

Implementation of project-based learning (PjBL) model to increase students' creativity and critical thinking skill in vocational creative product subjects

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Abstract: The primary goal of education was the development of an individual's potential to foster intellectual, emotional, social, creative, and critical ways of thinking. It was important to remember that the concept and purpose of education can vary across cultures and contexts, and attitudes about education can also change over time as social, technological, and human developments occur. This research aimed to solve problems that arise in the classroom to improve students' creativity and critical thinking. This type of research used classroom action research that focuses on improving classroom learning in a practical manner pursued by a teacher by developing activities that can improve the quality of the learning process in the classroom. The data analysis results of the student product creativity assessment were 75% in the excellent creativity category and 25% at the excellent creativity level. Implementation of PjBL model had an effect on increasing student creativity as evidenced by the results of hypothesis testing, namely by testing with the Gain Score method, which there were N-gain results of 0.53 and showed a moderate increase in creativity compared to student scores before the implementation of the PjBL model, which there was an increase in the value before the model was implemented.

Keywords: Project Based Learning, Creativity, Vocational Creative Products

1. Introduction

Education is a systematic process that involves transferring knowledge, skills, values, and norms from generation to generation (Naylor & Nyanjom, 2021; Pradana et al., 2021). The main goal of education is the development of a person's full potential intellectually, morally, socially, and emotionally (Fortuna et al., 2023). Education focuses on providing information and skills and developing character, critical thinking skills, adaptability, and individual independence. Education can occur in various settings, including formal educational institutions such as schools and universities, through everyday experiences, social backgrounds, and interactions with the surrounding environment (Alam, 2020; Febrianto et al., 2020). In addition, education can also contribute to the formation of society by providing the knowledge necessary to participate in political, economic and social life actively. Education also helps correct social inequalities and allows people to reach their full potential (Bali et al., 2020). It is important to remember that the concept and purpose of education can vary across cultures and contexts, and attitudes about education can also change over time as social, technological, and human developments occur.

Vocational high school (Indonesia: *Sekolah Menengah Kejuruan (SMK)*) is an educational institution at the secondary level that emphasises developing practical skills and expertise ([Khasanah, 2019](#); [Riska et al., 2023](#); [Suharno et al., 2020](#)). The main objective of SMK is to develop students' potential in several areas of technical, professional or artistic, and cultural knowledge. The potential developed through SMK programs includes 1) Vocational qualifications that offer engineering, health, tourism, catering, fashion, and more training. Students will receive practical knowledge and skills relevant to their chosen area of expertise. 2) Creativity and arts such as dance, music, fine arts, and design. This allows students to develop their creativity and artistic talents. 3) Critical thinking skills can also help students develop critical thinking and problem-solving skills. They are taught to analyse situations, make decisions, and solve problems in the context of their profession. 4) Independence and Accountability often involve on-the-job training or internships, helping students develop independence and responsibility in a real-world work environment. 5) Preparing SMK students for the world of work aims to equip students with the necessary skills to enter the job market immediately after graduation. This includes understanding work ethics, communication, and team collaboration.

It is important to note that vocational schools are a good choice for students more interested in practical and professional careers than a traditional high school academic education ([Fauzi & Ela, 2022](#); [Syahril et al., 2022](#)). Through its programs, SMK helps develop students' potential in their chosen field of specialisation so that they are ready to face the challenges of the world of work or continue their education in their area of interest ([Hendrawan et al., 2022](#)). SMK Karya Padang Panjang is a school that educates and produces graduates in technology and industry. SMK participates in producing mechanical engineering graduates who are expected to work according to their expertise and competencies. To realize this goal. SMK Karya Padang Panjang has adequate facilities, such as machining workshops and classrooms. To support the learning process to help students develop their abilities so that they can provide graduates who can be qualified for the world of work ([Hendriarto et al., 2021](#); [Lisá et al., 2019](#)).

