KnE Social Sciences
ICMScE
International Conference On Mathematics And Science Education
Volume 2024

Research Article

Effectiveness of Cooperative Problem Solving on Energy Concept in Physics Learning for Improving Students' Creative Thinking Skills

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Published: 26 April 2024

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the ICMScE Conference Committee.

Abstract.

This study aimed to determine the effectiveness of the cooperative problem solving learning model in improving students' creative thinking skills on the concept of energy. The research method used is a quasi-experimental design with a pretest-posttest nonequivalent control group design. The research was conducted at Garut. The research population were students of class X MIA 1-10. The sampling technique used was cluster random sampling. A total of 60 students of class X MIA 1 and 9 were selected, (41 female and 19 male). Students' creative thinking ability is obtained from pretest and posttest in the form of an essay test of 12 questions. The improvement of each student's creative thinking skills (Torrance) indicators to the concept of energy was obtained from the calculation of N-Gain with the values of smoothness (0.85), flexibility (0.56), and elaboration (0.72). The effectiveness of the learning model was tested using t-test hypothesis with the assistance of the SPSS version 28 proving that there is an increase in creative thinking skills after the implementation of cooperative problem-solving learning model on energy concept. Thus, the cooperative problem-solving learning model is very effective to be used as a solution in improving students' creative thinking skills.

Keywords: cooperative problem solving, energy concept, creative thinking skills.

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1. INTRODUCTION

The development of Indonesian people with character and competence is a challenge in the 21st century, especially in the field of education. Education in the 21st century has an important mission in forming a generation that is able to master creative thinking skills, flexible problem solving, collaborate and innovate [1, 2]. Education must evolve dynamically so that students can prepare their competencies from an early age by developing their talents and creativity to face global competition [3, 4]. Skills that must be possessed by students in the 21st century include communication skills, collaboration, critical thinking and problem solving as well as creativity and innovation [5–8].

Physics learning in Indonesia in reality still relies on mastery of concepts, facts and theories, but in the formation of higher-order thinking such as creative thinking which is needed in solving problems, it has not been implemented in every school. Such a situation is due to the lack of understanding of teachers in designing and developing science learning so that the ability to explore students' creative thinking skills has not been achieved [9, 10].

Based on preliminary research that has been carried out through interviews with one of the physics teachers explained that in learning, the teacher places more emphasis on mastering concepts and the ability to solve mathematical calculation problems independently. However, questions that practice creative thinking skills based on problem solving are almost never given and group learning activities are rarely carried out. To prove the truth of the interview activities, the researchers conducted tests on students to measure the creative thinking skills possessed by students. The results can be seen in Table 1.

TABLE 1: Results of preliminary study on creative thinking skills.

Indicators of creative thinking skills	Average Score	Interpretation
Fluenty thinking skills	1.29	Low
Flexibility thinking skills	1.10	Low
Elaboration thinking skills	1.07	Low

Table 1 shows that the indicators for fluently thinking skills of students on work and energy concepts obtained a score of 1.29 (low category), then on flexibility thinking skills of students obtained a score of 1.10 (low category) and on elaboration thinking skills of students obtained a score of 1.07 (low category). Problems that occur about the low creative thinking ability of students make researchers interested in conducting research on appropriate learning models to improve creative thinking skills.

work and energy concepts is very closely related to everyday life which requires students to think complexly so that it requires collaboration skills so that the learning problems encountered in these concepts can be solved cooperatively and creatively.

Based on the problems above, it is necessary to take action to improve the quality of the learning process so that students have higher-order thinking skills in physics learning, one of which is creative thinking skills. The appropriate action to overcome this problem is to use a learning model that is able to train and improve these creative thinking skills. The learning model chosen is problem solving-based cooperative learning.

Learning using the Cooperative Problem Solving (CPS) model is cooperative learning combined with problem solving techniques to direct students to have a critical and creative attitude [11, 12]. This learning model is also a learning model that is centered on the activities of students in a small group that aims to maximize problem solving-based learning so that thinking skills can be developed through learning that is built with interaction and collaboration [13, 14]. So that this learning model is suitable to be implemented in physics learning which demands a lot of high-level thinking activities in solving problems so that students have good 21st century skills. The Cooperative Problem Solving (CPS) learning model provides many positive influences on student learning. The positive influence of this model can increase the ability to cooperate in learning, improve communication in learning, improve understanding of concepts significantly, improve learning achievement, improve critical thinking skills, can increase learning activities, and increase student creativity. Based on the background described above, the researcher wants to apply the Cooperative Problem Solving (CPS) learning model and see how effective the Cooperative Problem Solving (CPS) learning model is in improving creative thinking skills.

