CO- CATALYST
Journal of Science Education Research and Theories

Vol. 2, No. 2, December 2024
e-ISSN: 3026–1597
DOI : 10.33830/cocatalyst.v2i2.11956

Enhancing Creative Thinking in Final-Hour Science Lessons Through Project-Based Learning: A Classroom Action Research

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Article Info

Article History:
Received April 20th, 2025
Revised August 1st, 2025
Accepted August 5th, 2025

Keywords:
Project-Based Learning, creative thinking, CAR

ABSTRACT

This study investigates the impact of learning models on students' creative thinking during the final hour of science instruction, a time often marked by student fatigue and disengagement. Using a Classroom Action Research (CAR) method through two cycles, the study applied a Project-Based Learning (PBL) model integrated with cooperative learning strategies. The participants consisted of 14 vocational high school students in West Java, selected due to their low creative thinking scores. Quantitative data collected through observations and performance-based assessments revealed a significant improvement in creative thinking skills, with scores increasing from an average of 56% before intervention to 88% after the second cycle. These findings suggest that PBL can effectively enhance student engagement and higher-order thinking, particularly in time-constrained instructional settings. The study offers practical implications for educators seeking to optimize learning in less favorable time slots.

How to Cite:
Zhohirya, N. & Damarsari, D. G. (2024). Enhancing Creative Thinking in Final-Hour Science Lessons Through Project-Based Learning: A Classroom Action Research. *Co-Catalyst: Journal of Science Education Research and Theories*, 2 (2), 98-105.

INTRODUCTION

Natural science, or science, is a group of interrelated disciplines that explain phenomena in nature (Doyan et al., 2018). In science learning, teachers are expected to stimulate students' interest in understanding natural phenomena, fostering intelligence, and nurturing scientific curiosity (Kustiyati, 2018). Science subjects aim to provide opportunities for students to develop scientific thinking, cultivate curiosity, and base reasoning on evidence. However, these objectives often face challenges when lessons are delivered during the final hours of the school day (1 to 2:30 PM), when students tend to be tired, less focused, and passive (Hartanti & Hidayah, 2019; Aldila et al., 2013). This phenomenon is particularly problematic in vocational high schools, where science learning is essential to support students' readiness for work and ability to respond to real-life problems with scientific reasoning (Fitriyati & Hidayat, 2017). Therefore, it is necessary to implement learning strategies that not only maintain student engagement but also foster higher-order thinking skills. This research focuses on the use of Project-Based Learning (PBL) to improve students' creative thinking during final-hour science lessons.

Education aims to achieve optimal individual development by reaching one's potential. To achieve this, educational activities must be comprehensive, not merely a

form of communication, but activities that encourage students to realize their potential and develop this potential as much as possible, by engaging them in skill-building activities that help foster responsibility and independence. Providing students with skills will make it easier for students to understand concepts and gain skills that can be used as provisions for further levels of education (Kustiyati, 2018), especially for vocational high school (SMK) students who are prepared to work in specific fields. The existence of science learning for vocational high school (SMK) students aims to support students' scientific thinking abilities in dealing with various things that occur in everyday life. Students are trained to recognize facts, identify similarities and differences between them, and look for relationships between facts so that students can create their knowledge (Fitriyati & Hidayat, 2017).

Science learning during the 7th and 8th hours, namely from 1 to 2:30 PM, usually, the class atmosphere is not conducive. This is because students are tired in the morning; as a result, the learning process is not effective because students are not actively involved. Learning implementation time is one of the factors that has an impact on learning outcomes. In the last hour of learning, students are usually not in top condition because they are sleepy and tired (Aldila et al., 2013). Based on the results of research conducted by (Hartanti & Hidayah, 2019). It indicates that students' passive attitude in the learning process during the day is attributed to the boring classroom atmosphere, and they are tired from their morning activities.

Therefore, effective learning methods are needed to increase student motivation. The choice of learning method is not only to increase students' learning motivation but also to improve students' thinking skills, which aligns with the goal of science education, namely, to be able to think scientifically in the application of various things in everyday life. In this research, learning improvements were carried out to determine the impact of the efforts made in the learning process to increase students' motivation and enthusiasm for learning in the last hour of learning using project-based learning methods.

METHODS

This research was conducted using a qualitative approach in the form of Classroom Action Research (CAR), which was then analyzed and presented in the form of quantitative results (Azizah, 2021). CAR, as seen in Table 1, is a reflective and cyclical process that allows teachers to evaluate and improve teaching practices. Among various CAR models, the one most commonly used in education is John Elliott's model due to its simplicity and systematic structure (Saraswati, 2021). The model involves four main stages: planning, implementation, observation, and reflection. If the research objectives have not been fully achieved, the process can be repeated in subsequent cycles to ensure improvement and effectiveness (Prihantoro & Hidayat, 2019).

This study was conducted at a vocational high school in Subang Regency, West Java Province, between October 23rd and November 6th, 2023. The participants were 14 students (5 males and 9 females) from a class identified as having low creative thinking scores in science subjects. The topic of the lesson was "The Nature of Substances and Their Changes". The intervention was implemented through two cycles of CAR using

the Project-Based Learning model, conducted in small groups with simple practicum tools.

