram (academic year 2025/2026). Samples were chosen purposively: Class XI Saintek 2 (28 pupils) acted as the experimental group, while XI Saintek 4 (34 pupils) served as the control. Data was gathered through pre- and post-tests consisting of six validated essay-style questions, all checked for reliability, difficulty level, and discrimination power. The analysis was run via IBM SPSS Statistics 27, including normality, homogeneity, and MANOVA testing. Findings showed a notable jump in creative thinking scores in the experimental group (from 38.24 to 78.00), compared to a more modest rise in the control group (41.91 to 67.40). The MANOVA result (Pillai's Trace = 0.001 < 0.050) confirmed a statistically significant difference. In short, PBL clearly had a meaningful impact on students' creative thinkin quite a solid outcome, to be fair.

Keywords: Creative thinking ability; Fluid; Project Based Learning model

Introduction

The 21st century is marked by rapid advances in technology, communication, and information that demand the mastery of various new skills in daily life (Martina & Rokhmat, 2024). These developments have had a considerable impact on changes in various aspects of life, applicable to education as well. This transformation requires the education system to be able to adapt in producing competent human resources. Within this context, learners are expected to develop learning and innovation skills that include four main aspects, namely communication, creativity, collaboration, and critical thinking (Alia & Mulyono, 2025). Therefore, 21st century skills are essential to be developed so that individuals are able to compete globally. One of the efforts made by the government in facing these issues is to change the learning paradigm to be in line with the demands of the 21st century (Firdaus et al., 2022).

According to Sari et al. (2024), education is a process that involves a reciprocal relationship between teachers and students that aims to achieve certain goals and improve the quality of life. Education goes beyond simply transferring knowledges, but can also shape students' abilities to be able to address future challenges. Therefore, education in the 21st century focuses on developing skills that fit the demands of the present era (Jayadi et al., 2020). National education seeks to foster creativity in students. Creativity is an important ability that allows a person to face various problems that are increasingly complex along with the changing times (Putri & Zulyusri, 2022). These competencies act as essential assets enabling students to cope with change (Astutik & Hariyati, 2021).

As technology advances, education no longer focuses only on the cognitive aspect, but also on improving high-level cognitive processes. These skills include critical and creative thinking skills, along with communication and collaboration abilities (Putri et al., 2022). These skills be instrumental in helping individuals solve problems, make rational decisions, and innovate in various aspects of life (Oktaviani & Safitri, 2024). In science learning, the development of these skills is very important since students are expected to take part in uncovering and learning concepts using a

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scientific approach (Susilawati et al., 2023). Therefore, the learning process must take into account attention to the active involvement of students. Learning in the classroom is no longer one-way, that is, only the delivery of information from teachers to students, but must take place in two directions, where students actively construct their understanding in depth (Dewi et al., 2023).

Science as a discipline has three main dimensions, namely processes, products, and scientific attitudes. The essence of science is not only shown by the collection of facts, but also by the application of scientific methods which is reflected in various scientific activities and attitudes (Doyan et al., 2021). Physics as part of science studies natural phenomena through the relationship between matter and energy (Zuhdi et al., 2022; Nisa et al., 2024). A key objective of studying physics is for learners to grasp its principles and utilise critical thinking with a scientific mindset in addressing challenges (Taufik et al., 2022). In addition, physics learning activities can also produce ideas and real works and encourage the creation of innovations by considering the creative thinking skills of students (Fajrina et al., 2018). In explaining natural phenomena, scientists build concepts and theories, where conceptual knowledge in physics is often abstract and symbolic (Doyan, 2018).

In the field, students often experience obstacles in understanding physics (Nurmayani et al., 2018). This challenge is not only related to conceptual understanding as well as fostering creative thinking skills. Creative thinking involves producing fresh and imaginative ideas, explore multiple alternative solutions, and develop innovatif approaches in problem-solving. It involves flexibility, imagination, and the ability to connect different concepts, enabling individuals to respond effectively to challenges and produce meaningful, creative outcomes. (Fatmah, 2021). This skill is crucial for tackling complex challenges in today's modern world (Kusumaningtyas et al., 2020; Hasan et al., 2024). This demonstrates that fostering students' creativity is crucial because it greatly contributes to 21st-century skill development (Doyan et al., 2024).

Findings from observations and discussions with physics teachers at SMAN 9 Mataram (29 July 2025) indicate that instruction commonly adopts PBL and guided inquiry methods. Although both models can theoretically encourage students to think critically, in practice learning is still dominated by the role of teachers. The methods used tended to be lectures, discussions, and questions and answers, while experimental and project activities were rarely carried out due to limited facilities. This condition causes learning to be more theoretical and less direct experience to students. As a result, students have difficulty in relating physics concepts to real situations and have not been able to develop ideas creatively.

