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Improving the Critical Thinking Ability of Science Class Students using the Project Based Learning Model

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1. Abstract

Improving the Motivation of 5th Grade Students in Learning Science using Project-Based Learning Model. This research aims to enhance critical thinking skills of 5th-grade students in Science through the implementation of the Project-Based Learning model. The type of research conducted is Collaborative Classroom Action Research (PKK). The hypothesis in this study states that the application of Project-Based Learning model can improve students' critical thinking and understanding in Science for 5th-grade elementary students. The research subjects are 28 students from 5th grade in elementary school. The study is conducted in 2 cycles, each consisting of 2 meetings. The methods used to collect data include observation, tests, interviews, and documentation. The research results show a significant influence on students' critical thinking ability when using the PjBL model compared to the conventional model. This is evident from the test scores obtained by students using the PjBL model, with initial data showing 52.85% in pre-cycle, increasing to 68.57% in cycle I, and 80.89% in cycle II. This indicates that there is a positive impact of using the PjBL model on students' critical thinking skills in Science for 5th-grade students at Elementary School.
Keywords: *Project-Based Learning method, Critical Thinking, Science subject.*

2. Introduction

Education is one of the essential aspects in achieving a prosperous and advanced human life. This is because prosperity is no longer solely dependent on natural resources and physical assets but also on intellectual and social resources. The 21st-century life is boundless, characterized by globalization, internationalization, and the rapid

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advancement of information and communication technology. According to NCREL and Metiri Group (in Punia, 2011), the digital economy era of the 21st century requires a skilled workforce capable of generating innovations and enhancing a nation's productivity. Therefore, students must be equipped with excellent critical thinking skills to solve various problems and be ready to contribute to the global society. According to Schafersman (2012), critical thinking is a crucial competency that needs to be developed and nurtured in students through learning activities. This skill is essential in various aspects of life. However, based on observations in elementary schools, the current learning process still relies on conventional teaching methods like lectures and assignments, making the learning process monotonous and limiting students' ability to explore their potential fully. Moreover, the use of learning media is also quite rare, indicating that the current learning process does not fully accommodate and facilitate the different learning abilities of each student. There is a need for improvement and creativity to make learning more engaging for students as the main subjects of learning and to develop their critical thinking skills.

The emergence of Project-Based Learning (PjBL) is rooted in the constructivist approach that emphasizes contextual learning (Khamdi, 2007). PjBL can be understood as a learning model that involves focusing on meaningful questions and problems, problem-solving, decision-making, searching for various sources, promoting collaborative work, and concluding with real-life product presentations (Thomas, in Ni Luh, 2012).

This research is focused on the efforts made by elementary school teachers, especially in Science subjects, through the development of learning materials that promote students' critical thinking abilities. Previous research conducted by Remziye Ergul et al. (2013) titled "The Effect of Project-Based Learning on Student's Science Success"

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showed a positive influence on improving students' learning outcomes and critical thinking skills through the project-based learning model in Science education at the elementary school level. Another study by Burcu Gulay (2014) titled "Project-Based Learning from Elementary School to College, Tool: Architecture" also demonstrated a positive impact on creating a more enjoyable learning process and increasing student engagement with the project-based learning model in elementary schools.

3. Methods

3.1. Participants and context

The type of research conducted is Collaborative Classroom Action Research (CCAR). In this research, the researcher collaborates with field advisors, teachers, the school principal, and classroom teachers. Action research is a series of steps or cycles that consist of planning, action, observation, and reflection, continuously producing new cycles until the action research is concluded (Azizah et al., 2021:18). This research adopts the PTK model by Kemmis and McTaggart, introduced by Kurt Lewin, which involves four stages in each cycle: planning, action, observation, and reflection.

3.2 Material

The instruments used in this research are observation sheets, interviews, and documentation. The observation sheet is used to collect data on students' activeness during the learning process. Interviews are conducted to obtain data about the initial condition of the learning process. Documentation, in the form of photos and videos, is used for documentary study to provide a concrete overview of the learning process while applying the Project-Based Learning model.

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3.3 Data Collection and analysis

Data collection techniques are crucial steps in research, as the main goal of research is to obtain data. The data collection techniques used in this research are observation, interviews, and documentation. Data analysis employs both quantitative and qualitative descriptive analysis techniques. The data collected from the observation sheets during each cycle of the research are calculated in percentage form and analyzed descriptively to observe the trends that occur during the learning activities.

3.4 Ethical Considerations

All research involves human subjects. Therefore, in this research, there are basic principles of research ethics that we must consider. The first principle is to respect people, which means we must respect and value the students who are the subjects of the research. The second principle is the benefit, and in this research, it benefits the students by providing an enjoyable learning experience through the Project-Based Learning model, which enhances their critical thinking skills. The third principle is non-harm, which ensures that the students are not harmed in any way during the research process. By following these ethical principles, we ensure the well-being and rights of the students involved and conduct responsible and ethical research.

3.5 Limitations to the Study

Due to limitations in time, resources, and costs, this research is focused on improving student engagement through the implementation of the Project-Based Learning model in 5th-grade elementary school students. The main topic of this research is to

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enhance students' critical thinking in the science learning process.

Based on the 2-cycle action implementation, which consists of 4 meetings, it was observed that the creativity of 4th-grade students improved. This improvement in student creativity was evident when applying the PjBL model based on the Tamansiswa teaching approach in the learning process.