The learning process in the classroom is one of the primary keys to achieving educational goals at SMK Karya Padang Panjang or any educational institution. A practical and quality learning process is essential in developing students' potential and preparing them for success in work or further education ([Römogens et al., 2020](#); [Singh et al., 2021](#)). The quality of teachers has a significant impact on students' learning experience. Qualified teachers with a deep understanding of the subject matter and creative and interactive teaching methods can help students engage and understand concepts better ([Huang et al., 2020](#); [Olaniyi, 2020](#)). A relevant curriculum is well designed and follows the needs of the world of work or the field of expertise that is the focus of SMK. An appropriate curriculum will help students develop the skills and knowledge required in employment or further education ([Dean & Campbell, 2020](#)). Adequate facilities, including comfortable classrooms, laboratories, libraries, and equipment related to the field of expertise, can provide a better learning experience for students ([Ghafar, 2020](#); [Li, 2020](#)). Continuous evaluation and constructive feedback help students understand their progress and identify improvement areas. Providing psychosocial support to students can help them cope with challenges and stress and maintain their mental and emotional well-being throughout the learning process.

The primary role of SMK is to produce graduates ready to work in the industrial business world, so the learning model must emphasise practical activities without overriding existing theories. Supporting facilities for learning the practice of entrepreneurial Creative Products, namely: 1 unit of milling machine, four slurry machines, and two welding machines with the available machine facilities, should be able to be maximally utilised so that student creativity in practice is maximised, for this reason, a learning model is needed that can make maximum use of existing facilities

([Abdulhameed et al., 2019](#)). In the competency standards of the Entrepreneurial Creative Product subject, students must meet the criteria applied by the school, namely the Minimum Completeness Criteria (KKM) 75.0. The following is a list of students' theory grades and practical grades in the 2023/2024 learning year, show in table 1.

Table 1: Final semester practice score of creative product entrepreneurship subject SMK Karya Padang Panjang 2023

Class	Total Students	≥75		<75		Average Class
		Total Students	%	Total Students	%	
XI TM	Eight people	Six people	68,75 %	Two people	31,25 %	71,5

Based on interviews with the teacher in charge of the vocational creative product lesson, where students are less creative in this lesson, and this is where the author's idea arises to conduct research with the application of learning that will help to increase the effectiveness of education, which increases the interaction that occurs with students and can increase student learning creativity, it is necessary to apply a learning model that directs students to the output form of knowledge learned in the form of products. So that with this, students will be stimulated to think critically and process command to obtain various information from the products they will create.

Project Based Learning provides opportunities for a learner-centred, more collaborative learning system, learners are actively involved in completing projects independently and working in teams and integrating real and practical problems ([Jalinus et al., 2019](#)). Project-based learning can stimulate motivation, process and improve student learning achievement by using problems related to specific courses in real situations ([Syahril et al., 2021](#)). Implementation the PjBL in Entrepreneurship Creative Products can provide students with a more in-depth and relevant learning experience ([Jalinus & Nabawi, 2018](#); [Latifa et al., 2022](#)). This model focuses on developing real projects that integrate various aspects of learning, including concept knowledge, practical skills, and application in a real-world context. The PjBL model in the Entrepreneurial Creative Products subject helps students experience learning experiences that are real and relevant to the real world. It also encourages developing creative, entrepreneurial, collaboration, and presentation skills critical for success in this field ([Jalinus, Sukardi, et al., 2023](#); [Jalinus, Syahril, et al., 2023](#); [Le et al., 2022](#); [Rini et al., 2023](#)).

2. Methods

Type of research

This research was conducted using the classroom action research method. Classroom action research is a type of research conducted by teachers to improve the quality of the learning process in the classroom ([Burns, 2009](#)). This type was chosen to overcome the problems in class XI TM SMK Karya Padang Panjang. Classroom action research (is research conducted by teachers (educators) in the classroom or where they teach which focuses on improving learning processes and praxis. Classroom action research (CAR) serves as a tool to solve problems that arise in the school and also as a tool for in-service training, where teachers use their skills and knowledge to improve learning.