These problems show that the learning process still positions teachers as the main source of information, while students play the role of passive recipients of information (Savitri & Meilana, 2022). Therefore, students lack opportunities to express ideas, cultivate creativity, and take part in problem-solving tasks, despite the fact that creative thinking is vital in physics for producing innovative and varied answers (Mu'minah, 2021; Artika et al., 2023). To solve physics problems, students need to understand concepts by developing their creative thinking skills (Sari et al., 2018).

The active involvement of students in learning is an important factor in developing these abilities. Learning that provides hands-on experience can help students understand the relationship between concepts and their application in daily life (Susilawati et al., 2022). In this case, the role of educators is very important, especially in delivering material creatively in order to encourage student participation. Thus, students will feel more that physics is not abstract and becomes easier to understand (Sinta et al., 2022). One of the materials that requires such an approach is fluid, because in addition to demanding an understanding of concepts, it also requires the ability to explore and analyze. Fitriani et al. (2021) stated that practicum activities can provide a meaningful learning experience. Accordingly, teachers hold an important position in supporting the growth in enhancing creative thinking skills in physics education (Dewi et al., 2019).

A suitable model to tackle this challenge is Project Based Learning (PjBL), where learning is centred on projects derived from authentic problems, encouraging students to take an active role in developing solutions (Nababan et al., 2023). Besides that, the contextual strategy within PjBL supports the improvement of critical and creative thinking (Anggraini, 2021). Student-oriented learning has been proven to be able to improve critical thinking skills and high-level thinking skills (Ananda et al., 2021). This model also aims to develop creative thinking skills, foster learning initiatives, increase internal motivation, and develop cooperative skills in problem solving (Elizabeth & Sigahitong, 2018). By involving students in the decision-making process through various activities, making it easier to store information in long-term memory (Muliani et al., 2021).

Earlier studies indicate that implementing PBL leads to greater improvements in enhancing students' creativity compared to traditional instruction. Savitri et al. (2024) stated that this model is able to increase students' creativity and science process skills. In addition, Wulandari et al. (2024) also showed that the application of PjBL significantly improves the ability to

think creatively in physics learning. Through this model, students can produce works or projects that can increase confidence in the results that have been made in groups (Siskawati et al., 2020).

Looking at all that, it feels pretty clear that a study on how PBL impacts students' creative thinking in fluid topics is worth doing. This research basically tries to figure out how far this model can boost the creativity of Year 11 student, whether it genuinely helps or just sounds good on paper. The findings are expected to give some fresh insight into making physics lessons more engaging, relevant, and not just textbook-heavy. Ideally, it can support the shift towards more innovative, real-world, and 21st-century-style learning that actually clicks with students today.

Method

A quasi-experimental approach is applied in this study, employing a nonequivalent control group design consisting of two distinct groups, the experimental and control groups, to compare outcomes and examine the effect of the treatment given during the research process. (Anantasia & Rindrayani, 2025).

Table 1 Research Design

Classes	Pretest	Treatment	Posttest
Experiments	O_1	X	O_2
Controls	O3	-	O4

(Agustianti et al., 2022).

This research includes independent, dependent and controlled variables. The PBL model acts as an independent variable, while the students' creative thinking ability is a bound variable. The control variables include learning tools, time allocation, materials taught, and learning environment conditions.

All students of Grade XI science stream at SMAN 9 Mataram for the 2025/2026 academic year, totalling 126 individuals in four classes, make up the population, with purposive sampled use to choose the sample (Setiawati, 2024). The sample comprised two groups: class XI Science 2 (experimental, 28 students) and class XI Science 4 (control, 34 students). The research process followed three steps, preparation, implementation, and closing. A six-item descriptive test was used to measure creative thinking, with data collected from pretest and posttest.

Before use, the instrument is first tested to determine its quality. Instrument testing includes validity, reliability, difficulty, and differentiation. Data analysis began with assumption testing, namely the Shapiro–Wilk test for normality and Levene's test for homogeneity, before proceeding to hypothesis testing using MANOVA. Although this study initially involved more than one bound variable, the analysis in this article is focused on creative thinking ability. The decision-making criterion is that if the significance value < 0.05 then H_0 is rejected and H_a is accepted, while if the significance score is > 0.05 then H_0 is accepted and H_a is rejected.

Result and Discussion

The purpose of this study is to evaluate the influence of PBL on students' creative thinking skills in fluid topics for Grade XI at SMAN 9 Mataram during the 2025/2026 even semester, involving both experimental and control classes

Findings from the descriptive analysis revealed that initial test scores in both classes were relatively low. This indicates that students do not have an adequate initial understanding of the material being tested. The pretest data can be seen in Figure 1.

