

Improving Critical Thinking Skills Through a Demonstration of a Water Wheel for Generating Electricity, Content for Science Lessons, Students of Grade VI SDN 3 Pakikiran

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ABSTRACT

The ability to think critically in science class VI students at SDN 3 Pakikiran is low, namely learning completeness is 46.16% with an average score of 53.73. The formulation of the research problem is: How to improve critical thinking skills through a demonstration of a water wheel for science power generation for class VI students at SDN 3 Pakikiran?. The research was conducted in class VI at SDN 3 Pakikiran in semester 1 of the 2022/2023 academic year. The research subjects were 13 students. The research data is descriptive quantitative with data collection techniques through written tests and observations. Based on the analysis of the data, the results of the critical thinking ability test achieved 92.31% mastery with an average score of 80.77. It was concluded that the demonstration of a water wheel for generating electricity could improve the critical thinking skills of science grade VI at SDN 3 Pakikiran.

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1. INTRODUCTION

One of the 21st century competencies that students must have is critical thinking. This competency emphasizes the ability to reason, understand, analyze and solve problems that will be useful in real life in line with the development of science and technology. Thinking critically student can solve problem, formulate conclusions. Gather various possibilities and make decisions that can be useful in everyday life [1].

Therefore, critical thinking skills need to be honed and developed in students from elementary school. Especially in learning natural sciences. The content of this lesson prioritizes process skills in learning. The purpose of learning science in elementary school is for students to understand and develop knowledge of natural science concepts that are interrelated with everyday life and understand the natural environment, the physical environment and are able to apply scientific methods that simple and scientific attitude to solve the problems encountered [2].

The fact is in the field, there are still many teachers who present science learning as limited to conveying information without giving students the opportunity to reason, analyze, and solve problems. The teaching method and media used by teachers are still very simple. Of course this causes low critical thinking skills and below the minimum limit. It also happened in our school, SDN 3 Pakikiran, where science lessons still present conventional material, have not applied appropriate methods and media so that students' critical thinking skills are low.

Based on the results of observations on science learning activities in class VI of SDN 3 Pakikiran, it was found that students' critical thinking skills in the material for the process of generating electricity were low, namely only 46,16% or 6 out of 13 students who achieved learning mastery with an average score of 53,73. This is due to several things namely, 1) students are rarely trained to think critically, 2) students are only given material limited to student books, 3) learning methods or techniques also tend to be monotonous so students are less active, and 4) teaching media used is also still simple and less attractive.

Formulation of the problem

The formulation of the problem in this research is "How to improve critical thinking skills through the fuel conversion of triangulations in science lessons material for the process of generating electricity for class VI students at SDN 3 Pakikiran in the 2022/2023 academi year?"

Research Purposes

The general aim of this research is to improve the learning process. The spesific objective of this research is "To describe the improvement of critical thinking skills through the fuel conversion of triangulasi in science lessons material for the process of generating electricity for class VI students at SDN 3 Pakikiran in the 2022/2023 academi year".

Theoretrical Basis

Critical Thinking

Define critical thinking skills as the ability to think rationally, logically, and high-level thinking skills, in which there are several activities, manely analysis, synthesis, recognizing problems and their solutions, concluding and evaluating according to existing data and facts [1]. Critical thinking is the ability of students to think critically in the form of reasoning, expressing, analyzing and solving problems [3].

Another meaning states that critical thinking skills are high-level thinking skills in solving problems, namely the clarification stage, the assessment stage, inference and strategy. The clarification stage is the stage where students state the problem and analyze the meaning of the problem, at this stage students can find information that is known in the problem correctly. The assessment stage is the stage where students submit relevant information and determine the assessment criteria, at this stage students can formulate the questions. The inference or inference stage, the stage of students making conclusions and generalizing, at this stage students can determine the ideas or concepts that will be used in solving problems. The strategy stage is the stage where students take action, at this stage students can explain the correct steps for solving problems that have been found [4]. Critical thinking it's also skill education should start at early ages and this skill should be activated constantly with different techniques" [5]. Critical thinking skill is a reasoning process by involving mental operation, such as induction, deduction, classificiation and reasoning" [6].

