The Effect of Project Based Learning Model on Creative Thinking Ability

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Abstract

This study aims to determine the effect of the project based learning (PjBL) model on creative thinking skills. This quantitative research was a quasi-experimental design with a non-equivalent control group. The research was conducted on 9th-grade students at Cendikia Junior High School in the academic year 2022/2023, using purposive sampling to obtain 50 students, comprising 25 students in the PjBL class and 25 students in the conventional learning class. The research instrument used was a creative thinking test sheet with indicators of fluency, flexibility, originality, and elaboration. Data analysis used a paired-sample *t*-test. The research results indicate a significant influence of the PjBL model on creative thinking abilities. There was an improvement in each indicator of creative thinking after implementing PjBL, and the posttest scores achieved were higher than those of students in the conventional learning class. Based on this study, researchers recommend the learning process with a PjBL model to improve creative thinking skills.

Keywords: Creative thinking ability, Project based learning, Teacher center.

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INTRODUCTION

Education plays a very important role in determining the development of human resources that have high quality in competing in the era of globalization because education is a means that can improve the nation's standard of living (Abidin, Rohaeti, & Afrilianto, 2018). Through education, it is expected to be a bridge to form humans who have noble morals, have creativity, can communicate, are independent, and have the ability to face all possibilities in the era of globalization (Ariyani, Jalmo, & Yolida, 2019). The ability must be possessed to face competition in the era of globalization, that is a person is required to have critical thinking, be able to think creatively and be able to solve a problem (Nugroho, Jalmo, & Subakti, 2019). We can see that creative thinking has an important role in realizing quality human resources, someone who thinks creatively when faced with problems in the era of globalization and (s)he will think in finding ideas to solve these problems. Creative thinking is skills that are very important to be trained and familiarized by every human being in preparing for competition as superior human resources (Abidin et al., 2018). People who have the ability to think creatively are those who have imagination, intuition and are able to think as a whole (Ariyana, 2007). That way in education that plays a role in the development of superior human resources, students are required to be able to think creatively to solve problems in the real

world, by looking at the world from various angles, students will be able to find new solutions to solve these problems (Sumarni, Wijayati, & Supanti, 2019).

Creative thinking is an ability to solve problems, find concepts, and create something new in the learning process (Yasiro, Wulandari, & Fahmi, 2021). Creative thinking has several indicators that can be used to measure the ability to think creatively, as identified by Rahmazatullaili, Zubainur, and Munzir (2017). These indicators include: (1) fluency, where students have the ability to generate many ideas; (2) flexibility, where students can solve problems and see them from different points of view; (3) originality, where students can provide new ideas that are rarely given by others; and (4) elaboration, where students can detail ideas in depth. These four indicators are expected to be incorporated into the learning process.

The role of creative thinking is very important in the learning process, especially in science learning (Yasiro et al., 2021). Science is a collection of facts, concepts and discovery processes related to nature (Khaerani, Utami, & Mursali, 2020). Science learning is a systematically arranged learning that has the aim of understanding facts, concepts and phenomena that have a relationship with nature (Fatmawati & Shofiyah, 2022). To understand a concept given earlier and to continue the next concept that will be given requires effective science learning, learning that helps students to think, especially creative thinking so that students can answer questions that are in their own minds (Fitriyah & Ramadani, 2021). Knowledge in science learning can also help students in solving problems in everyday life (Fahmi, 2016). Therefore, creative thinking plays an important role in science learning because creative thinking is an ability to solve problems, and find concepts to create new things (Munandar, 2014). However, creative thinking skills in the science learning process still do not get more attention, the science learning process tends to be monotonous so that the results of the learning process do not influence the creative thinking process (Santoso & Wulandari, 2020). Students who have low creative thinking skills will have difficulty solving problems in the learning process or problems that will or are being faced (Amtiningsih, Dwiastuti, & Sari, 2016).

The low creative thinking ability of students in Indonesia according to the Global Creativity Index (GCI) 2017 shows that among the 127 countries studied, Indonesia ranks 87th, this can happen because students are less able to find various alternative solutions ideas and find answers that vary in doing problems (Pulungan & Khairuna, 2023). This is supported by the results of pre-research on science learning at Cendikia Junior High School Sidoarjo through a test of creative thinking skills in grade 9 students as many as 108 students. From the results of the creative thinking ability test, it was obtained that students at Cendekia Junior High School belonged to the low creative thinking categories with an average of 28%, which was in the indicator fluency Obtained an average of 44% (low category), indicator flexibility with an average of 39% (low category), indicators originality with an average of 12% (low category), and indicators Elaboration with an average of 18% (low category). The low ability to think creatively of these students in the results of the answer test given to students have not varied and still refers to the source of the book and the average between the answers of students shows the same answer.

