Improving creative thinking skills of student related to the concept work and energy

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Abstract. Creative thinking skills are skills that must be possessed by the students in the 21st century, however, the learning activities in schools, in general, do not practice the skills of creative thinking of students, so the creative thinking skills of students are still low. This study aims to determine effect model Creative Problem Solving (CPS) to increase creative thinking skills of students in the work and energy concept. The method used in this study is a pre-experiment with the design of one-group pretest-posttest. The population of this study was the students of class X MIA SMAN 22 Garut, the sample was selected by random sampling technique that is class X MIA 2 with the number of 27 students. The instrument for measurement creative thinking skills of student used test essay. The improved creative thinking skills of students are based on the normalized gain score <g> of 0.85 included in the high category. Hypothesis testing is done using test-t obtained Tcount (58.33) > Ttable (2.056) which means that Ho refused and Ha accepted. CPS models can thus be used as an alternative to improve the creative thinking skills of students in the work and energy concept.

1. Introduction

Thinking is an activity that human beings have always done [1]. According to Lai & Viering [2] definition of creative is interaction between talent, processes, and the environment in which the individual and the group can produce a clear product, either new or useful as defined in the social context that includes the current thinking in the field.

Creative thinking skills is a tendency to generate or recognize ideas, alternatives, or possibilities that may be useful in solving problems, communicating with others and entertain yourself and others [3]. According to Supardi the basic process of creative thinking is used for the discovery of new, constructive style works relating to the material being taught that emphasize aspects of intuition and rational thinking. Creative thinking skills to develop students to generate new ideas relating to the concept of physics and applied to everyday life [4]. Aspects of creative thinking skills, such as thinking well (fluency), which stimulates students to provide questions about things they do not understand, think flexible (flexibility) which stimulate the students to give an opinion or the latest ideas and thinking to detail (elaboration) stimulates students to design an idea or the idea of making a work or results in accordance with the submitted topic.

Creative Problem Solving (CPS) model invites students to think creatively to solve a particular problem, both in context physics and in everyday life. This is confirmed also by Karen model of CPS is a learning model that is centered on problem-solving skills, followed by strengthening creative thinking...
skills [5]. The CPS is a learning model that does a focus on teaching and problem-solving skills, followed by strengthening skills [6]. This learning model emphasizes the creative thinking skills of students in connect, explain, analyze, evaluate and solve problems of the ideas that emerged from group discussion [7]. According to Supaman of learning model CPS is also a way of dynamic approach, students become more skilled because students have internal procedures more composed from scratch, so students could choose and develop ideas, not as rote that little use thinking [8]. CPS learning that emphasizes problem-solving process, requiring an innovative instructional media in order to create an interesting learning [9] [10].

This research facilitates teachers in the learning process of managing the class well by applying problem-based learning models to improve creative thinking skills. Creative thinking skills are activities that can develop the latest ideas or ideas that can produce works and concepts of energy related to certain products. This research integrates the application of each syntax of the CPS model with laboratory activities so that it is expected to further to improve the ability of students to solve problems.

2. Methodology
The method used is the pre-experimental method. This research method, creative thinking skills improvement can be seen from the results of the pretest and posttest before and after being given treatment (implementation CPS model). The design used in this study is a one-group pretest-posttest design [11]. Samples were given an early test in the form of a pretest to determine the beginning of knowledge, then proceed with treatment of the application of learning models CPS on material and energy works, then given a posttest using the same instrument as the pretest. The test instrument used in this study to measure the creative thinking skills of students who have been validated.

The population in this study are all students of SMAN 22 Garut class X the academic year 2017/2018 consisting of five classes with the number of students 169 people. The sampling technique in this research is by simple random sampling. Taking classes at random without regard to ability or whether many students in the class were sampled. The samples used were 27 students in class X MIA 2.

Instruments in this research used creative thinking skills tests essay. This study uses an instrument that consists of the pretest and posttest. The pretest and posttest in the form of matter that is based on indicators of creative thinking skills that consist of four questions a description that includes thinking well (fluency), think flexible (flexibility), think itemizes (elaboration), that aims to identify and measure thinking skills creative students before and after applying the CPS model. The improvement students' creative thinking skills was shown by calculating average normalized gain <g> and interpreted into the category according to Hake [12]. Hypothesis testing is done by using parametric statistic paired sample t-test because after the second normality test normal distributed data.

3. Result and Discussion
Data onto this study is the increase in creative thinking skills of students in a work matter and energy of use Creative Problem-Solving learning model. Data in brief about the <g> overall, <g> every sub concept work and energy and the <g> each indicator creative thinking skills. The distribution of scores increases the creative thinking skills of students were analyzed by comparing pretest, posttest and <g> of students to work and energy can be seen in Table 1.

| Score | Interpretation |
|-------|----------------|
| Pretest | Posttest | <g> |
| Amount | 666 | 2396 | 0.85 | High |
| Average | 25 | 89 | |

Average scores pretest of students is 25 whereas for posttest scores obtained an average total score of 89. After calculating the normalized gain scores <g> 0.85 means that with the implementation of
Creative Problem-Solving learning model there is an increase in creative thinking skills of students in the topic of work and energy included the high category. The CPS learning model train problem-solving skills through systematic techniques in organizing creative ideas to solve problems [13] [14].