From these definitions, it can be concluded that critical thinking is a reasoning process using logic and higher-order thinking skills to solve probelms through several stages including analysis, problem solving and concluding.

Critical thinking indicators used in this research are reasoning, analyzing, solving problems and concluding. The ability to think critically in this study is the ability of students to reason, analyze, solve problems and conclude the process of generating electricity from a hydroelectric power plant.

Demonstration

Demonstration method is a way of presenting lesson material by demonstrating or demonstrating to students about a particular process, situation or object that is being studied, both actual and imitation, accompanied by an oral explanation [7].

Demonstrations were practices exhibites by teachers to students. the application of the demonstration method can improve the process of teaching and learning interaction in class and students can focus on the lessons given. Besides that, they can participate actively and gain direct experience and can develop their skills so that students can better understand the subject matter being taught properly [8].

Demonstrations it's also activities carried out using verbal and also actions by showing a certain process which is then followed and tried byb students to carry it out. Further explains the implementation steps with the demonstrations method, namely 1) preparing the tools to be used in learning, 2) providing an explanation of the topic to be demonstrated or which will be explained directly, 3) implementation with the attention and imitation of students or implementation with student participation to demonstrate the material, 4) reinforcement with discussion techniques, question and answer or practice questions on learning outcomes with the demonstration method and, 5) providing conclusions and closing of learning [9].

From these opinions, it can be concluded that demonstrations is a method of presenting learning by demonstrating original or imitation activities, processes or objects accompanied by oral explanations.

The demonstrations in this study was the teacher's activity demonstrating the media of watereheel for power generation to explain, describe and demonstrate the process of generating electricity from a hydroelectric power plant. The learning steps using the demonstration method refer to Magnatis's opinion, namely: 1) preparing the water wheel for power generation, 2) explaining the material for the process of generating

electricity and its use, 3) involving students in the learning process, 4) strengthening with discussion techniques, question and answer or practice question, and 5) provide conclusions and closing learning.

Hydropower Generator

The learning media for a miniature waterwheel for power generation is an imitation of the real object where only the most important parts are made as simple as possible so that they are easy to learn, the imitation here is an imitation of a power plant [10].

The hydroelectric power wheel is a hydropower plane made by humans to convert water energy into mechanical energy [11].

A water wheel as a mechanical device in the form of a wheel with blades around the edges which are placed on a horizontal shaft and power generation is the utilization of the potential energy and kinetic energy of water which is converted into angular power by a water turbine. Moving water drives turbines, turbines rotate generators and electrical energy can be generated [12].

From the several opinions above, it can be concluded that the water wheel for electricity generation is an imitation of a hydroelectric generator made by humans to convert the motion of water into electricity..

The waterwheel for power generation in this study is a miniature waterwheel combined with a generator as a power plant to give an overview to students about the process of generating electricity from a hydroelectric power plant.

Action Hypothesis

Based on the framework and theoretical basis above, the hypothesis of action to improve learning through classroom action research is the demonstration of a waterwheel generating electricity can improve the ability to think critically about the content of science lessons for class VI students at SDN 3 Pakikiran.

Success Indicator

The criteria for measuring critical thinking skills are 1) reasoning, 2) analyzing, 3) solving problems, and 4) concluding. After the implementation of the research conducted in 2 cycles, the indicator of success was "The ability to think critically was declared successful, if 75% or 10 out of 13 students were declared to have completed their studies with a minimum average score of 70,00".

2. METHOD

Types of Research

This study uses a classroom action research design or classroom action research through cycle stages. The PTK which took place at SDN 3 Pakikiran consisted of 2 cycles. This class action research procedure was carried out through 4 (four) stages namely planning, acting, observing, and reflecting (Kemmis & Tagart).