Low creative thinking ability can be developed by designing a learning model that can stimulate students to explore the abilities of students themselves, because

each student has different creative thinking abilities, so in solving a problem, students have answers in different ways (Sari, Zuhri, & Rubowo, 2020). Learning models that can be applied to develop low creative thinking skills are learning models that can stimulate students to provide new ideas and solve problems, according to creative thinking indicators (Pulungan & Khairuna, 2023). Through strategy in the PjBL model which is part of the creative thinking indicator which includes fluency (sparked many ideas), flexibility (solving a problem), originality (providing new ideas), and elaboration (detailing in detail the ideas already created) (Pulungan & Khairuna, 2023). These strategies include guiding students to design, solve problems, make decisions, carry out investigative activities, and provide opportunities for students to work independently or in groups to solve real problems (Mokambu, 2021) . This has been described in the PjBL syntax including (1) project determination, (2) project design/completion, (3) preparation of schedules, (4) teacher settlement and monitoring, (5) preparation of reports and presentations. Through the process in PjBL, it can improve the creative thinking ability of students, because from the indicators of creative thinking ability students are required to find ideas to complete the project to be made (Pulungan & Khairuna, 2023). Therefore, the application of the PjBL model is appropriate to improve students' low creative thinking skills. This is by Amalia, Saefan, and Siswanto (2019) which state that the PjBL model is a learning model that makes students more creative in finding new ideas according to the concept of the material used to develop the project they create, and the learning model can familiarize students with thinking smoothly and flexibly in solving a real problem.

The result of the PjBL model is a product in the form of a design, model, or prototype. Making these products is the result of students' creative thinking process by pouring their ideas into a real product. This is following Anas and Murti (2016), it also stated that the PjBL learning model is an innovative learning model that involves students in solving a real problem by pouring their creative ideas into a project, so that this learning emphasizes students to produce a work. This is what can improve students' creative thinking skills in providing new ideas related to innovative products created. In line with previous research that revealed related to the PjBL learning model and creative thinking, including research by Noviyana (2017) which has similarities with the research to be carried out, namely the research aims to improve the creative thinking ability of students, but with a different subject focus, namely mathematics, while the research will be carried out on science subjects. Amalia et al. (2019) regarding the effectiveness of the PjBL model in improve students' creative thinking skills, where this study uses design one-group pretest-posttest design while the research that will be carried out uses design control group nonequivalent design, the results of the study stated that the PjBL model is effective for improving creative thinking skills. There is also previous research conducted by Putri, Nuroso, and Khoiri (2018) which states that the PjBL learning model has a significant effect on students' creative thinking. The research was carried out at the high school level, while the research will be carried out at the junior high school level.

Based on previous background and research, the application of the PjBL learning model is expected to help students solve real problems using their creative thinking skills, especially in science learning. Therefore, this study aims to determine the influence of the PjBL model on the ability to think creatively with

different methods and subjects, besides that it can also be the basis for development research in science learning on biotechnology material in developing creative thinking skills in students.

RESEARCH METHODS

This research was conducted in the even semester of March 2023 at Cendikia junior high school Sidoarjo. The type of research used is quantitative research using the quasi experiment method, which is a method whose control group cannot fully function in controlling outside variables that can have an impact on the conduct of experiments (Sugiyono, 2022), the design used is control group noneequivalent design (see Figure 1). The population in this study were class IX students totaling 108 students with a sampling of 50 students, samples taken using purposive sampling, considering the number of sampling used, namely 25 students per class, so that 25 students in class IX-1 were obtained as the Experimental class and 25 students in class IX-2 as a Control class.

O_1	X	O_2	Experiment
O_3		O_4	Control

Figure 1. Pretest and Posttest control group design

Information: O_1= Experimental class pretest value, O_2= Experimental class posttest value, O_3= Control class pretest value, O_4= Experimental class posttest value, X= Treatment with PjBL model by providing projects in the form of biotechnology product innovations for 4 meetings.

The design above can be explained as follows, in phase 1 researchers compile learning tools in the form of lesson plans, syllabus, worksheet, and research instruments. Phase 2 researchers gave pretest questions (see Pretest-Posttest Questions) to the experimental class and control class. In phase 3, researchers conducted a PjBL model in the experimental class to improve creative thinking skills, at this stage it is carried out according to the PjBL syntax where at the first meeting students are given worksheet, with the worksheet that students determine projects, design and schedule preparation (students determine innovation products namely making tapai from different raw materials), at the second meeting students carried out the process of making tapai from raw materials other than cassava, at the third meeting students monitored product manufacturing and at the last meeting student do report preparation and presentation of product result . At this stage in the experimental class the researcher is only a facilitator. While in the control class, it uses conventional learning with the teacher center method. In phase 4 after the application of the learning model in the experimental class and control class, the researcher will give posttest questions (see the Pretest-Posttest Questions) to measure creative thinking skills in the experimental class and control class.

