

The Influence of Project-based Learning Integrated STEAM on the Creative Thinking Skills

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ABSTRACT

Project-based learning can develop the student's creative thinking skills because students will learn better if they are engaged in a meaningful learning activity. The implementation of this learning strategy with a STEAM approach supported the students to create a product. This study was aimed to measure to investigating the effect of project-based learning integrated STEAM on creative thinking skills of class X students of SMA 6 Malang. The method used in this study was quasi-experimental research using Pretest Post-test Nonequivalent Control Group Design. The result of an essay test was analyzed by using analysis of covariance (ANCOVA) test followed by post hoc LSD test. The research result showed that the implementation of PBL-STEAM had a significant effect on the student's creative thinking skills. Moreover, the post hoc LSD test findings showed several variations between the PBL strategy and the conventional learning strategy in the notation. These findings suggested that the project-based learning strategy might develop students' capacity for creative thinking skills.

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1. INTRODUCTION

21st century education requires students to accomplished in global competition and acquire survival skills and knowledge (Milla et al., 2019). The rapid development of science is reflected in the industrialization and global age, and people should be aware of the proficient skills that accompany the development of science and technology. The ability to think creatively has an important role in the life of the 21st century to prepare productive, innovative, and creative human beings in public life (D.J.Treffinger, G.C. Young, E.C Selby, 2002). Creative thinking included four characteristic that is flexibility, fluency, elaboration, and originality (Torrance, 2010) in thinking, the ability to generate ideas and apply them to problem solving (Drapeau & Carter, 2014). Fluency refers to one's ability to produce many ideas, suggestions, questions, and alternative answers. Flexibility is the capacity to provide ideas, responses, and inquiries from a variety of viewpoints. Being original is having the capacity to come up with solutions to issues and formulate original, distinctive ideas. Finally, the capacity to develop concepts together with the specifics is referred to as elaboration (Handayani et al., 2021). Creative students explore things that have been actively researched during the learning process. Creative thinking means coming up with and expressing new, fresh and problem-solving ideas, so it's important to be used in learning and solving problems in everyday life. Learning to think creatively helps children learn more effectively, develop self-assurance, and become more responsible learners. In order to build creative problem-solving capabilities, students' creative thinking skills must be developed (Supratman et al., 2021). The capacity for creative thought is crucial for a number of reasons, including its ability to promote self-actualization, the capacity for problem-solving, the satisfaction of people with their work and the products they produce, and the wisdom of motivating others to advance their standard of living (Hanif et al., 2019).

It can be seen from the interview that students are also very dependent on the teacher's direct presentation. This fact is inconsistent with the requirements, which requires students to study actively. Therefore, there is a need for learning models that allow students to be more active in the learning process to help them develop their skills in the future (Sukmawijaya & Juhanda, n.d.). One method of student-centered instruction known as project-based learning takes the form of an investigation that includes decision-making based on data analysis, group

collaboration, product-oriented learning, and document creation (Yamin et al., 2020). Furthermore, PBL is stated to aid social gaining knowledge of due to the fact it's far taken into consideration an education for students to cause them to equipped to match the 21st century competencies together with communication, creativity, collaboration and teamwork. PBL is a type of learning that emphasizes research and requires students to be actively involved in completing projects (Handrianto & Rahman, 2018). The teacher acts as a facilitator and motivator during the learning process to guide the student so they finished the assignment appropriately and complete it on time (Yamin et al., 2020).

Meeting the high market demand for science and technology-based products requires an educational system capable of meeting the challenges of. STEAM is one of the approaches that including Science, Technology, Engineering, Arts and Mathematics developed from STEM education by adding elements of art (Arts) in its learning activities (An, 2020). The art component in STEAM is expressed through art elements, but includes elements of ethics, aesthetics, and rhetoric. Arts can also be linked to students' emotions and creative expression in cognitive understanding (Rahmawati et al., 2019). STEAM has been designed with the framework that is very adaptable styles of teaching. One of the crucial elements of a STEAM framework is creative design. Additionally, the paradigm emphasizes the associated component of STEAM education, which stands for compassion, creativity, communication, and convergence (4C). When it is included to the learning process, this may make all elements of information more relevant (Rahmawati et al., 2019).

Based on the background of the problem has been presented, the purpose of this study is to analyze the process of PBL by applying STEAM approach can affected the ability creative thinking of class X students of SMA 6 Malang.

2. RESEARCH METHOD

This study is included in quasi-experimental research, to compare the PBL-STEAM and conventional learning strategy in gaining the student's creative thinking skills. The design used in this research was Pretest-Posttest Nonequivalent Control Group Design. Based on the research design, as indicated in Table 1.

Table 1. Research Design

Group	Pre-test	Learning Strategy	Post-test
X1	O ₁	PBL-STEAM strategy	O ₂
X2	O ₃	Conventional Learning strategy	O ₄

Notes:

O₁,O₃ : Pretest score's

O₂,O₄ : Posttest score's

X1 : Experiment class

X2 : Control class

This research was conducted from January to March 2023 on class X students of SMA N 6 Malang. The total participants in this research were 70 students. The participant was selected using *random sampling*. The instruments used in this research were in the form of an essay test using creative thinking rubric by Torrance (2010). The essay test was given at the beginning (pre-test) and at the end (post-test) during research. The test instrument in this research had initially tested for validity and reliability. The results show that essay tests were valid and reliable. This research consisted of two group, namely group X1 was taught by using conventional strategy and implemented by the teacher without any treatment from the researcher. The other group namely X2 was taught by using PBL-STEAM by the researcher. The topics of the learning material used in this research was Ecosystem. The data obtained will be analyzed using ANCOVA test followed by post hoc LSD test to determine the students' creative thinking skill. This study needs eight meeting to finish all stages of PBL-STEAM learning strategy. The procedures of learning strategy on this research can be seen on Table 2

Table 2. Research Procedures

Stage of PBL	PBL Strategy Students' activity	Conventional learning Strategy
	Pre-test	
Step 1. Start with the essential question	Students actively answered questions on students' worksheet	
Step 2. Design a plan for the project	Students start to design a project planning by a group. Each member gave each other ideas. In this stage, their writing what the element of STEAM on their product.	