Subject, Place and Time Research

The subjects of this study were students of class VI with a total of 13 children at SDN 3 Pakikiran for the 2022-2023 academic year. The research location was SDN 3 Pakikiran, Korwilcam Susukan, Banjarnegara. This research was conducted from September 2022 to January 2023.

Data Source

1. Students
Data on students' critical thinking skills were obtained through a written test.
2. Teacher
Data from teachers obtained data on students' critical thinking abilities.
3. Colleague (collaborator)
The colleagues or collaborators of this study were fellow teachers at the same school, namely the fifth grade teacher at SDN 3 Pakikiran.

Data collection technique

Data collection technique in this study are as follows:

1. Test
The test in this study was used to measure students' critical thinking skills. The test is carried out in writing at the end of the lesson.
2. Observation
Observations made in this study were observations of the application of a water wheel demonstration for power generation in the learning process taking place in cycles I and II.
3. Documentations
The documentation in this study is photos of learning activities in each cycle. The contents of the document are related to the way of teaching the teacher, the attitudes of students and the interactions between students and students and teachers.

Data Analysis

The data obtained were analyzed using descriptive quantitative analysis techniques on the critical thinking ability test scores with the minimum completeness criteria (KKM). Comparing the percentage of

learning completeness and the average score before the study, after the research cycle I and after the research cycle II.

Research Procedure

Classroom action research is divided into 2 cycles with stages of each cycle consisting of planning, implementing, observing and reflecting. The description of each stage is as follows:

1. Planning

In this section, the researcher carries out an action plan to improve critical thinking skills and learning achievement through a demonstration of power generation water wheel with the following step:

- a. Determine the setting and time for carrying out the research with 2 cycles and each cycle consists of 2 meetings.
- b. Determine learning materials, namely basic competencies 3.6 Explain how to produce, distribute and save electrical energy and 4.6 Present works on various ways to save energy and purpose alternative sources of electrical energy.
- c. Make research permits, collaborator statement letters and schools principal recommendation letters.
- d. Develop a research design of types of activities and time of implementation.
- e. Develop a complete learning implementation plan (RPP).
- f. Compile observation sheets which include: 1) skill assessment sheets for preparing learning improvement plans, 2) observation sheets for critical thinking skills, and 3) observation sheets for carrying out learning skills.
- g. Compile attendance list of student and collaborators.
- h. Compile observation sheets.
- i. Develop reflection discussion sheets.
- j. Compile data analysis sheets.
- k. Determine the schedule for implementing reflection.

2. Acting

To improve critical thinking skills and learning achievement through a demonstration of a power generation water wheel, the learning steps are as follows:

a. Preliminary Activities

The activities carried out are opening (greetings, attendance, prayer), apperception (the teacher asks about the previous material), conveying the learning objectives and learning steps that will take place, preparing the media for a waterwheel for electricity generation.

b. Core Activities

The activities carried out demonstrating the waterwheel media for electricity generation and how it works, giving students the opportunity to try to demonstrate the media in turn, asking students to re-present how the media works in generating electricity, asking questions about material.

c. Closing Activities

The activities carried out guiding students to conclude material, student doing evaluation or homework, giving motivation to learn and greetings.

3. Observing

To obtain data, researchers were assisted by observers, namely colleagues or fellow teachers at SDN 3 Pakikiran. The observer's duties before carrying out learning research are 1) compiling observation sheets with researchers, 2) assessing lesson plans using the format "Ability Assessment Sheet for Developing Learning Plans (attached)". During the implementation of improving learning the observer's duties are 1) to make observations about the skills of carrying out learning using the format "Observation Sheet of Skills"

4. Reflekting

The observed data is then analyzed as material for reflection. Reflection activities are carried out after the action process of the second meeting is complete. The things that are done during reflection are as follows:

- a. Perform an analysis of critical thinking skills
- b. Conduct an analysis of the teacher's ability to prepare lesson plans through the APKG 1
- c. Conduct an analysis of the teacher's ability to carry out learning through the APKG 2 assessment tool.
- d. Conduct reflection discussions with collaborators using reflection discussion sheets.
- e. Comparing the results of actions with indicators of success.