Furthermore, as a tool to create innovative learning, as a tool to improve communication between teachers and scientific researchers, and as a tool that provides alternatives to problems that occur in the classroom. CAR is carried out through four stages: action planning, learning actions, observation activities, and reflection to analyse the data obtained through action. CAR is different from formal or scientific research, including the training required by the teacher, the purpose of the investigation, the method in identifying the problem to be studied, determining the basic theory, defining the research sample, research design, measurement procedures, data analysis, and application of research results.

This article is expected to help SMK Karya Padang Panjang students conduct research, considering that they must conduct class action research to complete their thesis. The proactive action research is the application and investigation of new practices, with six stages of action, namely: wish list, try new, collect data, check what, reflect, and improve (Schmuck, 2006).



Figure 1: Implementation and investigation of new practices, adapted from proactive action research (Schmuck, 2006)

Research variables

A research variable is an attribute, trait, or value of people, objects, or activities that have certain variations set by researchers to study and then draw conclusions (Thamhain, 2014). Variables are symptoms that vary or research that varies (Kemmis et al., 2014). Based on the above opinion, it can be concluded that variables are everything used as an object in a study, so variables have a significant role in supporting the smooth running of a study. The research variables that are used as the target point to answer the problems faced, namely:

1. The target variable in this study is student creativity.
2. The Action Variable in this study is the Project Based Learning model.

Action implementation procedure

The implementation procedure in this action research study was carried out with only one treatment because in pro-active research said by Richard Schmuck in his book that this research was carried out with seven steps that must be done in this study.

Table 2: Action implementation procedure (Schmuck, 2006)

Step	Action
List of hopes and wishes	<ol style="list-style-type: none"> 1. The project tasks that students work on are potential to develop the potential of their region. 2. Project tasks based on regional potential will increase student engagement. 3. Implementing this learning model will encourage project tasks based on regional potential. 4. List of Concerns Some students may need help to identify the region's lack of developed potential. 5. Students may need help finding ideas about the innovation of the project assignment. 6. Some students may note utilising other sources of knowledge, such as videos of creative machines or tolls shown on youtube. 7. Some students may not share or discuss information with their peers.
Try a New Way	<ol style="list-style-type: none"> 1. Teachers provide opportunities for consultation and guidance outside of class. 2. Students are trained to find references from journals and youtube.
Collect Data and check Data Results.	The teacher assesses students' products.
Reflect on alternative ways to behave.	Teachers inform successful and failed implementations.
Practice makes perfect	Report the study's conclusions and provide implications for the project based on the potential for implementation in the student's region.

Research subject

The subjects in this Classroom Action Research are students of SMK Karya Padang Panjang, Department of Mechanical Engineering class XI TM, totaling eight students. The aspect studied is student creativity through the application of project-based learning models.

Research instruments and data collection techniques

Data collection techniques in this research use student practical assessments, each of which is described on the Project Assessment Sheet, to see the learning outcomes of students' skills in the subject of Entrepreneurship (vocational) creative products with the application of project-based learning models referring to the results of projects made by students (Yusop et al., 2023)

Table 4: Creativity assessment

Areas	Description	Very Poor (1)	Poor (2)	Fair (3)	Good (4)	Very Good (5)
Fluency	Ability to generate multiple ideas and directions of thought for a given problem					
Flexibility	Ability to think of as many uses and classifications for a particular item or subject as possible					
Originality	The ability to think of ideas that are not inherently obvious or superficial or statistically common but rather unusual and sometimes even contradictory					
Elaboration	Ability to extend existing ideas, develop and refine them by integrating existing frameworks with new ideas					
Credibility Index	Average fluency, flexibility, originality, and elaboration.					

Data analysis technique

Data analysis is the processing of data obtained using existing formulas or rules per the research approach taken (Dash & Paul, 2021). The data analysis used in the study looked at the increase in stu; closey from before the method was applied and aferavailablewas applied. To determine improvement of students from one cycle to the next cycle, a gain core was used (Hake & Reece, 1999), show in eq. 1.

$$(g) = \frac{(S_{post}) - (S_{pre})}{100\% - (S_{pre})} \tag{1}$$

Note:

- g = gain score
- S_{post} = posttest score (score after implementing the method)
- S_{pre} = pretest score (score before implementing the method)

Tabel 5: N-Gain score category

No.	N-Gain score	Category
1	g > 0,70	High
2	0,30 < g < 0,69	Medium
3	g < 0,29	Low

Research Success Indicators

The indicators of success in this study can be successful if there is an increase in creativity in students and an increase in the scores obtained by students. In contrast, the indicators of student learning creativity towards project-based learning will be said to be successful if they get a score with a moderate category or g > 0.30 < g 0.69 (Hujjatusnaini et al., 2022).

