

Implementation of project-based learning for improve students' critical thinking skills in creative product and entrepreneurship subjects

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Abstract: The implementation of monotonous learning that lacks active student participation can contribute to the low critical thinking skills of students. This research aims to enhance students' critical thinking skills through the application of project-based learning (PjBL). The study evaluates the extent to which students' critical thinking skills can be improved through the implementation of PjBL. The research employs a Quasi-Experimental method. The study subjects consist of two groups: the experimental group, which utilizes the PjBL, and the control group, which follows a conventional model. Overall, after conducting prerequisite tests and hypothesis testing, a significant difference in critical thinking scores is observed between the experimental and control groups. Students are provided with the opportunity to exercise their critical thinking skills during the execution of project tasks. Consequently, it can be concluded that the PjBL model positively impacts the essential thinking abilities of 11th-grade mechanical engineering students in creative products and entrepreneurship subject.

Keywords: Project based learning, critical thinking, creative products and entrepreneurship subject, mechanical engineering course, vocational high school

1. Introduction

National education in the 21st century aims to realize the ideals of the nation, namely a prosperous and happy Indonesian society, with a respectable and equal position with other countries in the global world, through the formation of an organization consisting of quality human resources, namely individuals who are independent, willing and able to realize the ideals of their nation ([Andersen & Rustad, 2022](#); [Kabir et al., 2020](#); [Miranda et al., 2021](#)). The various implications of the impact of globalization on education include aspects of the curriculum, education management, education personnel, educational strategies and methods ([Charfeddine & Umlai, 2023](#); [Yanto et al., 2023](#)). Therefore, education must be able to prepare human resources that can face the challenges of the 21st century ([Le et al., 2022](#)). Practical and quality learning processes are essential in developing students' potential and preparing them for success in employment or further education ([Azmi et al., 2022](#); [Bayley, 2022](#)).

Critical thinking skills can be taught so that these skills can be learned ([Saputra et al., 2019](#)). Critical thinking requires students to master six cognitive thinking skills: interpreting, analyzing, evaluating, making inferences, explaining, and self-regulating. In creative products and entrepreneurship subject, students should be taught to create work (products) that are worth selling and are expected

to have more practice making products that meet industry standards so that their skills are increasingly honed. In addition, the purpose of training critical thinking skills is to prepare students to become critical thinkers, able to solve problems and become independent thinkers so that they can face life, avoid indoctrination, deception, and brainwashing and make decisions appropriately and responsibly ([Bezanilla et al., 2019](#); [Mahanal et al., 2019](#); [Shaw et al., 2020](#)).

Based on interviews conducted with grade XI teachers of the Creative Products and Entrepreneurship subject at SMK Negeri 1 Sumatera Barat, it is evident that students' critical thinking skills have not reached their full potential. This is due to several factors, one of which is the selection of learning strategies that are still not appropriate and less relevant in supporting learning, especially in improving students' critical thinking skills. In connection with that, efforts can be made by presenting education that can provoke students' in-depth understanding of the material provided. The learning carried out must provide opportunities for students as widely as possible to pursue these skills to the fullest. One of the learning models that can support students' critical thinking skills is the Project-based learning (PjBL).

PjBL is learning that centres on a principle of a discipline that involves students in problem-solving activities and other meaningful tasks, provides opportunities for students to work autonomously to construct their learning, and culminates in producing valuable and realistic student work products ([Bezanilla et al., 2019](#); [Mahanal et al., 2019](#)). PjBL provides opportunities for more collaborative and learner-centred education in this system, and learners are actively involved in completing projects independently, working in teams and integrating real and practical problems ([Jalinus & Nabawi, 2018](#)). PjBL can stimulate motivation and cultivate and improve student learning achievement by using issues related to specific courses in real situations ([Jalinus et al., 2023](#); [Syahril et al., 2021](#)). Implementation of PjBL to Entrepreneurial Creative Products can give students a more in-depth and relevant learning experience ([Aziz et al., 2023](#); [Sutianah & Sobandi, 2022](#)).

The PjBL can bring out students' critical thinking skills and the ability to understand product manufacturing design material according to techniques and procedures in the learning process, which makes passive learners active ([Untari et al., 2020](#)). Because from the beginning to the end all learners will solve a problem and produce a product, the educational process must be able to develop character and skills, both related to the pillars of education and the skills needed in the 21st century. This study aims to apply the PjBL to improve the critical thinking skills of students in class XI of creative products and entrepreneurship subject at SMK Negeri 1 Sumatera Barat, which later is expected that students will be able to solve a problem and help schools improve the implementation of the learning process.

2. Methods

Type of research

The type of research conducted is quantitative research with the quasi-experiment method because researchers cannot control all variables that appear. The design used in this study is to use an equivalent control group design ([Miller et al., 2020](#)). The experimental-control group design conducted with pre-test and post-test can accurately describe the causal relationship between variables ([González-Alonso et al., 2020](#)).