4 Results and Discussion

The observer observed the implementation of the learning activities conducted by the teacher during the learning process using the PjBL model based on the Tamansiswa teaching approach. Overall, the teacher successfully carried out the learning activities according to the PjBL syntax in the correct sequence, although there were some stages that could be improved for better execution.The results of the student's creativity observation in the science subject using the PjBL model based on the Tamansiswa teaching approach during the pre-cycle and cycle I can be seen in the following table:

Table 1. Observation Results of Students' Critical Thinking Cycle I

Note	pre-cycle	cycle I
Sum	1480	1920
Average	52,85%	68,57%
Scor Max	80%	85%
Scor Min	30%	40%
Student Complet	6	17
Student Not Complet	22	11
Presentation Student Complet	21,43%	60,71%
Presentation Student Not Complet	78,58%	39,28%

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Based on the data in the table, it can be seen that the average creativity score of students in the pre-cycle is 52.85%, with 6 students achieving a passing score, which is 21.43% of the total students. In the implementation of cycle I, the average score of students is 68.57%, and 17 students achieved a passing score, which is 60.71% of the total students. A comparison between the average scores of the pre-cycle and cycle I in student creativity can be seen in the following table:

Table 2. The comparison of the average critical thinking scores of students in the pre-cycle and cycle I.

The number of students	Rata-Rata Hasil		
	pre-cycle	cycle I	Enhancement
28	52,85%	68,57%	15,72%

Based on the table, it can be seen that the implementation of the PjBL model in learning activities increased students' critical thinking by 15.72%. In the pre-cycle, the average score was 52.85%, which improved to 68.57% in cycle I. Although there was an improvement in the average creativity score of students, it did not meet the success criteria of the research, which is an average score of ≥ 39.28% for 5th-grade students, indicating that further improvement is still needed.

In the observation of student creativity in cycle II, there was a noticeable increase compared to the observations in the pre-cycle and cycle I. The results of student creativity observation in cycle II are presented in the following table.

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Table.3 Observation Results of Students' Critical Thinking Cycle II

Note	Pra Siklus	Siklus I	Siklus II
Sum	1480	1920	2265
Average	52,85%	68,57%	80,89%
Scor Max	80%	85%	100%
Scor Min	30%	40%	60.00%
Student Complet	6	17	25
Student Not Complet	22	11	3
Presentation Student Complet	21,43%	60,71%	89,28%
Presentation Student Not Complet	78,58%	39,28%	10,71%

Based on the table, it can be observed that the average score of students in cycle II is 80.89%, showing an improvement from the pre-cycle and cycle I. The highest score reached 100%, while the lowest score was 60.00%. The minimum passing score set was 70, and 25 students achieved this score, with a passing percentage of 89.28%. There were 3 students who did not pass, with a percentage of 10.71%. A comparison of the pre-cycle and cycle I scores for the variable of students' critical thinking can be seen in the following table.

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Table 4. Comparison of Average Pre-Cycle, Cycle I, and Cycle II Students

The number of students	Average Yield			
	Pra-cycle	Cycle I	Cycle I	Cycle II
25	52,85%	68,57%	68,57%	80,89%
Enhancement	15,72%		12,32 %	

Based on the data in the table, it can be observed that the implementation of the PjBL model in learning activities significantly improved the critical thinking of 5th-grade students in Elementary School by 15.72% from Cycle I. Before the action was taken, the average score was 52.85%, and after the action, it increased to 68.57% in Cycle I. However, the score in Cycle I did not meet the research's success criteria. Therefore, Cycle II was conducted, resulting in an average score of 80.89%, showing a further improvement in students' critical thinking.

The diagram below illustrates the percentage increase in student critical thinking scores before the action (pre-cycle), during Cycle I, and after Cycle II.

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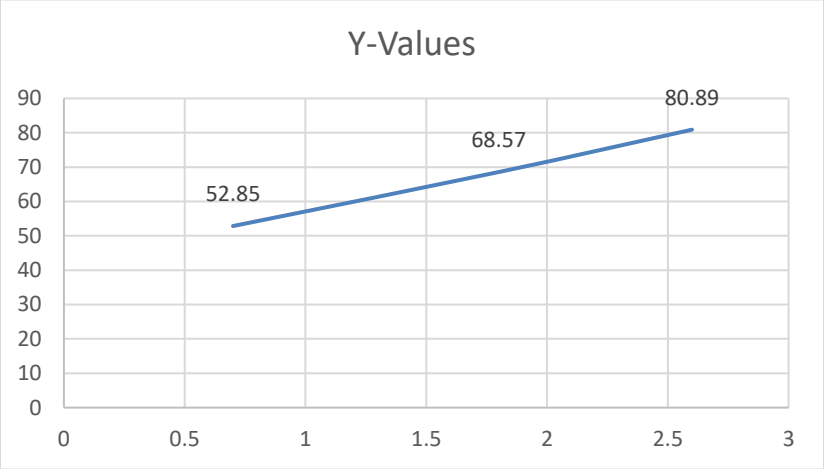

Figure 1. The diagram below illustrates the percentage increase in student critical thinking

The image illustrates the average creativity scores of 5th-grade students showing improvement. In the pre-cycle, the average score was 52.85%, which increased to 68.57% in Cycle I, and further improved to 80.89% in Cycle II. These average scores have now met the success criteria of the research, which is an average critical thinking score of ≥ 89.28% for 5th-grade students, indicating that further improvement is no longer necessary.

5 Conclusion

Based on the results of the action research conducted in 5th-grade of Elementary School, it can be concluded that implementing the Project-Based Learning model in science education can enhance students' critical thinking abilities.

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