JESE 2 (2) (2022)

Journal of Environmental and Science Education

http://journal.unnes.ac.id/sju/index.php/jese

Creative Problem Solving (CPS) Learning to Improve Ability an Strudent's Critical and Creative Thinking on Science Materials

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DOI: https://doi.org/10.15294/jese.v2i2.55641

Article Info

Received 4 Mei 2021
Accepted 10 Agustus 2021
Published 26 September 2021

Keywords:
Creative Problem Solving,
Critical Thinking,
Creative Thinking,
Human Digestive System

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Abstract

This study aims to determine the effectiveness of using the CPS (Creative Problem Solving) learning model to improve students' critical and creative thinking skills. This research is an experimental study using a quasi-experimental research design with a non-equivalent control group design. The sampling technique used purposive sampling and obtained class VIII A and VIII F. Improving students' critical thinking skills based on T-Test test data pretest and posttest were 4.01 in the control class and 10.29 in the experimental class, both of which were higher than the $T_{table,}$ which was 1.99. Improving students' creative thinking skills based on the STUDENT WORKSHEET T-Test Test of 5.035 in the control class and 10,041 in the experimental class, and the T-Test mind mapping of 6,428 in the control class and 6,240 in the experimental class. From the test results, it was found that H_0 was rejected so that there was an increase in students' critical and creative thinking skills. Thus, the application of the CPS (Creative Problem Solving) model on the Science material is effectively used to improve students' critical and creative thinking skills.

p-ISSN 2797-0175
e-ISSN 2775-2518

INTRODUCTION

Education is a process that directs students to develop their existing potentials. Based on Law no. 20 of 2003, the purpose of National Education is to develop capabilities and shape the character and civilization of a dignified nation in order to educate the nation's life, develop the potential of students to become human beings who believe and fear God Almighty, have noble character, are healthy, knowledgeable, capable, creative, independent, and become a responsible citizen.

According to Agustin (2022), the main purpose of education is to increase retention and transferability. It is important for students to acquire sufficient knowledge so that they can overcome and solve new problems encountered, one of which is Science learning (Agustin, 2022). Science learning is learning through a systematic process using the scientific method. Science learning provides opportunities for students to gain learning experiences through experimentation and direct observation of natural phenomena (Naezak, 2021).

Science learning at MTs Negeri 1 Temanggung is taught in an integrated manner but is still theoretical in nature, has not been associated with many problems faced by students in everyday life, learning activities have not been optimal and tend to be teacher-centered, and have not trained students to think scientifically. Science learning should be directed to *inquiry* and discussion so that it can help students gain experience and a deeper understanding of the natural surroundings (Purwanti, 2013).

Teachers should use methods that are considered effective enough to reach the needs of all students regardless of their background. One of the learning models that can be used is a problem-based learning model. Teachers are now using methods that they feel are feasible will meet all the individual needs of students regardless of the student's background (Bada, 2022). The use of the right learning model can help the effectiveness of the learning process (Budiarti, 2022).

Today, this problem-based learning model is starting to be adopted., because this model uses authentic problems and is around students to conduct investigations and *inquiries.* One type of problem-based learning model that can increase students' activeness and critical and creative thinking skills is the CPS learning model.

The CPS learning model is a learning model that focuses on learning problem solving skills (Hamzah, 2011). In using this model students are required to be able to solve problems by selecting and developing responses, not only by memorizing without thinking, but solving problems by expanding the thinking process.

This learning model is considered capable of improving students' critical and creative thinking skills (Udiyah, 2017). This is because in the learning process it involves students who think critically about a problem and think creatively about each assignment that has been given to students. So that this research is needed to find out whether the CPS learning model is effective in improving students' critical and creative thinking skills.

METHOD

The type of this research is *quasi-experimental* with *Non Equivalent Control Group Design* as the design. This design is to measure in two classes, with one class receiving X treatment using the CPS learning model and the other class not receiving this treatment. Both classes were given pre-test and post-test. The research design can be seen in Table 1.