The material that will be taught to determine the effect of the PjBL model on students' creative thinking skills is biotechnology material, because in this material students can analyze the principles of biotechnology through the manufacture of biotechnology products to be made, and students can develop their creativity through ideas in making these products.

Pretest-Posttest Questions

Read the text below, to answer questions No. 1-4!

Tape entrepreneurs in Bondowoso Regency complained about the difficulty of getting cassava. Even when it is available, the price is very expensive. This problem makes tape industry players need the attention of local governments, so that there is a solution. The scarcity of cassava is caused by the shortage of land to grow cassava besides that farmers are also reluctant to plant cassava, so since 2021 it has begun to be scarce which makes tape producers confused about getting raw materials. Due to the scarcity and high price of cassava, it has an impact on tape production which is increasingly rare.

1. Based on his problem above, what do you think is the right solution to overcome the decline in tape production?
2. Based on the solution you have described, how do you think you implement the solution you have described?
3. Based on the above problems, make a unique and common solution to overcome the decline in tape production with the materials around you! Also give examples of alternative raw materials that can be used for tape reduction problems!
4. Based on answer No.3, explain in detail why you are using these alternative raw materials as a solution to overcome declining tape production!!

Read the text below, to answer questions No. 5-8!

Tempe is one of the most popular side dishes in Indonesia, from children to adults. However, farmers are currently reluctant to grow soybeans because the price of imported soybeans is cheaper, the land is narrow and also soybean seeds are of poor quality, so soybean farmers no longer supply soybeans to tempe entrepreneurs. Because the demand for tempeh continues to grow while the soybean harvest is not proportional to the demand for tempe, making tempeh production decrease.

5. Based on the problems above, what do you think is the right solution to overcome the decline in tempeh production?
6. Based on the solution you have described, how do you think you implement the solution you have described?
7. Based on the above problems, make a unique and common solution to overcome the decline in tape production with the materials around you! Also give examples of alternative raw materials that can be used for tempeh reduction problems!
8. Based on answer No.7, explain in detail why you are using these alternative raw materials as a solution to overcome declining tempeh production!!

Read the text below, to answer questions No. 9-12!

Nowadays, we can find a lot of seedless fruits in the market, such as seedless watermelon, seedless avocado, seedless orange and many more. Seedless fruit is now much favored by the public because we can comfortably eat the fruit without thinking about the seeds. With the many positive responses from the public, the production of seedless fruit will continue to increase, with the increasing production of seedless fruit will affect the fruit with seeds or the original fruit, and the original fruit (seedless) may become extinct.

9. Based on his problem above, what do you think is the right solution to overcome so that drupes do not become extinct?
10. Based on the solution you have described, how do you think you implement the solution you have described?
11. Based on the above problems, make a unique and common solution to overcome the extinction of drupes!
12. Based on the solution, explain in detail why the solution you have described is suitable to solve the problem!

In this study, the instrument used in this study was a creative thinking test sheet. The creative thinking assessment is arranged in the form of description questions which are compiled based on 4 indicators of creative thinking according to Rahmazatullaili et al. (2017) including fluency (thinking fluently), flexibility (flexible thinking), originality, elaboration (detailed thinking) which are grouped in 12 questions (see the Pretest-Posttest Questions). Before being used with students, this instrument was validated by two experts, where the instrument was valid and reliable.

The data collection technique was carried out by giving a test where the pretest of creative thinking skills in both classes, namely the experimental class and the control class at the first meeting. Furthermore, learning was carried out with the PjBL method in the experimental class and the teacher center method in the control class. Furthermore, at the last meeting each class was given a creative thinking posttest.

The data obtained in the form of pretest and posttest results of creative thinking skills in experimental and control classes, to determine the level of creative thinking ability of each indicator was carried out by calculating the score obtained divided by the maximum score in times 100% and then grouped based on the level of creative thinking by Kurnia (2021), namely low (percentage less than 55%), medium (percentage more than 55% and less than 75%), and high (percentage more than 75%). Then the data was analyzed using normality tests, homogeneity tests and paired sample *t*-tests to determine the effect of the PjBL model on creative thinking skills.