The CAR implementation cycle can be seen in Figure 1. In each cycle, students were engaged in active exploration through projects and experiments, while the teacher acted as a facilitator. Data collection techniques consisted of observations, documentation, and scoring of students' performance. The scoring instrument adopted a rubric assessing five indicators of creative thinking: fluent thinking, divergent thinking, independent thinking, detailed thinking, and evaluation skills (Sari et al., 2020). Each indicator was rated using a 3-tier score scale (5, 3, 1), with descriptive quantitative analysis applied to determine the average and percentage gains across both cycles. The complete assessment rubric is provided in Table 1.

Table 1. CAR assessment rubric

No.	Factors	Indicator	Assessment	Score
1	Fluent Thinking Skills	Provide correct answers or ideas to the questions presented	Students can answer questions correctly and with explanations	5
			Students answer with correct answer but do not include an explanation	3
			Students answer with wrong answers and are not accompanied by explanations	1
2	Divergent Thinking Skills	Resulting in varied answers and different points of view	Students provide varied answers and different points of view with the correct answer	5
			Students provide varied answers and different points of view, with less precise answers	3
			Students do not provide varied answers and different points of view, with incorrect answers	1
3	Independent Thinking Skills	Able to give answers according to his thoughts	Students provide answers based on their thoughts and the answers are correct	5
			Students give answers based on their thoughts, but the answers are not correct	3
			Students give answers that are not the result of their thoughts and language and the answers are not correct	1
4	Detailed Thinking Ability	Able to answer with detailed ideas	Students give answers with detailed ideas and the answers are correct	5
			Students provide detailed answers and ideas, but the answers are not precise	3
			Students do not provide detailed answers and answers are inaccurate	1
5	Evaluation skills	Able to evaluate and present the results of the practicum carried out	Students answered correctly based on the results of the practicum carried out	5
			Students gave partially correct answers based on the practicum results	3
			Students gave incorrect answers based on the practicum results	1

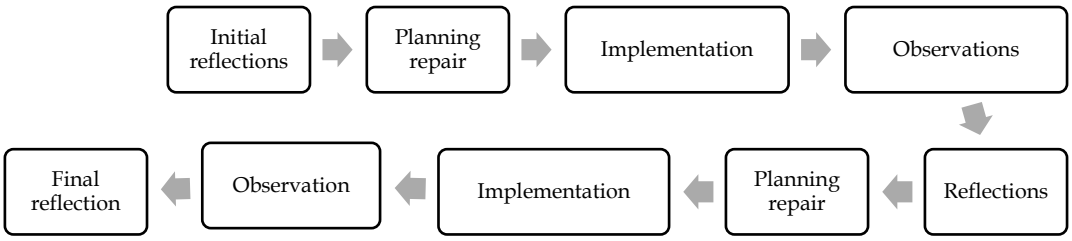

Figure 1. Classroom Action Research (CAR) implementation cycle

RESULT AND DISCUSSION

The research was conducted from 23 October to 6 November 2023 at 1:00 to 2:30 PM at a vocational school education located in Subang Regency, West Java Province with research subjects based on classes that had low average work skills scores with a total of 14 students consisting of 5 male students and 9 female students on the learning material 'The Nature of Substances and Their Changes' using project-based learning methods carried out in groups with the help of simple tools.

Before implementing the project-based learning method, students are given a pretest on the material explained by the teacher. Based on these learning activities, the following assessment data is produced as seen in Table 2.

Table 2. Assessment data before CAR was carried out

No.	Assessment Aspect	Average Score of Male Students	Average Score of Female Students
1	Fluent Thinking Skills	3	3
2	Divergent Thinking Skills	1	3
3	Independent Thinking Skills	3	5
4	Detailed thinking ability	3	3
5	Evaluation Skills	1	3
	Total Score	11	17
	Overall Average	2,2	3,4
	Percentage	44%	68%
	Overall Percentage	56%	

The use of the lecture method alone in the last lesson was considered less effective because students' motivation to learn had decreased, and students merely acted as passive listeners who listened to the teacher's explanations and assessments that were focused on written test results, so that students were required to rely on their memory alone. Students find the lecture method less impressive because it requires memorizing written material, which often leads to forgetting the material studied after a few days. According to students, learning through the lecture method does not support their memory, so the learning outcomes achieved are still low (Lestari & Parmiti, 2020). In this research, learning was implemented using a project-based learning method, where students had full opportunities to explore and demonstrate their understanding of the learning material presented and obtained through group practicums. The teacher acts solely as a facilitator, assisting students when they

encounter problems during experiments. According to (Rati et al., 2017). Project-based learning (PBL) is one application of active learning. Project-based learning is a teaching approach that connects technology with everyday problems or familiar school projects, making learning more relatable to students. Through various activities that explore project-based learning, students can build their knowledge to understand concepts better and more meaningfully compared to studying independently (Rahayu & Hartono, 2016).