Distribution score pretest-posttest with calculation and analysis of the normalized gain score \( \langle g \rangle \) in each sub-concept work and energy can be seen in Table 2.

| Sub concept                              | Pretest | Posttest | \( \langle g \rangle \) | Interpretation |
|------------------------------------------|---------|----------|--------------------------|----------------|
| Work concept                             | 28      | 82       | 0.75                     | High           |
| Work and energy theorem                  | 25      | 85       | 0.80                     | High           |
| Law of conservation of mechanical energy | 21      | 87       | 0.86                     | High           |
| Average                                  | 25      | 85       | 0.85                     | High           |

The normalized gain scores every sub concept work and energy the highest is the law of conservation of mechanical energy with \( \langle g \rangle \) 0.86, the average of pretest score of 21 and the average score posttest 87 included in the high category. Meanwhile, subconcepts of work concept have \( \langle g \rangle \) 0.75 the lowest, the average of pretest scores 28 and the average score posttest 82 included in the high category. The CPS learning model evokes the ability to think critically and creatively so that it can solve problems related to physics in the context of everyday life [15].

The normalized gain score \( \langle g \rangle \) each indicator creative thinking skills of students can be seen in Table 3.

| Indicators creative thinking skills       | Score       | \( \langle g \rangle \) | Interpretation |
|------------------------------------------|-------------|--------------------------|----------------|
| Current thinking (fluency)               | 30          | 94                       | 0.91           | High           |
| Thinking supple (flexibility)            | 24          | 91                       | 0.88           | High           |
| Thinking detailing (elaboration)         | 19          | 82                       | 0.78           | High           |
| Average                                  | 25          | 89                       | 0.85           | High           |

Students' creative thinking skills after applying the CPS learning model showed an increase in the high category. The normalized gain scores every indicator of creative thinking skill is the highest fluency with \( \langle g \rangle \) equal 0.91, the average score of pretest 30 and posttest of 94 included in the high category. Increased flexibility aspects caused by students are always stimulated to issue their opinions to ask. The improved flexibility aspect is the high category. Flexible thinking ability which is one of the creative components as important abilities, even the most important, that must be possessed by individuals in solving problems [16].

Meanwhile, indicators of creative thinking skills that have a \( \langle g \rangle \) of the lowest are elaboration equal 0.78 which are the average score of pretest 19 and posttest of 82 included in the high category. Students still find it difficult to expand or enrich ideas to solve a problem. Elaboration ability is a key factor that stimulates students to create their knowledge in problem-solving activities [17] [18].

Hypothesis testing is also performed in this study, prior to the first hypothesis test done Liliefors normality test as shown in Table 4.

| Criteria       | Pretest | Posttest |
|----------------|---------|----------|
| Total students | 27      | 27       |
| Average        | 25      | 89       |
| Standard deviation | 1.76   | 2.1      |
| L\text{count} | 0129    | 0145     |
Based on Table 4 known values of the data Liliefors pretest is $L_{count} < L_{table}$ (0.129 < 0.161) with a 0.05 significance level, indicating that the data is normally distributed. Data onto posttest known $L_{count} < L_{table}$ (0.145 < 0.161) with a 0.05 significance level, posttest data also showed the normal distribution. Data normality test results using Liliefors stated that the research data pretest and posttests normal distribution, then the hypothesis testing is done by using a paired samples t-test. The recapitulation hypothesis testing results can be seen in Table 5.

**Table 5. Summary of Test Results Hypothesis**

| Criteria                        | Value  |
|---------------------------------|--------|
| The number of samples (N)       | 27     |
| N-Gain maximum                  | 78     |
| N-Gain minimum                  | 55     |
| Standard deviation              | 2.09   |
| $T_{count}$                     | 58.33  |
| $T_{table}$                     | 2.056  |
| Result                          | $T_{count} > T_{table}$ |
| Interpretation                  | Ho rejected, Ha accepted |
| Criteria                        | There is improving creative thinking skills of students |

Based on the results of hypothesis testing using a paired sample t-test in Table 4, the value $T_{count} = 58.33$. At the 0.05 significance level the value $T_{table} = 2.056$ ($T_{count} > T_{table}$). Results of the calculations and the analysis showed that Ho refused and Ha is received so that the calculation and analysis showed that there is the effect of the application of the Creative Problem Solving (CPS) in improving the skills of creative thinking of students. The CPS learning model that is the basis of the development of the HOT-Lab model can improve high-level thinking skills (critical thinking and creative thinking) and communication skills [19]-[22]. These results reinforce previous research Learning that uses Practical Physics Work (PPW) can foster a creative culture a large number of students [23].

**4. Conclusion**

We have successfully carried out research to investigate the effect of Creative Problem-Solving (CPS) in improving the creative thinking skills of students. The improved student creative thinking skills including high category. However, further research is required to implementation model CPS in another physics topic.

**Acknowledgments**

The authors would like to thank the principal of SMAN 22 Garut who had given permission to conduct research, as well as to the physics teacher of class X MIA 2 of SMAN 22 Garut who had helped during the research.

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