2. RESEARCH METHOD

This study uses a quasi-experimental research method with a Pretest Posttest Nonequivalent Control Group Design. In this design, the researcher conducted initial measurements of the two samples, the difference being that in the experimental class, the researcher gave treatment by applying the Cooperative Problem Solving model while the control class did not. At the end of the lesson, the researcher re-measured the two research samples. The research sample was students of class X MIPA 1 and 9 SMA Negeri 1 Garut in the academic year 2020/2021. The data from the research results are processed and analyzed quantitatively and qualitatively. The quantitative analysis

technique used is to find the n-gain value from the pretest-posttest results which will then be tested with a t-test to determine the effectiveness of the learning model used by researchers to improve the skills to be achieved [14, 15], while qualitative techniques are used to measure implementation of the learning model using observation sheets and Student Activity Sheets.

3. RESULTS AND DISCUSSION

The presentation of the results and discussion in this paper is focused on analyzing the results of research quantitatively and qualitatively to determine the effectiveness of the Cooperative Problem Solving (CPS) learning model in improving students' creative thinking skills on work and energy concept.

3.1. Improvement of Students' Creative Thinking Skills on Work and Energy Concept

The increase in the results of students' creative thinking skills is known through the normalized gain value obtained from the pretest and posttest scores. The N-Gain value can be seen in Table 2.

TABLE 2: N-gain value of students' creative thinking skills.

N-Gain	Interpretation
0.71	High

Table 2 Shows that students' creative thinking skills increase after the Cooperative Problem Solving learning model is applied, it can be seen from the N-Gain value of 0.71 with a "high" interpretation. The increase in creative thinking skills that occurs after the application of the Cooperative Problem Solving learning model is because at each stage of the model creative thinking skills are trained, in line with the statements of other researchers who state that Cooperative Problem Solving learning is a learning model that can be applied in the classroom to improve communication and creative thinking skills in learning [15].

3.2. Improvement of Each Indicator of Students' Creative Thinking Skills on Business and Energy Materials

The recapitulation of pretest and posttest scores for each indicator of students' creative thinking skills can be listed in Figure 1.

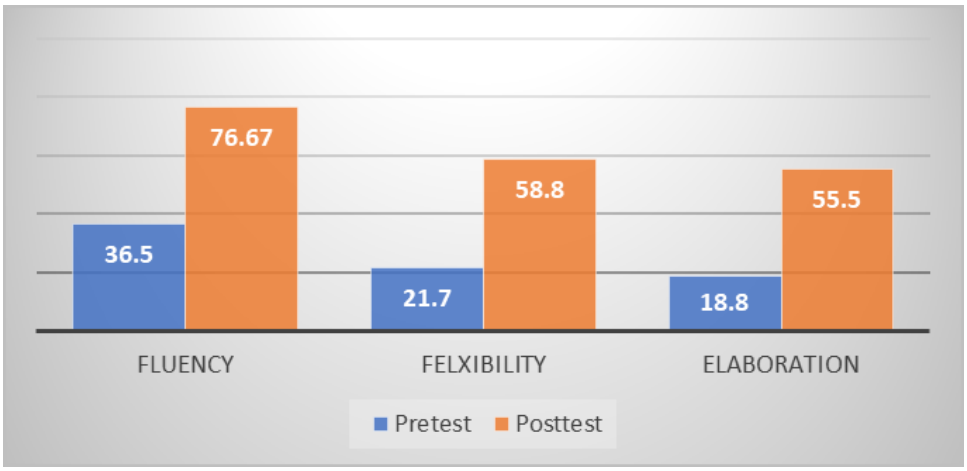

Figure 1: Improved Pretest-Posttest Results on each Indicator of Creative Thinking Skills.

Figure 1 shows the condition of students before and after receiving treatment using the Cooperative Problem Solving learning model seen from the results of the pretest with the results of the posttest. The posttest value is greater than the pretest value. In the fluency indicator, the results of the posttest were greater than the results of the pretest, which were 76.67 and 36.5, respectively. On the flexibility indicator, the posttest results are greater than the pretest results, respectively 58.8 and 21.7. And on the elaboration indicator the posttest results are greater than the pretest results respectively 55.5 and 18.8. This shows that there is an increase in students' creative thinking skills in business and energy materials after the implementation of the Cooperative Problem Solving learning model. This is in line with the opinion of Fitriyantoro and Prasetyo who state that problem solving-based learning can improve mathematical creative thinking skills in the experimental class compared to the control class [16]. If we examine more deeply the improvement of creative thinking skills when viewed from the N-gain results for each indicator of students' creative thinking skills consisting of 3 indicators, there are indicators that have the lowest and highest N-gain values. The lowest N-gain value is 0.56 with a medium category, namely there is an indicator of Flexibility which is an aspect in determining the cause and effect of a physical phenomenon on the student worksheet. This indicator has the lowest N-gain because students are not familiar with categorizing several ideas, analyzing some of the causes and effects of an event as

stated by [17, 18] that creative thinking itself has the meaning of a thinking activity to build various ideas or ideas.