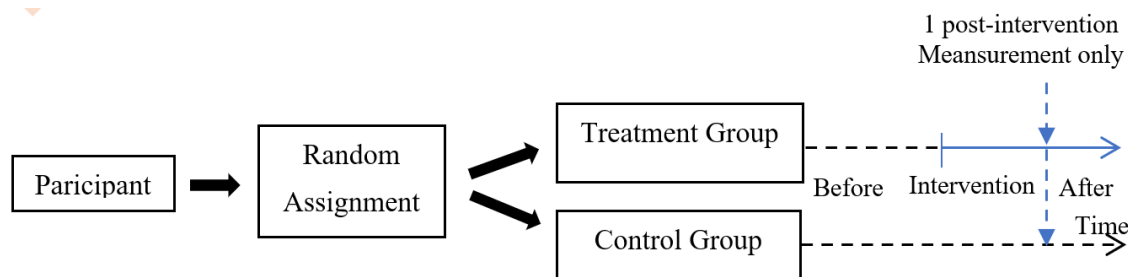


Figure 1. Quasi experiment design

Research participant

The research comprised 59 students enrolled in the creative products and entrepreneurship subject at SMK Negeri 1 Sumatera Barat, Indonesia. Among them, 35 students were exposed to the PjBL model, while the remaining 24 students underwent conventional learning methods.

Research instruments

The assessment instrument used was an objective question, which one lecturer and one subject teacher validated. The device was made based on five indicators of critical thinking skills by (Ramdani et al., 2021): providing simple explanations, building basic skills, inferring, making further explanations, and organizing strategies and tactics. The instrument framework, structured around critical thinking indicators, is presented in Table 1.

Table 1. The instrument framework

Indicators	Number of Items
Elementary clarification - Provides a simple explanation	9
Essential support - Building basic skills	7
Inference - Summarize	7
Make further explanations	6
Organize strategies and tactics	6
Total	35

For the data obtained to be accurate, an instrument test must be carried out, which will be used as a pre-test and post-test question. The trial was conducted in class XI TMI with as many as 24 students. The problem was conducted to determine the validity and reliability of the instrument. Five of the 40 questions on the instrument test were declared invalid. The invalid question is no. 16, 26, 28, 36, and 38. The calculations carried out also obtained an r value of 0.881. So, it can be concluded that the learning outcomes test instrument is reliable with very high criteria.

Research procedure

The treatment group implemented PjBL, while the control group followed the conventional teaching model. The pre-test was conducted at the first meeting to determine the level of critical thinking skills of students before being given treatment. Furthermore, different treatments were carried out in both classes for two sessions to see the difference in learning outcomes (Hamilton et al., 2021). The post-test was given in the fourth week, where students had to answer the same questions used in the pre-test.

The implementation of PjBL in learning creative products and entrepreneurship subject is done in four stages. In the first stage, the students identified what to make. The second stage is formulating the problem-solving to become a project by making working drawings. In the third stage, they make the project. In the fourth stage, they present their projects through class presentations. The teacher's function during the implementation process is to direct students if they pass the limit of the discussion material, monitor the project implementation process if there are obstacles, and conclude the results of the mind map or presentation that students have made. The research procedure follows the steps of PjBL (Jalinus et al., 2019).