RESULTS AND DISCUSSION

The results of the research obtained data from 50 students, in experimental and control classes. Data on students' creative thinking skills are obtained from pretest and posttest results. The following are the results of pretest and posttest values in the experimental class and the control class, it is presented in Table 1.

Table 1. Pretest and Posttest Results

Data	N	Min	Max	Average
Pretest Experiment	25	7	43	26,00
Posttest Experiment	25	30	90	64,00
Pretest Control	25	7	47	27,00
Posttest Control	25	34	80	49,00

At Table 1, There is an increase in value pretest and posttest in the experimental class, where the highest score Pretest which is 43, while the highest score on posttest which is 90, this also happens in the control class there is an increase in value Pretest and posttest, where is the highest value on Pretest which is 47 and the highest score on posttest is 80. Average value data Pretest and posttest The ability to think creatively above is presented succinctly in Figure 2.

In Figure 2 explains that the control and experimental classes, both classes have almost the same initial ability. This is evidenced by the average acquisition of values Pretest In the control class, it was 27 and in the experimental class it obtained an average score Pretest amounted to 26. While on the results of obtaining value

posttest which is given after the treatment of learning in class, in the experimental class grades posttest obtained after the PjBL learning process there was an increase by obtaining an average score of 67 and in the control class after learning in class using the model Teacher Center Obtained an average score of 49, the average score of the experimental class was higher than the average score of the control class. This indicates that the implementation of the PjBL model can improve students' creative thinking skills as seen from the achievement of average scores posttest The experimental class is higher than the control class. Like previous research Orcito, Hidayat, and Hartati (2021) which states that the average score of creative thinking ability in the class in which the learning model is applied PjBL has a higher value than in classes that the model does not implement PjBL. The average value of creative thinking skills in experimental classes is higher because in teacher learning provides opportunities for students to be directly involved in real-world situations, students work on project assignments with groups regarding updates from biotechnology products, thus indirectly training students' creative thinking skills. In contrast to the control class in the learning process teachers play a more active role as informants, so that students become less active and do not have initiative in acquiring knowledge.

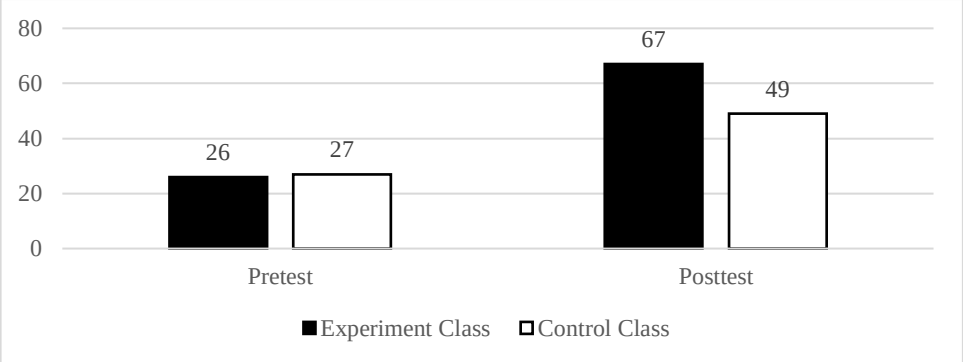

Figure 2. Comparison of the Average Score of Pretest and Posttest

Furthermore, the scores obtained in the pretest and posttest from the control class and experiments, broken down by creative thinking achievement categories based on each indicator as in Table 2.

Based on Table 2, it consists of 4 (four) indicators of creative thinking ability used, namely fluency, flexibility, originality, and elaboration. Result Pretest In the control class and experimental class, it showed that the creative thinking skills of students in each indicator were in the low category. In contrast to the results posttest, In the control class, students' creative thinking ability on the originality indicator is included in the medium category, while the other three indicators are still in the low category. The low ability to think creatively of students in the control class occurs because in the learning process only transfers teacher knowledge information to students, students are not involved optimally so that only some students are active and others experience boredom so that in the learning process tends to be passive. This is in accordance with Orcito et al. (2021) which states low creative thinking can occur because in the learning process teachers tend to transfer knowledge information and become the dominant factor. While in the experimental class, the originality indicator occupies the high category, flexibility in the medium

category, while the other two indicators are still in the low category. In this case, students are able to provide solutions to the impact of a problem and are also able to provide new ideas to overcome a problem, but students are still unable to provide many solution ideas to overcome the impact of a problem and students are also less able to detail the accuracy of the new ideas described.