Stage of PBL	PBL Strategy	Conventional learning Strategy
	Students' activity	
Pre-test		
Step 3. Create a schedule	They were arranging schedules, so the project was completed on time according to a predetermined plan	Students answered some question on students' worksheet.
Step 4. Monitor the progress of the project	In this stage, the student would create the product that integrated with a STEAM approach.	
Step 5. Assess the outcome	The students presenting their product.	
Step 6. Evaluate the experience	All of them gave their opinion about the experiences during creating their products and give evaluating about the learning strategy.	The students presenting their worksheet in front of class one by one
Post-test		

3. RESULT AND DISCUSSION

The normality test of the student's creative thinking skills using the *Kolmogorov-Smirnov* test showed that the data were normally, were distributed ($p > 0.05$). The results of the homogeneity test of the student's creative thinking skills using *Levene* test of Equality of Error Variances indicated that the data came from a homogeneous population ($p > 0.05$). Therefore, the data had normal distribution and were homogeneous. The results of *ANCOVA* test on the student's creative thinking skills are presented in Table 3.

Table 3. The Results of ANCOVA on the Creative Thinking Skills of Senior High School 6 Malang

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3504.200 ^a	2	1752.100	18.195	.000
Intercept	68.079	1	68.079	.707	.404
Pre-test	1090.961	1	1090.961	11.329	.001
Class	2433.452	1	2433.452	25.270	.000
Error	5007.426	67	96.297		
Total	52338.419	70			
Corrected Total	8511.626	69			

The findings of the ANCOVA test indicate that the PBL strategy has an influence on the students at SMA 6 Malang's ability for creative thinking skills ($p < 0.05$). The LSD test was given once it was determined that the student's learning approach had an impact on their capacity for creative thinking. According to the results of the post hoc LSD test, there were variations in the students' creative thinking abilities between those who were taught using a PBL method and those who were taught using conventional strategy is indicated in Table 4.

Table 4. The Results of Post Hoc LSD Test on the Creative Thinking Skills of Senior High School 6 Malang

CLASS	PRETEST		POSTEST		DIFERENC E	CORRECTED MEAN	LSD NOTATION
	MEAN	SD	MEAN	SD			
Control	60.5428 6	10.7249	74.4857 1	5.47102	13.942857	74.48	a
PBL-STEAM	66.7085 4	3.82040 8	82.4571 4	4.20081 6	15.748600	82.46	b

Project-based learning has a greater chance of enhancing students' capacity for creative thought, with a 1,81- point difference scores between pre-test and post-test results. The result of this study demonstrate how implementing a PBL strategy made students to be independent learners in project planning, responsible for project implementation, and reporting the results or products obtained, thereby enhancing their capacity for creative thought. Through PBL, students are required not only to identify problems and find solutions to the problems they face, but also to combine their knowledge and creative thinking skills to produce products that are solutions to the problems they face. Students are expected to advance academically and practically in their own environment and find solutions to everyday life problems (Zakiah et al., 2020). In this research, the students are designed a product where the solution to the problem about an ecosystem, which was a pop up book. Students are divided into 5 groups. Each group was given freedom to make a pop-up book with a biogeochemical cycle according to their creativity, that includes a Water cycle, Oxygen cycle, Phosphorus cycle, Nitrogen cycle, and Carbon cycle. In the

end of research, all of them explained and tested the products they had made. The students should think creatively about how to get their attention when presenting products (Li & Schoenfeld, 2019).



Figure 1. Student presenting their product

Based on post-test's score that students improve their knowledge about ecosystem especially biogeochemical after they making a pop up book. Developing creative thinking skills enables students to understanding of the subject matter, judge evidence more critically, think flexibly, and make judgments and decisions that lead to conclusions. This kind of thinking is necessary both in school and in society. Students should develop thinking strategies to use when faced with new situations (Yamin et al., 2020).



Figure 2. Process of making pop up book

Moreover, in this research was found that PBL-STEAM can improve creative thinking skills. That showed by Table 2. Based on the data suggest that project-based learning strategy trains students to become independent learners who can plan projects, take responsibility for the execution of projects, and report on the results and deliverables achieved give them strength. Project-based learning can be done in groups or individually. According to Lee, Huh, and Reigeluth (2015), the complexity and difficulty of individual initiatives are frequently lower than those of groups. Individual social skills are less significant than group social skills. This indicates that compared to solo projects, group projects have a considerably wider range of difficulties and learning objectives. Students will get in-depth information through activity materials and develop collaboration abilities when collaborative groups are used. According to Miller (2017), compared to independent learning, collaborative learning helps students in developing more relevant information. Students should also be able to think creatively, work in groups to solve issues, and make decisions. In this research, the PBL model was integrated with the STEAM approach. The implementation of STEAM approach is shown by the students' products. The element Science seen in learning the concept of the topic being studied, that is about an ecosystem (Anggraeni & Suratno, 2021). The technology seen from the use of tools or application used by students in learning. This gave the students the opportunity to further develop their ideas using different tools and materials that could improve the quality of their products. It can be concluded that the student who learned science through her project-based STEM learning has great creativity. The Engineering shown by the engineering efforts carried out by students to product or innovation, such as making the pop-up books' design with *Canva*. The arts are student activities related to creativity, in this case the students' creativity can showed from the ideas written down about the product design.

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