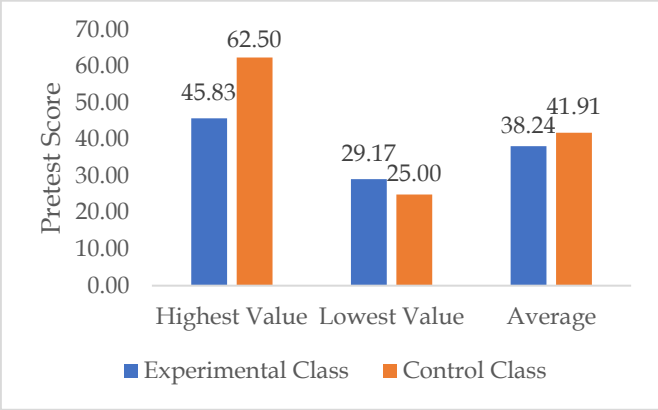

Figure 1. Pretest results data

After the learning process took place, the posttest scores increased in both classes. Even so, the increase was more pronounced in the experimental than in the control group. The posttest data are shown in Figure 2.

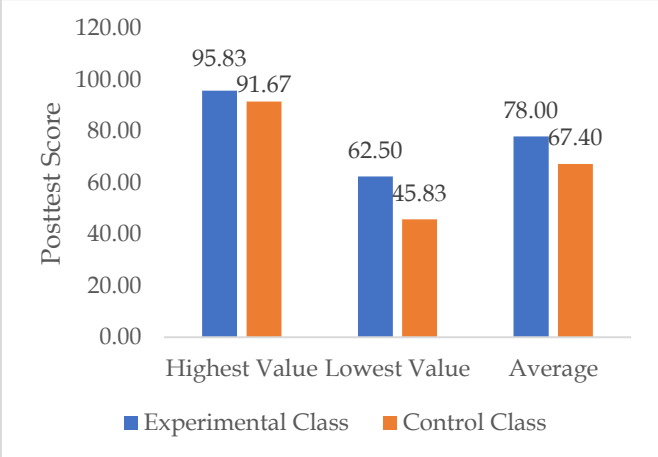

Figure 2. Posttest results data

Besides that, prerequisite testing consisting of normality and homogeneity checks was undertaken. The analysis revealed that the data were normal and homogeneous, which is presented in Tables 2 and 3.

Table 2 Normality Test Results

Classes	Shapiro-Wilk Sig.	Sig	Remarks
Experiments	0,088	0,050	Normally distributed
Controls	0,649	0,050	Normally distributed

Table 3 Homogeneity Test Results

Asmp.Sig	Significance Levels	Criteria
0,247	0,050	Homogeneous

The hypothesis testing was also carried out using MANOVA, and the results can be seen in Table 4

Table 4 MANOVA Test Results

Effect	Sig	Significance Levels
Pillai's Trace	0,001	0,050

As show in Table 4, the sig-score of Pillai's Trace is 0.001, which is below 0.05, so H_0 is rejected while H_a is supported. This indicates that the PBL model impacts students' creative thinking skills.

The increase in creative thinking observed in the experimental class can be attribute to the implementation of project-based activities that provide students with greater autonomy in exploring ideas and constructing their own solutions. Through these activities, learners are encouraged to actively engage in the learn process, analyse problems from different perspectives, and test various approaches. This not only strengthens their conceptual understanding but also enhances their ability to generate original and innovative ideas when addressing complex and real-world problems.

To think creatively means having the capability to produce new and inventive ideas an essential skill to be developed in modern learning. According to Nugraha et al. (2023), creative thinking skills are the ability to generate new ideas that can be used to solve problems or find new connections between existing concepts. In more traditional classroom settings, pupils often rely heavily on information delivered directly by the teacher, which rather limits their chances to explore and develop original ideas. As a result, learners in the control group experience less optimal improvement in creative thinking skills. In contrast, project-base activities provide a more engaging environment where learners are encouraged to think independently. Students are facilitated to rethink problems creatively, view them from diverse angles, and generate solution strategies. This makes PBL a suitable strategy to support the development of creative thinking in a more active and dynamic classroom setting.

T he findings of this research are consistent with a number of earlier studies indicating that the use of the PBL model enhances students' creative thinking abilities. A study by Wulandari et al. (2024) revealed that PBL significantly improves creative thinking in physics education. Similarly, research conducted by Hikmah et al. (2023) found that this model has a meaningful impact on both critical and creative thinking skills. These results further support the view that PBL is an effective instructional approach for fostering key competencies required in 21st-century learning.

Hence, PBL is confirmed to be more effective in fostering creative thinking skills than traditional teaching approaches.

Conclusion

Base on the findings obtained, it can be inferred that the Project Based Learning model exerts a significant influence on the creative thinking skills of Year 11 students in fluid topics. The experimental group demonstrated a more substantial improvement compared to the control group, which is supported by statistical results indicating a significant difference between both groups. The use of PBL allows students to expand ideas, examine multiple solution pathways, and address problems in innovative ways. Consequently, this model proves to be effective in fostering creative thinking abilities, which are recognised as essential competencies in 21st-century education.

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