Table 1. Non Equivalent Control Group Design

Class	*Pretest*	Treatment	*Posttest*
Control	√		√
Experiment	√	X	√

Information
X: treatment in the learning process

This research was conducted at MTs Negeri 1 Temanggung, having its address at Mandisari, Parakan, Temanggung Regency, Central Java, 56254. The population used in this study was class VIII students in even semesters. The technique used in this research is *purposive sampling technique* . The samples taken were two classes, 1 as the control class, namely class VIII A, which consisted of 32 children, and the experimental class, namely class VIII B, which consisted of 34 children.

The steps of data collection include (1) the documentation method used to obtain data regarding the total population and sample, sample members, the value of sample members, and documentation during research activities, (2) the test method, to determine students' critical thinking skills after giving the material using CPS model with *pre-test* and *post-test* using *Essay* questions of 10 questions that have previously been tested for validity, reliability, difficulty, and discriminating power, (3) a questionnaire, the questionnaire in this study was to determine the

response to the effectiveness of using the CPS learning model in learning. The questionnaire sheet was consulted with the supervising lecturer.

RESULT AND DISCUSSION

Test for Increasing Students' Critical Thinking Ability

The results of the research on students ' critical thinking skills were measured using the *pretest* and *posttest scores* . The results of the *pretest* and *posttest scores* were then analyzed for the normality test which was used to determine whether or not the distribution of the test list obtained from the study was normal. The analysis used in this study uses the *Chi Square test* , the results of the normality test are from Table 2.

Table 2. Pretest and Posttest Normality Test Results

Treatment	X^2_{count}	X^2_{tables}	Information
Pretest	10,13	15.51	Data is normally distributed
Posttest	11.85		

The calculation results show that both the control class and the experimental class show data that are normally distributed so that the hypothesis calculation uses *T-Test* test . The results obtained from the test on the students' *pretest* and *posttest scores* show the results that can be seen in Table 3.

Table 3. Results of T-Test for Improving Students' Critical Thinking Ability

Class	t_{count}	t_{table}	Information
Control	4.01	1.99	$H_{0\ is}$ rejected, t_{count} is higher than t_{table}
Experiment	10.29		

The results of the analysis in Table 3. show that the value of $t_{arithmetic}$ is higher than t_{table} so that there is an increase in students' critical thinking skills between before and after treatment.

Test for Increasing Students' Creative Thinking Ability

Improving students' creative thinking skills can be seen from the STUDENT WORKSHEET scores and *mind mapping* . The results of the assignment scores were then analyzed for the normality test which was used to determine whether or not the distribution of the test list obtained from the study was normal. The analysis used in this study uses the *Chi Square test* , the results of the normality test can be seen in Table 4.

Table 4. Task Normality Test Results and Mind Mapping

Treatment	X^2_{count}	X^2_{tables}	Information
Task	7.91	7.81	Data is normally distributed
mind mapping	1.31		

The calculation results show that both the control class and the experimental class show data that are normally distributed, so that the hypothesis calculation uses *the One Tail T-Test Test* . Calculation results The results obtained from the test on the task scores and students' *minds* show the results that can be seen in Table 5.

Table 5. T-Test Results for Improving Students' Creative Thinking Ability

Class	$t_{calculate}$ STUDENT WORKSHEET	t_{count} *mind mapping*	t_{table}	Information
Control	5.035	6,428	1.097	$H_{0\ is}$ rejected, t_{count} is higher than t_{table}
Experiment	10,041	6,240		

The results of the analysis in Table 5. show that the value of $t_{arithmetic}$ is higher than t_{table} so that there is an increase in students' critical thinking skills between before and after treatment.