Table 2. Achievement of Creative Thinking Indicators

Class	Indicators	Pretest		Posttest	
		Score (%)	Category	Score (%)	Category
Experiment	Fluency	25%	Low	50%	Low
	Flexibility	32%	Low	74%	Keep
	Originality	27%	Low	78%	Tall
	Elaboration	21%	Low	53%	Low
Control	Fluency	36%	Low	37%	Low
	Flexibility	26%	Low	48%	Low
	Originality	27%	Low	67%	Keep
	Elaboration	18%	Low	42%	Low

As for the increase in the results of creative thinking as described in Table 2, in order in the experimental class, indicators originality ranks first where on Pretest obtained a large average value (27%) with an average value posttest by (78%), then in second place there are indicators flexibility where on pretest obtained a large average value (32%) with an average of grades posttest (74%), followed by indicators of elaboration where on pretest obtained a large average value (21%) with an average of grades posttest by 53% and the last order is found in the fluency indicator with an average value pretest by (25%) with an average score posttest by (50%) . While in the control class, in order of indicators originality ranks first where the average value pretest by (27%) with an average score posttest by (67%), then in second place there are indicators flexibility where is the average value pretest by (26%) with an average score posttest (48%), followed by indicators of elaboration with an average pretest score of (18%) with an average score posttest by (42%) and the last order is found in the indicator fluency by average rating pretest by (36%) with an average score posttest by (37%). These results show that in both experimental and control classes, indicators originality has a greater increase compared to the other three indicators. Students can provide new ideas to overcome a problem, in line with previous research Nugroho et al. (2019) stated in the originality indicator shows that students are able to offer solutions in a way that is understandable to laypeople when solving a problem. The above results also showed that in the experimental class, the improvement that occurred in the four indicators was greater than in the control class.

Based on the results of improving students' creative thinking skills in Figures 2 and Table 2, in general, it can be concluded that PjBL can affect students' creative thinking skills. This is reinforced by conducting a *t*-test to determine the differences in students' creative thinking skills in experimental and control classes, with the condition of testing normality and homogeneity data. The normality test uses the Shapiro Wilk test to prove that the data obtained are normally distributed or not. This test is presented in Table 3.

Table 3. Normality Test Results Table

Class	Statistic	*df*	*p*-value
Pretest Experiment	0.969	25	0.622
Posttest Experiment	0.984	25	0.952
Pretest Control	0.958	25	0.377
Posttest Control	0.870	25	0.004

Based on Table 3, it is known that in the experimental class, *p*-value=0.622 (pretest) and *p*-value=0.952 (posttest), the values are more than α=0.05, it can be concluded that the data obtained are normally distributed. In the control class on the pretest is *p*-value=0.377>0.05=α, so it can be concluded that the data obtained is normally distributed, while in the control class on the posttest is *p*-value=0.004<0.05=α and it is stated that the posttest control class data is not distributed normally.

After evaluating the data distribution, the next stage is the homogeneity test, with the results of the analysis in Table 4.

Table 4. Homogeneity Test Results

	Levene Statistic	*df1*	*df2*	*p*-value
Based on Mean	0.689	1	48	0.411

Based on Table 4, it is obtained that *p*-value=0.411>0.05= α. It can be concluded that the data is homogeneous. After reviewing the requirements, a hypothesis test was carried out with paired sample *t*-test.

Table 5. Result of the Analysis Effect Using Paired Sample *t*-test

Posttest Data	Mean	Confidence Interval	*t*	*df*	*p*-value
Eksperimen-Kontrol	14.680	[6.531 - 22.768]	3.746	24	0.001

Based on Table 5, it is known that t=3.746 greater than $t_{(df=24,\ \alpha=0.05)}$=2.063. In addition, *p*-value=0.001<0.05=α, it can be concluded that there is a significant influence on the PjBL model on creative thinking ability. In accordance with Figure 2, students' creative thinking ability in the experimental class is higher than in the control class. It shows that the PjBL model can improve students' creative thinking abilities, as previous research Santoso and Wulandari (2020) stated that the PjBL can improve students' creative thinking skills.

Students' creative thinking ability can be trained in the learning process in the classroom, which is a learning process that involves students into a project-based activity to find a concept of knowledge, the activity is able to provide encouragement to students to build students' creative thinking skills. So that this PjBL model is appropriate to be applied in the learning process in the classroom to improve the creative thinking ability of students.

CONCLUSION

Based on the results of the study, it can be concluded that the PjBL model has a significant influence on students' creative thinking abilities. This is shown from the average value of creative thinking ability in experimental classes where the PjBL

model is applied in the learning process is greater than control classes using conventional models (teacher center). The increase in scores on each indicator of creative thinking ability also showed that the experimental class had a greater improvement, especially in originality indicators that fell into the high category.

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