3. Results

Research implementation

The research was conducted at SMK Karya Padang Panjang on 25 February to 10 April 2023, with the target of the research sample, namely class 11 mechanical engineering, which numbered eight people as an experimental class with treatment using the Project Based Learning learning model, to increase student creativity in making an entrepreneurial, creative product in entrepreneurial, creative product subjects. In this study, the data that will be taken comes from the Assessment of student products that will be made. In this study, students will be divided into four groups. One group will consist of 2 people so that later in making products, students do not experience difficulties compared to individuals making this product. In the research process to make this product, there will be stages, planning, implementation, and product results. The effect will be assessed using a product assessment whose score refers to the product assessment rubric criteria. The procedures in the research that will be carried out are as follows:

The actuality of the research process

The implementation of learning was carried out in 3 meetings where (1 meeting was held in the classroom and two in the Mechanical Engineering practice room). The first meeting was held on Wednesday, 26 February 2023. Learning lasts 2 hours of lessons Learning according to the material Entrepreneurial, creative products in the current independent curriculum after the researcher gives the product that will be made, namely the minimalist flower pot rack. While at the meeting. At this meeting, researchers provided material related to entrepreneurial, creative products. At the same time, the second meeting was held on Wednesday, 2 March 2023. At this second meeting, students were asked to make a simple product drawing that would be made after the researcher gave the product that would be made, namely a minimalist flower pot rack. Whereas at the third meeting, the activities carried out were finishing the products produced and the Assessment of the students' outcomes. As well as activities carried out following the RPP that the researcher has prepared for the research activities to be carried out. For the stages of making products that have been planned, the following steps can be carried out:

1. Group division Before starting the activity, the thing that must be done is to divide the group first. Students are divided into four groups, and the teacher provides material about what will be made and what should be achieved in the research process.
2. Designing product planning activities, students are given the freedom in each group to discuss the projects they will make. Here the researcher only provides a clue about the product to be made, namely a simple product, a minimalist flower pot rack.
3. Developing a schedule is carried out to arrange the schedule and time allocation needed for each group to complete a creative product.
4. It was making products with the time given to complete the product designed by lending tools and materials for creating products.
5. Product Assessment After the students finish making the product, they and the researcher assess their creativity.

Data analysis

Table 6: Student Product Creativity Assessment

Student Name	Fluency	Flexibility	Originality	Elaboration	Credibility Index/Average
Student 1	4	3	4	5	4
Student 2	3	5	4	4	4
Student 3	5	4	4	4	4
Student 4	4	5	5	4	5
Student 5	4	4	5	4	4
Student 6	3	4	5	5	4
Student 7	3	5	5	5	5
Student 8	4	5	4	4	4
Student 9	3	4	5	4	4
Average	4	4	4	4	4

Based on the table above, it can be seen that the average results of the achievement of students' creativity abilities have a total percentage of 75% in the excellent creativity category and 25% at the superior creativity level, with a total of 6 people at a good creative level and two people an excellent creative level. Here is a visual of the achievement of students' creativity skills.