Students' creative thinking ability was also measured using observation sheets taken by two observers at each meeting. The indicators that are used as guidelines on the observation sheet consist of 4 indicators which are described in 10 sub-indicators, namely generating many answer ideas to solve problems/questions smoothly, providing many ways or suggestions for doing various things, producing varied answers or questions, being able to see a problem from a different point of view, looking for many alternatives or different directions, able to change the way of approach or thinking, able to produce new and unique expressions, able to make unusual combinations of parts or elements of the material, able to enrich and develop an idea or product, and adding or detailing the details of an

object, idea or situation to make it more interesting.

The percentage of achievement scores for each sub-indicator between the experimental class and the control class at the first meeting is presented in Figure 1.

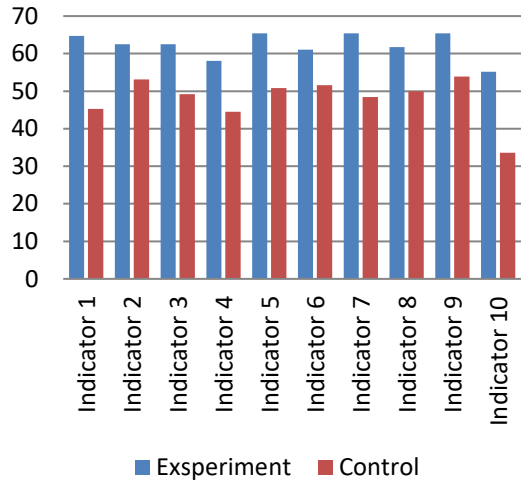

Figure 1. Presentation of the Observation Results of Creative Thinking Ability Meeting 1

At the first meeting, it was stated that the experimental class had 9 good sub-indicators and 1 good enough sub-indicator, while the control class had 9 fairly good sub-indicators and 1 bad sub-indicator.

The percentage of achievement of each indicator of the results of observing students' creative thinking abilities at the second meeting can be seen in Figure 2.

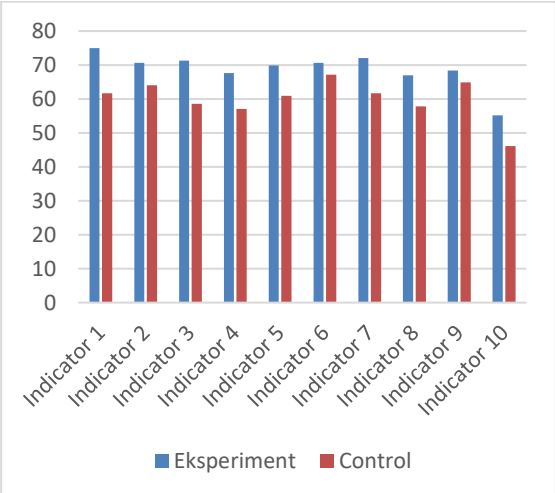

Figure 2. Presentation of the Observation Results of Creative Thinking Ability Meeting 2

At the second meeting, it was stated that the experimental class had 9 good sub-indicators and 1 good enough sub-indicator, while the control class had 6 good sub-indicators and 4 good enough sub-indicators.

The percentage of achievement of each indicator of the results of observing students' creative thinking abilities at the third meeting can be seen in Figure 3.

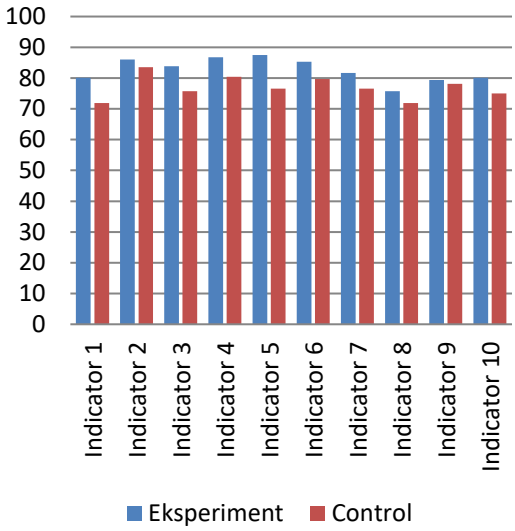

Figure 3. Presentation of the Observation Results of Creative Thinking Ability Meeting 3

At the third meeting, it was stated that the experimental class had 8 very good sub-indicators and 2 good sub-indicators, while the control class had 2 very good sub-indicators and 8 good sub-indicators.