3.3. Hypothesis testing

Hypothesis testing was conducted to determine the effectiveness of the Cooperative Problem Solving Learning model on increasing creative thinking skills. Before testing the hypothesis, we must first check the normality of the data. Normality test is needed to determine if the data found in this study are normally distributed or not [19]. The use of parametric statistics requires that the data for each variable to be analyzed must be normally distributed and if the data is not normally distributed, non-parametric statistics are used. To test the data is normally distributed or not, that is by using the Liliefors test because the sample is 30. The recapitulation of the results of the normality test using the Liliefors test can be seen in Table 3.

TABLE 3: Normality test results.

Description	Pretest	Posttest
Number of Students	30	30
Average	27.200	33.867
Standard Deviation	6.359	4.133
L_{count}	0.042	0.064
L_{table}	0.162	0.162
Result	0.042 < 0.162	0.064 < 0.162
Criteria	$L_{count} < L_{Table}$ then the data is normally distributed	$L_{count} < L_{Table}$ then the data is normally distributed
Number of Students	30	30

Based on Table 3, the results of the normality test using liliefors show that the pretest data is L_{count} (0.042) < L_{Table} (0.162), while the posttest results are L_{count} (0.064) < L_{Table} (0.162) with a significance level of 0.05 indicating the data is normally distributed. Furthermore, homogeneity test was conducted to determine the variance of a population used. The recapitulation of homogeneous test results can be seen in Table 4.

Based on Table 4 above, it is known that the significance value of the pretest variable based on the posttest variable = 0.208 > 0.05, meaning that the pretest variable data on the posttest variable has the same variance so that to test the hypothesis, parametric tests can be used. From the results of normality and homogeneity tests, it can be concluded that the hypothesis test used is the t-test. The results of the t test analysis can be seen in Table 5.

Table 4: Homogeneity test results.

Description	Pretest (X)	Posttest (Y)
Number of Students	30	30
Average	6.45	8.61
Standard Deviation	1,33	
L_{count}	1.860	
L_{table}	$L_{count} < L_{Table}$ 1.33< 1.860	
Result	Homogeneous Distribution	

Table 5: Recapitulation of hypothesis test results.

Column Header Goes Here	Column Header Goes Here
Number of samples	30
Maximum N-Gain	60
Minimum N-Gain	27
Standard Deviation	9.94
t_{count}	23.83
t_{Table}	2.045
Results	$T_{count} > t_{Table}$
Interpretation	H0 is rejected, Ha is accepted
Criteria	There is an Improvement

Based on the results of the t-test in Table 5, the value of t_{count} = 23.83 and for the value of t_{Table} = 2.045 at a significant level of 0.05. If $t_{count} > t_{Table}$ then H_0 is rejected, H_a is accepted while if $t_{count} < t_{Table}$ H_0 is accepted, Ha is rejected. The results of hypothesis testing with t-test indicate that the value of $t_{count} > t_{Table}$, so that H_0 is rejected, H_a is accepted. Thus, the results of hypothesis testing conclude that there is an increase in students' creative thinking skills after the implementation of the Cooperative Problem Solving learning model on work and energy material, so it can be said that the Cooperative Problem Solving learning model is effective in improving because the Cooperative Problem Solving learning model allows students more students are directly involved in the learning process, where students can solve problems through group discussions, on the other hand students can train creative thinking in seeking knowledge, collecting ideas and realizing ideas with the stages of the Cooperative Problem Solving learning model. This is in line with the opinion of Dwi [20] who explained that the Cooperative Problem Solving learning model is a learning model that is centered on the activities of students in a small group aimed at maximizing problem-solving-based learning so that thinking skills can be built through learning that is built with interaction and collaboration.

In line with the opinion of [21] which states that problem solving-based cooperative learning models require creative thinking skills in solving problems because the decisions of each student to solve problems can be different.

4. CONCLUSION

Based on the discussion of the research results, it can be concluded that the application of the Cooperative Problem Solving learning model on work and energy materials can improve creative thinking skills, this is evidenced by the N-Gain value showing a high category. Reinforced by the results of hypothesis testing with t test shows that Ha is accepted, so that the Cooperative Problem Solving model is significantly effective for improving creative thinking skills.

Acknowledgments

The author expresses his deepest gratitude to LP2M UIN Sunan Gunung Djati Bandung which has provided financial support so that this paper can be published.

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