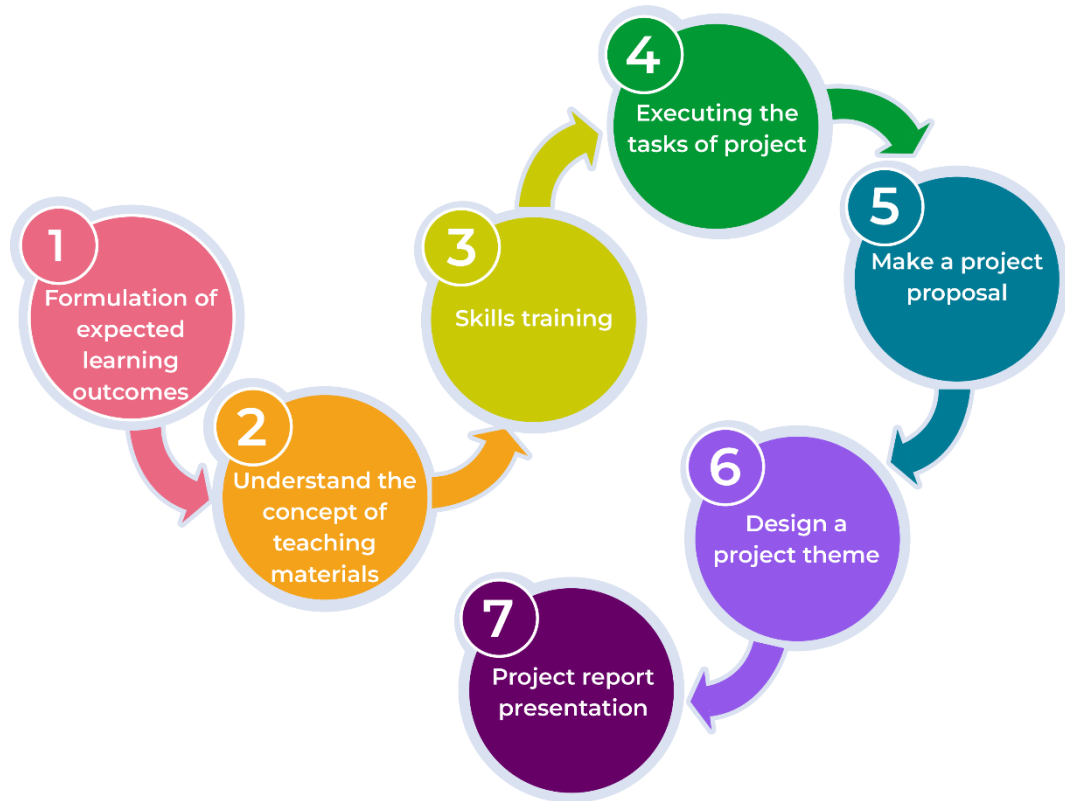


Figure 2. Seven steps of PjBL (Jalinus et al., 2019)

3. Results and discussion

The results of data analysis of students' critical thinking skills scores between experimental and control groups, including descriptive data, normality, and homogeneity, are presented in Table 2. The average score of the experimental group students' critical thinking skills in the pre-test was 75.29, with a standard deviation of 7.189, and the average score in the post-test was 82.14, with a standard deviation of 6.335. The standard deviation of the post-test was lower than the pre-test. This shows that the average student score before being treated is close to the average student score after being treated. In the control class, students' average pre-test critical thinking and problem-solving ability was 72.29, with a standard deviation of 8.338. In the post-test, it increased to 76.67, with a standard deviation decreasing to 7.02. Based on the results of descriptive analysis, both in the experimental and control groups, the value of critical thinking and problem-solving skills has increased.

The normality test results of student critical thinking ability assessment data in the experimental group Post-test [Sig. > 0.05 = 0.068, SW = 0.943] and control group Post-test [Sig. > 0.05 = 0.112, KS = 0.933]. Based on these results, it can be concluded that the data is normally

distributed. Based on the results of the homogeneity analysis on all variables, it was found that there were no significant differences in the population [Sig. > 0.05 = 0.449, L = 0.889]. Based on the normality and homogeneity tests of critical thinking data, the Independent Sample t-test can continue the data.

Table 2. Descriptive analysis, normality and homogeneity

		Mean	SD	Normality		Homogeneity	
				Statistics (S-W)	Sig.	Levene's Statistic	Sig.
Experimental group	Pre-test	75.29	7.189	0.948	0.100	0.889	0.449
	Post-test	82.14	6.335	0,943	0.068		
Control group	Pre-test	72.29	8.338	0.944	0.197		
	Post-test	76.67	7.02	0.933	0.112		

Based on the results of the independent sample t-test on hypothesis 2 (Table 2), it was found that there was a significant difference in the average critical thinking skills between students in the control and experimental groups [$t = 3.061$; Sig. (2-tailed) < 0,05 = 0. 03).

Table 3. Independent sample T-test results

	F	Sig.	t	df	Sig. (2-tailed)
Equal variances assumed	0.272	.604	3.122	57	0.03
Equal variances are not assumed.			3.061	46.128	0.04

In this study, the experimental class that applied the PjBL model obtained higher critical thinking skills than the control group students who did not use it. Based on research (Suradika et al., 2023) applied the same thing, namely the implementation PjBL to improve critical thinking skills and student learning independence in making dispersion colloids, which used curriculum 13 in its implementation. The difference from the research conducted by the researcher is that the application of PjBL is more specific to the creative products and entrepreneurship subject of prototype-making material and uses an independent curriculum in its implementation.

Based on the study's results, the experimental group of students who carried out tasks based on the PjBL model found the job very useful. The reason is that designing, solving problems, making decisions and conducting investigative activities can hone students' critical thinking skills. In implementing students' critical thinking skills, the implementation of this model is one of the appropriate strategies to be applied in learning because it is a learning model that directs students to focus on developing their critical thinking skills. In addition, this model provides more meaningful learning features for students to create authentic connections with the latest knowledge and technology (Amin et al., 2020; Saputra et al., 2019).

4. Conclusion

Based on the results of the analysis to answer the formulation of the problems that have been proposed, the results of this study can be concluded that the implementation of the PjBL can improve the results of students' critical thinking skills. The research findings show that PjBL can promote the development of students' critical thinking skills. They learn to ask questions, search for solutions, and evaluate information more carefully. Despite the positive evidence regarding the

effectiveness of PBL, the study also found that the results may vary between the experimental and control groups. This is due to inconsistent implementation or students' initial characteristics. Based on the research findings, this study provides recommendations for further development in improving teacher training in implementing PjBL, identifying factors that influence student outcomes or exploring some methods of modifying PjBL to suit student needs better.

Author contribution

Roza Febrianti: Original Draft, Writing-Review & Editing, Conceptualization, Visualization, investigation and Resources. Yufrizal A: Conceptualization, Visualization, Investigation and Supervision. Randi Purnama Putra and Phonepasith Phongdala: Visualization, Formal analysis, Investigation and Supervision.

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Competing interest

The author declares that there is no conflict of interest.

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