Student Response Questionnaire Test

Response questionnaire data analysis was used to collect student responses to the use of the CPS in Science Learning on the Human Digestive System Material. The response questionnaire was given at the last meeting, namely the 5th meeting, after students finished working on the *posttest questions* with the results of the student response questionnaire analysis as shown in Figure 4.

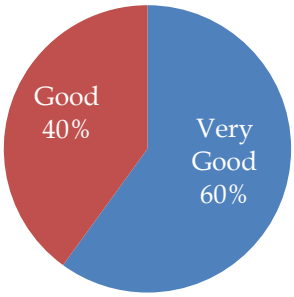

Figure 4. Results of Teacher and Student Responses to Science Learning Using the CPS Learning Model

While the average value of the questionnaire responses obtained was 84.7% with a very good category.

The Effectiveness of *Creative Problem Solving Models* to Improve Students' Critical Thinking Ability

Critical thinking ability is an ability that can be trained, so that this ability can be learned . Wahyuni (2021) said that critical thinking skills are students' cognitive skills that can be developed by integrating several subjects. Critical thinking skills can be improved by developing learning models, one of which is *Creative Problem Solving*. According to Fisher in Fatimah (2020), so far the teaching that has been applied only teaches the content of the subject matter and puts aside the ability to think, even though thinking skills really need to be taught. Morison *et al* in Fatimah (2014) reveal that there are five criteria for *essay questions* that are used to measure students' critical thinking skills, namely each answer choice contains clear information, requires more than one scientific concept to answer the question, has a high level of discriminating power, the percentage of cognitive questions is mostly in the form of applications . Critical thinking ability in this study was measured using *pretest* and *posttest questions* conducted in the control class and experimental class to measure students' critical thinking skills. The research process was carried out with a *non-equivalent control group design research design* . The researcher gave *treatment* to the experimental class in the form of using the CPS learning model while for the control class the researcher used a conventional model. Before learning science on the material of the digestive system in humans, students were given *pretest questions* to determine the initial score of students and at the end of *treatment* students were given *posttest questions* . Observations were carried out for 5 meetings by two observers. There are 10 *essay questions* with the 5 criteria mentioned earlier. The results of data analysis of the CPS model are effective for improving students' critical thinking skills, which are marked by an increase in the average *pretest* and *posttest scores* of the control class and experimental class. It can also be seen from the results of the *T-Test* which can be seen in Table 4.1 where the t_{count} of the control class is higher than the t_{count} of the experimental class, but both the control class and the experimental class have a t_{count} greater than the t_{table}. This is what causes this learning model to be effective for improving students' critical thinking skills. The cause of the control class t_{count} is lower than the experimental class t_{count} because some students did not experience an increase or even decrease in *posttest scores* .

The Effectiveness of *Creative Problem Solving Models* to Improve Students' Creative Thinking Ability

Creative thinking skills are able to make students develop their thinking to see problems from various perspectives (Septian, 2020). Creative thinking skills are needed in science learning. Learning and proof can be done if students have creative thinking skills. In this study, to measure the increase in students' creative thinking skills using the scores from the student worksheet and also the value of *mind mapping* . The student worksheet sheet is composed of 4 indicators, namely, *fluency* (fluency), *flexibility* (flexible thinking), *originalty* (original thinking), *elaboration* (elaboration). This indicator is also used as an indicator for *mind mapping assessment* . There are 3 LDS/LKS scores obtained from each student which is then calculated on the average of each value. This average value is used for the *One Tail T-Test test,* which is also carried out on the *mind mapping score*

The results of the data analysis of the CPS model are effective for improving students' creative thinking skills which are indicated by the t_{count} results of the student worksheet scores and the *mind mapping* is higher than the t_{table} value. It can also be seen from the results of the *T-Test* which can be seen in Table 4.2 where the t_{count} student worksheet of the control class is lower than the t_{count} of student worksheet of the experimental class. The t_{count} value of the control class *mind mapping* is higher than the t_{count} value of *mind mapping*, but both t_{count} student worksheet and *mind mapping* of both classes is greater than t

table.