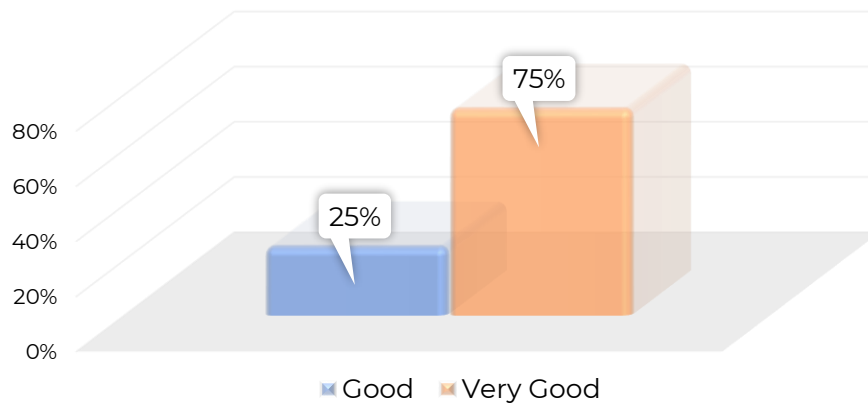


Figure 2: Graph of student creativity achievement

Table 7: Group product score

No.	Student Name	Value
1	Group 1	80
2	Group 2	86
3	Group 3	84
	Average Group Score	83,5

Based on the table above, it can be seen that the achievement results on the value of student products have an increase in value where at the average value at the time before the application of the action in the class, the average value of students was only 71.5. After the action was taken to 83.5, there was an increase of 15%. Here is a visual of the Student Product Value Improvement Chart.

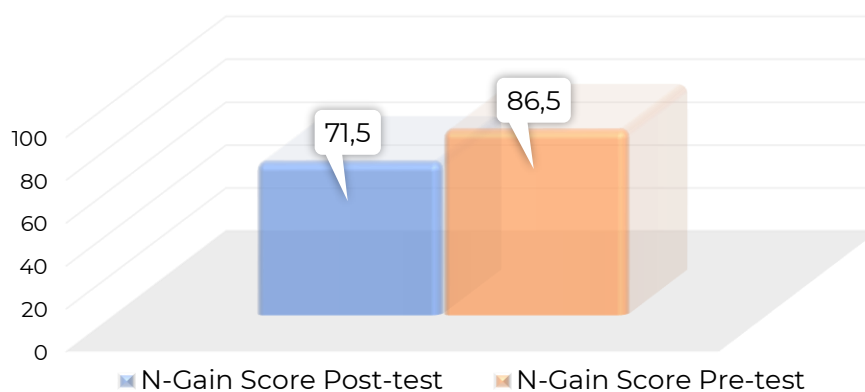


Figure 3: Graph of Improvement in Student Product Value

$$Ng = \frac{(86,5)-(71,5)}{100\%-(71,5)} = 0,52$$

The N-Gain from the above analysis shows the number 0.52 with the medium category.

4. Discussion

Based on data sourced from product assessments on students above as an assessment instrument in research to measure the level of creativity on five indicators of creative thinking, namely fluency, flexible, originality, and elaboration in research to know the ability of creativity before being treated and after being treated in the experimental class. Referring to the results in the Assessment of student creativity in creative thinking, namely, there is a creativity ability with a suitable category of as much as 75% and with an excellent ability of 25%, it states that in the experimental control class, it can provide different possibilities of things that happen when we do the treatment, here it can be seen that the percentage of students' creative thinking ability is categorized into a class that thinks creatively.

It can be seen that the increase in student creativity occurs significantly based on the Assessment of student products where the products produced have a level of creativity. Based on the average value of students in the mechanical engineering department, it increases by an outstanding amount, where the matter before the treatment is carried out in the class, and the average value of student products is 71.5. In contrast, after treatment in the class, the student value increases to 86.5. This means that the project-based learning model is very effective for increasing student creativity because, in project learning, students can independently determine solutions to problems, build their knowledge, and make real work in the form of products. Besides that, students are also challenged to collaboratively solve problems in their environment within a predetermined time.

The research that has been done is in line with previous research ([Sumarni & Kadarwati, 2020](#)). There is a significant difference between the creativity of students who learn with the project-based learning model and those who know with conventional learning. A series of learning activity processes with learning syntax using project-based learning models provide an increase in student creativity because this model is one of the innovative learning models that involve students actively in building knowledge, developing various student potentials through a series of processes that help students understand what they learn through actions and facilitate students to realise ideas and ideas through products with a series of creative and meaningful approaches.