- f. Determine the action steps of cycle II the results of the reflection discussion based on theoretical studies.
- g. Developing cycle II action plan instruments based on the results of reflection with collaborators.

3. RESULTS AND DISCUSSION

Result Research

Data on the results of the implementation of learning with pre-cycle classroom action research, cycle I and cycle II are as follows:

Table 1. Pre-cycle critical thinking skills test results

Nu	Category of critical thinking skills	Value Range	Frequency	Percentage %	StxF
1	Very good	90 - 100	0	0	0
2	Good	80 - 89	1	7,70	84,5
3	Enough	70 - 79	5	38,46	372,5
4	Not enough	0 - 69	7	53,84	241,5
Amount			13	100	698,5
Average					53,73
Mastery Learning				46,16	

Based on the table above, it can be seen that the number of students who have very good critical thinking skills does not exist, there is 1 student or 7,70% of good critical thinking skills, 5 students or 38,46% in sufficient critical thinking skills and critical thinking skills low category there are 7 student or 53,84%. In general, it can be concluded that the critical thinking skills of class VI students at SDN 3 Pakikiran are in the low category.

Tabel 2. Frequency distribution of critical thinking skills cycle I

Value	ST	Tally	Frequency	%	STxF
90-100	95	II	2	15,38	190
80-89	84,5	II	2	15,38	169
70-79	74,5	III	5	38,47	372,5
0-69	34,5	IIII	4	30,77	138
Amount			13	100	869,5
Average					66,88
Mastery Learning					69,23

The results of the critical thinking ability test obtained the following results: students with very good score were 2 or 15,38%, student with good scores were also 2 or 15,38% of students with moderate scores were 5 or 38,47% and still there were 4 students (30,77%) who scored below the minimum learning mastery (KKM=70).

Table 3. Frequency distribution of critical thinking skills cycle II

Nilai	ST	Tally	Frequency	%	STxF
90-100	95	III	3	23,08	285
80-89	84,5	IIII	6	46,15	507
70-79	74,5	III	3	23,08	223,5
0-69	34,5	I	1	7,69	34,5
Amount			13	100%	1050

Nilai	ST	Tally	Frequency	%	STxF
Average					80,77
Mastery Learning					92,31

The results of the critical thinking ability test obtained the following results: students with very good scores had 3 children or 23,08%. Student with good grades had 6 children or 46,15%, student with fair scores 3 children or 23,08% and there was only 1 student (7,69%) who scored below the minimum learning mastery (KKM=70)

Discussion

The ability to think critically as measured through test shows that the average result is 53,73% with a learning completeness of 46,16%. After learning by using a demonstration of a water wheel, the power plant has increased. In the first cycle, the average was 66,88 and the learning completeness was 69,23%. However, based on reflections at the reached indicators of success. By fixing the deficiencies in cycle I, namely by managing classes, improving media and using LKPD, the results of the critical thinking skills test incycle II average to 80,77 and learning completeness became 92,31%. Comparison of the results of pre-cycle critical thinking skills test, cycle I and cycle II after evaluation at the end of the cycle obtained the following data:

Table 4. Comparison of Pre-cycle Critical Thinking Skills, Cycle I and Cycle II

Category	Value	Pre-Cycle		Cycle I		Cycle II	
		F	%	Frequency	%	Frequen	%
Sangat Baik	90-100	0	0	2	5,38	3	3,08
Baik	80-89	1	7,70	2	5,38	6	6,15
Cukup	70-79	5	8,46	5	8,47	3	3,08
Kurang	0-69	7	3,84	4	0,77	1	7,69
Jumlah		13	100	13	100	13	100
Rerata		53,73		66,88		80,77	
Ketuntasan belajar			46,16		69,23		92,31