In cycle 1, learning takes place in an orderly manner and results in satisfactory levels of understanding. Students can differentiate the properties of material, and all 14 class members are present. Meanwhile, in cycle 2, the number of students attending dropped by 43%, leaving only 8 participants, so the overall achievement target for the number of students in the class was not achieved. However, the results of learning using this method showed that students who participated were able to classify the material based on the changes that occurred. Notably, female students achieved the same score percentage as in the first cycle. However, based on the results of applying the learning method in cycles 1 and 2, there was an increase in students' thinking skills and learning motivation. Previously, most students had always wanted to end learning immediately, but after implementing this method, they demonstrated increased enthusiasm and engagement during the learning process. The results of the learning can be seen from Table 3, and the learning achievements can be compared before and after CAR is carried out, as depicted in Figure 2.

Table 3. Assessment results after CAR

No.	Assessment Aspect	Cycle 1		Cycle 2	
		Average Score of Male Students	Average Score of Female Students	Average Score of Male Students	Average Score of Female Students
1	Fluent Thinking Skills	5	5	5	5
2	Divergent Thinking Skills	3	5	3	5
3	Independent Thinking Skills	3	5	5	5
4	Detailed Thinking Ability	3	3	3	3
5	Evaluation Skills	5	5	5	5
	Total Score	19	23	21	23
	Overall Average	3.8	4.6	4.2	4.6
	Percentage	76%	92%	84%	92%
	Overall Percentage	84%		88%	

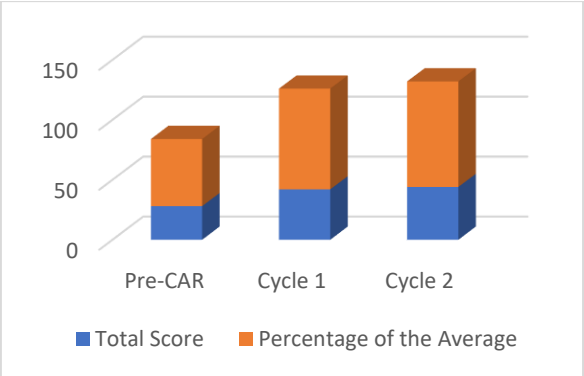

Figure 2. Comparison of assessment achievement

The decline in student attendance during Cycle 2 (only 8 of 14 students were present) slightly limited the generalizability of the results. However, qualitative observations indicated that those present showed improved independence and engagement, particularly in the Independent Thinking and Evaluation indicators. These findings are consistent with Rahayu & Hartono (2016), who found that PBL not only promotes critical thinking but also increases intrinsic motivation. The stagnation in Detailed Thinking Ability scores suggests that while students became more active, scaffolding strategies such as guided questioning may be necessary to deepen their elaborative responses. Future interventions should consider how to sustain participation, particularly in afternoon sessions, possibly through blended or flipped learning elements.

Furthermore, these findings illustrate that students not only became more engaged but also showed measurable improvements in creative thinking skills, especially in fluency, evaluation, and independent thinking. The development of these skills is closely tied to both student engagement and the quality of the learning task. Creating engaging projects that meet expectations requires a combination of creativity and subject knowledge. A balance between the two supports meaningful learning experiences and long-term retention. This is in line with Rati et al. (2017), who emphasized that creativity and learning outcomes are mutually influential—students who engage in creative tasks tend to demonstrate higher cognitive performance and deeper understanding.

Overall, the implementation of project-based learning proved more effective in enhancing students' thinking skills compared to conventional methods. In PBL, students are required to explore information through research and collaborative problem-solving actively. The teacher functions as a facilitator, guiding students toward independent learning. As supported by previous studies (Rahayu & Hartono, 2016). This model enhances not only learning outcomes, but also critical and independent thinking as well as motivation, making it particularly suitable for time-constrained or low-energy periods such as the final lesson hour.

CONCLUSION

The use of Project-Based Learning (PBL) in science instruction during the final lesson hours significantly enhanced students' creative thinking skills. Based on data collected across two CAR cycles, students' overall achievement increased by approximately 30%, from 56% before the intervention to 88% after its implementation.

The most notable improvements were observed in indicators such as fluency, independent thinking, and evaluation skills. While student attendance decreased in Cycle 2, those who remained showed higher engagement and better mastery of the material compared to the initial phase. Students also expressed that learning through hands-on projects made the material easier to remember and encouraged them to participate more actively in class. Science teachers are encouraged to integrate project-based activities—especially during final-hour sessions—where student fatigue and disengagement tend to occur. Providing opportunities for students to investigate, experiment, and present results fosters not only engagement but also deeper cognitive processing. The role of the teacher as a facilitator is crucial in guiding students through the process and scaffolding their thinking when necessary. To further enhance the effectiveness of PBL in time-constrained settings, future implementations should address issues such as fluctuating student attendance and energy levels by integrating blended learning or flipped classroom elements. Teachers should also conduct reflective evaluations after each cycle to adjust strategies based on classroom realities. Future research may explore variations of PBL tailored to specific student characteristics, subject complexity, or school contexts.

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