From the data obtained, the average value of the student worksheet in the experimental class is 85.82, which is higher than the control class, which is 80.59. While the average value of *mind mapping* in the control class is 81.84, which is higher than the experimental class, which is 79.38. This is because in the experimental class students become more active when given *treatment* , in contrast to the control class which tends to be more shy during learning so that the experimental class has a higher student worksheet score. The difference in the average value of *mind mapping* occurred because several groups from the experimental class were late in submitting the *mind mapping* and according to the collective agreement when they were late in collecting the *mind mapping* , the group received a penalty in the form of a reduction in grades. But even so, both the control class and the experimental class collected all the assignments that had been given.

The difference is quite high in the student worksheet scores between the control class and the experimental class because there are 5 students from 32 control class students who still have an average score below the KKM value that has been determined by the school. However, both the control class and the experimental class for the average value of student worksheet and the average value of *mind mapping* have exceeded the KKM value that has been determined by the school.

KKM is not achieved because students are not present during the learning process. Therefore, the average score of students has not been able to reach the KKM. In addition, students are also reluctant to ask the teacher for assignments so they cannot catch up with other students' grades. However, the final result of the class average has a good score.

From the observations obtained, it is shown that the experimental class has a better achievement value in each meeting than the control class. This is also seen when students in the experimental class are more active than students in the control class. Besides, the curiosity of the experimental class is higher than the control class. Students in the experimental class were also more active during a question and answer session and answered with more varied answers. In contrast to the control class, where students tend to be more passive and only listen to what the teacher explains.

Student Responses to Learning Using the *Creative Problem Solving Model*

Student responses regarding the learning process using the *Creative Problem Solving model are needed to find out whether the Creative Problem Solving* learning model is effective or not to improve students' critical and creative thinking skills on the material of the human digestive system. Student responses were carried out on the experimental class. The assessment aspect for student responses to this learning model consists of 10 statements, with the response scale for positive statements being 4 with strongly agree; 3 agree; 2 disagree; 1 strongly disagree and for negative statements is 4 strongly disagree; 3 disagree; 2 agree and 1 strongly agree. Questionnaire of students' responses to the *Creative Problem Solving learning process* to improve students' critical and creative thinking skills on the material of the human digestive system.

The results of the student response questionnaire data analysis showed that students gave a positive response to the learning process by using the *Creative Problem Solving model* on the human digestive system material. This can be seen from the percentage of each statement stating very good and good. This positive response arises from new knowledge and experiences that have never been obtained before. In this study, there were 67.6% of the total experimental class students who gave a positive response to this study. This shows that the *Creative Problem Solving learning model* on the human digestive system material that has been carried out states that based on the questionnaire responses, the students overall stated a positive response to the application of the *Creative Problem Solving learning model* that was considered effective for improving students' critical and creative thinking skills.

CONCLUSION

Based on the results of research and data analysis that has been carried out, it can be concluded that the CPS learning model is effective for improving students' critical thinking skills with the *T-Test results* on the *pretest and posttest scores* of the experimental class 3.63, where the *T -test results The test* is higher than t_{table} which is 1.99 . The CPS learning model is also effective for improving students' creative thinking skills with the *T-Test results* in the experimental class of

10,041 (for student worksheet scores) and 6,240 (for *mind mapping scores*). *Treatment* also has a positive impact on students such as making it easier to understand the Human Digestive System material and training students in solving problems.

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