From the table above, it is known that the average pre-cycle value of 53,73 in cycle I rose to 66,88 and in cycle II increase again to 80,77. Thus learning through demonstrations assisted by a water wheel for generating electricity can increase the average value of the material in the process of generating electricity. The pre-cycle learning completeness in cycle I rose to 69,23 while in cycle II increased again to 92,31%. A very significant increase, proving that the application of the demonstration method assisted by a waterwheel for electricity generation in the material the process of producing electricity has succeeded in increasing the learning completeness of students.

4. CONCLUSION

Based on the description of the implementation of learning, data analysis and discussion, it can be concluded that: "Demonstration of a waterwheel for electricity generation can improve the critical thinking skills of class VI students at SDN 3 Pakikiran for the 2022/2023 academi year in the natural sciences lesson material for the process of generating electricity.

REFERENCES

- [1] Yanti, R., Sumardi, S., & Suryana, Y. The Effect of Problem Solving Approach on Students' Critical thinking Ability in Completion of Math Story Problems. *Pedadidaktika: Scientific Journal of Elementary School Teacher Education*, 5(1), 319-337.

-
- [2] Marudut, M. R. H., Bachtiar, I. G., Kadir, K., & Iasha, V. (2020). Improving Critical thinking Ability in Science Learning through the Process Skills Approach. *Basicedu Journal*, 4(3), 577-585.
- [3] Saputri, M. A. (2020). Application of the Problem Based Learning Model to Improve the Critical thinking Skills of Fifth Grade Elementary School Students. *Journal of Education and Counseling (JPDK)*, 2(1), 92-98.
- [4] Nurkhasanah, D., Wahyudi, W., & Indarini, E. (2019). Application of the Problem Based Learning Model to Improve Critical Thinking Skills of Grade V Elementary Students. *Satya Widya*, 35(1), 33-41.
- [5] Sarıcan, E. GÜNEŞ, & Büşra, E.(2021). Developing Critical Thinking Skills in Elementary School Students Through Foreign Language Education: An Action Research. *Education Quarterly Reviews*, 4(2).
- [6] Sari, DR, Handoyo, E., & Awalya, A. (2020). Mind Mapping to Improve Critical Thinking Skills and Learning Achievement of Elementary School Students. *Journal of Elementary School* , 9 (1), 7-13.
- [7] Arifuddin, A., Maufur, S., & Farida, F. (2018). The Effect Of Applying Puzzle Props Using The Demonstration Method On Student's Learning Motivation In Learning Mathematics in SD/MI. *Elementary School Scientific Journal*, 2(1), 10-17.
- [8] Nahdi, D. S., Yonanda, D. A., & Agustin, N. F. (2018). Efforts to Improve Students Understanding of Concepts Through the Application of Demonstration Methods in Science Subjects. *Pendas Horizon Journal*, 4(2), 9-16.
- [9] Magnatis, U. (2019). Efforts to Improve the Learning Achievement of fourth grade students at SD Negeri 7 Sungailiat in Mathematics about Mixed Arithmetic Operation Through the Demonstration method. *Scholar*, 1(1), 20-28.
- [10] Wismaya, E. J. (2018). Development of Three-Dimensional Learning Media (Miniature Waterwheel Power Plant) for Class IV Material Theme 2 Always Save Energy. *Basic Education*, 7(31), 3-096.
- [11] Khalid, A. (2016). Design and Build of a Miniature hydroelectric Power Plant (PLTA) with a Capacity of 9 Watts/0, 3 Volts. *INTEKNA Journal: Technical and Commercial Information*, 16(1), 22-30.
- [12] Morong, J. Y. (2016). Design of an Irrigation Waterwheel as a Power Generator in Talawaan Village (Doctoral dissertation, Politeknik Negeri Manado).