When viewed based on the achievement of learning, using the project-based learning model increases creativity. This is evidenced by aspects of creativity seen during learning as follows: First stage Group division Before starting PjBL activities, the thing to do is form student groups. The group is divided into four groups, and the teacher provides the topic to be studied, learning objectives, motivation, and competencies to be achieved. Students are given an essential question that can provoke students in learning activities. Students eagerly answered the questions that the teacher had asked. Almost all students want to raise their hands to answer, and the teacher gives a critical question that can provoke students. In this stage of the activity, students' abilities begin to appear on creativity indicators, namely fluency, and flexibility, in the fluency indicator is seen when students fluently reveal answers to questions posed by the teacher regarding environmental problems. Meanwhile, the flexibility indicator shows that students provide an idea different from other friends in answering a question from the teacher.

Furthermore, students are directed to think about the projects they will make; based on the identification results of the four groups, students are invited to make projects or products that they will make, and creativity abilities begin to appear again on the originality and elaboration indicators. The elaboration aspect is seen when investigating activities. Students collaborate with group friends to identify in detail. In contrast, students' creativity abilities in the originality indicator are seen in students interpreting and which can be making a new and unique product from other group friends so that originality abilities can begin to appear. Project-based learning allows students to discover new things that make students more creative (Hanif et al., 2019).

The second stage is project planning teachers in planning activities need to direct students to choose appropriate activities and ensure that projects can be done based on the availability of existing materials and learning resources. Scheduling activities will improve students' habits in respecting time, and not only that, all indicators in this stage began to appear: fluency, flexibility, Originality, and Originality. Flexibility is seen when students provide an idea about planning a product, and elaboration is seen when students work collaboratively to produce detailed product planning for students. Originality is seen when students provide ideas by planning a new and unique product as a solution to creative product planning. At the same time, fluency is seen when students present ideas about product planning with their friends.

This research is also in line with (Shi et al., 2020), who stated that in the planning of making products, students' creativity began to appear in all aspects of creativity. In the third stage, which is the scheduling of this project, students will be trained to be disciplined and responsible and use the best possible time for the agreement that has been made with the teacher for monitoring activities and projects that must be collected at a predetermined time, students must use the best possible time to complete the project.

Students will have creative abilities when faced with various skills and competencies such as collaboration, project planning, decision making, and time management through project learning (Belwal et al., 2020). In the next stage, which is the Assessment of product assessment activities, all aspects of creativity are seen again, namely the fluency aspect seen when students smoothly convey the results of product presentations and ask questions about the products displayed. The flexibility thinking aspect is seen when students provide different thoughts about solutions to problems from the products they make, the originality aspect is seen when students have their way of conveying the results of their projects, and the elaboration thinking aspect is that students can detail and develop the observations they get to find solutions to environmental problems. This research is also in line with (Shi et al., 2020) who stated that students' creativity abilities appeared in all aspects of creativity at the stage of assessing the outcome.

5. Conclusion

Based on the discussion results, it can be concluded that this study uses PjBL model to increase student creativity in making entrepreneurial, creative products at SMK Karya Padang Panjang compared to students who only use lecture and assignment methods. Proven by the results of hypothesis testing, namely by testing with the Gain Score method, where there are N-gain results of 0.53 and shows a moderate increase in creativity compared to student scores before implementation of the PjBL model. From the effects of the rise in the value of student products, there is an increase in the matter before implementation the model. The average weight of students is 71.5 only, while after implementation PjBL model, the value of student products increases to 86.5. There is an increase in student grades by 15% from applying the method. While the ability to think of students obtain research results with the ability to think of the good criteria, 75% of students are in this criterion. In comparison, with excellent thinking criteria, 25% of students are in this criterion. With flawed criteria, less good, and not good, there are no students in this criterion 0%. From the data above, there are six students with good creativity categories and two students with very good categories. Based on the research data, implementation PjBL model can increase student creativity, especially in making products.

Author contribution

Indra Lesmana played a role in conceptualizing research, collecting data, analyzing research data and writing articles. Muliandi and Primawati analyzed research data and interpreted the data. Gulzhaina Kuralbayevna Kassymova is the design of the research method.

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Competing interest

The authors declare that we have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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