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# Implementation of project-based learning to explore students' creativity, innovation, and creative thinking ability

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**ABSTRACT**

Project-based learning is a learning model involving the participants' active role, who use the project as a learning tool to achieve student attitudes, knowledge, and skill competencies. Therefore, this study aims to examine the implementation of the Project-based Learning (PjBL) model in implementing entrepreneurship lectures. This learning model is carried out to help, encourage and guide students to focus on collaboration by involving group work and helping students to focus on their development. This research uses qualitative methods. The research was conducted at a state university in Yogyakarta with 51 students taking creativity, innovation, and entrepreneurship courses, working in groups to get projects on making business proposals and prototypes of technology-based product innovations. The stages of learning include essential questions, planning, scheduling, monitoring, assessing, and evaluation. The study results show that implementing project-based learning in lectures can explore students' creativity, innovation, and creative thinking skills. Creativity, innovation, and creative thinking skills are shown by students in preparing business proposals and prototypes of technology-based product innovations. By doing these works, students can find out their level of understanding of learning. Group project assignments can generate creative ideas to assist students in exploring creativity, innovation, and creative thinking.

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## INTRODUCTION

Education increasingly depends on the digital world, especially after the Covid-19 pandemic hit (Chick et al., 2020; Tarkar, 2020). Therefore, teachers must also adapt to technology so that learning is carried out adaptively (Code et al., 2020). In the future, the relationship between humans and technology will develop further, and technology-savvy students will become the main point. Because of this, there are several emerging trends in the world of education and trends that teachers must begin to adapt to, including educational technology in teaching and learning, soft skills training, decreasing student attention spans, teaching versus facilitating learning, innovative e-learning platforms, and learning

analysis (Daniel, 2020; Pokhrel & Chhetri, 2021). This opinion emphasizes that educators can find the best teaching method.

Using appropriate learning models is expected to improve learning skills and certain attitudes acquired in learning activities in class, where the learning model is a conceptual framework that describes systematic procedures in organizing learning experiences to achieve specific learning objectives and serves as a guide for teachers in planning teaching and learning activities (Glaser & Bassok, 1989).

So far, the learning process in the classroom only leads to the ability of students to memorize information where students listen and write more, lack of two-way discussion and clarification with lecturers, the inability of students to concentrate on learning because of the many distractions they encounter (Islam, 2019; Kamble et al., 2021), but there has never been an effort to understand and find the true meaning of the learning objectives, so students are less motivated (Gillis & Krull, 2020). Thus, causing the lesson content to be rote and students not understand the actual concept. Having problem-solving skills will help students to be able to make their ideas about the breadth of insight in learning material more concrete and help students to be able to solve a complex problem to be more straightforward (Perignat & Katz-Buonincontro, 2019; Rahman, 2019). One of the innovative learning models that can be applied in the learning process with an emphasis on problem-solving abilities is the Project-based Learning (PjBL) model (Guo et al., 2020; Sharma et al., 2020).

Project-based Learning (PjBL) is a learning model that focuses on the central concepts and principles of a scientific discipline, involves students in problem-solving activities and other meaningful assignments, provides opportunities for students to work autonomously to construct learn themselves, and leads to the creation of a product that is valuable and realistic (Hmelo-Silver, 2004; Thomas et al., 1999). PjBL usually requires collaboration, communication, problem-solving, and independent learning of all students in groups. Because learning like this encourages students to use ideas from various concepts, PjBL fosters critical and analytical thinking, ultimately improving higher-order thinking skills (Capraro & Slough, 2013).

The PjBL learning model in this study was applied to students at a state university in Yogyakarta, which focused on entrepreneurship learning. The output is expected to produce students who are compatible, able to think creatively, have a leadership spirit, dare to take risks, adhere to business ethics, have expertise in the technology field, think critically and logically, are proficient in communication, able to make plans, have strategic planning, able to build work teams, able to manage time and follow trends (Samuel & Rahman, 2018; Shekarian & Parast, 2021; Wang et al., 2022). Creativity, innovation, and the ability to think creatively are assets that students must have to achieve entrepreneurial learning achievements. Student creativity does not mean you have to create something entirely new, but you can also combine ideas/ideas you already have to apply them to something different from what you have before (Walia, 2019). Students who think creatively can digest information

from different perspectives, face challenges in a rapidly developing world, see opportunities, and be flexible (Özdas & Batdi, 2017). It is hoped that implementing practical learning activities through PjBL can encourage students to be more creative.

Research related to the application of the PjBL learning model has also been successfully carried out, which can help improve student skills (Bell, 2010; Vorbach, 2023; Zen et al., 2022) and grow the confidence to start their own business, where technology and informatics are used as a means to increase entrepreneurship, starting from the concept and ending with the actual promotion of the products that have been made (Dragoumanos et al., 2017), PjBL is effective in stimulating creativity or innovative thinking from students (Okudan & Rzasa, 2006; Wahyudi et al., 2023), students can produce innovative products (Sudarmin et al., 2019).

Education today requires a learning model that follows the demands of the times. This research harmonizes classroom learning through a PjBL model, which is expected to trigger and encourage students to take an active part in the learning process to explore creativity, innovation, and entrepreneurial thinking skills in students. From this description, this study aims to find ways to explore creativity, innovation, and students' thinking skills through entrepreneurship learning.

## METHOD

This study uses qualitative methods to observe the phenomenon of participants in learning activities based on the application of PjBL. The participants were 51 students from a state university in Yogyakarta who took part in creativity, innovation, and entrepreneurship courses. These students work in groups (about 5-6 people) on projects about making business proposals and prototypes of technology-based product innovations.

The learning flow of the PjBL model consists of 6 stages as shown in Figure 1, namely by (1) preparing essential questions related to a topic of material to be studied (assignments in accordance with the relevant real world then investigating in depth), (2) make a project plan (a collaborative plan between lecturers and students, a plan containing rules of the project, selection of activities that can support finding solutions by integrating various possible subjects, knowing tools and materials that can be accessed to help complete the project), (3) make a schedule (make a timeline, make a deadline, guide in planning, guide when the student's focus expands, make an explanation of choosing a method), (4) monitor the implementation of project-based learning (the lecturer monitors while students complete the project by facilitating each process, the lecturer acts as a mentor), (5) conducting outcome assessments (measuring standard achievement, evaluating student progress, providing feedback on the understanding achieved by students), and (6) evaluation of project-based learning (reflection on project activities and outcomes) (Bell, 2010; *Project-Based Learning Handbook*, 2006).

Learning is carried out in a blended learning manner while still involving students in class discussions with the topic of discussing project progress and the results lead to product development, including (1) what products are proposed, (2) reasons why choose these products, (3) technological

innovation, benefits and the use of the product, (4) product attributes ranging from brand to product display design, (5) product selling price, and (6) calculation of estimated capital and product profits.

By implementing the stages of the Project-based Learning (PjBL) learning model, it is hoped that students will have knowledge and practice regarding entrepreneurship to explore creativity and innovation and develop students creative thinking abilities.

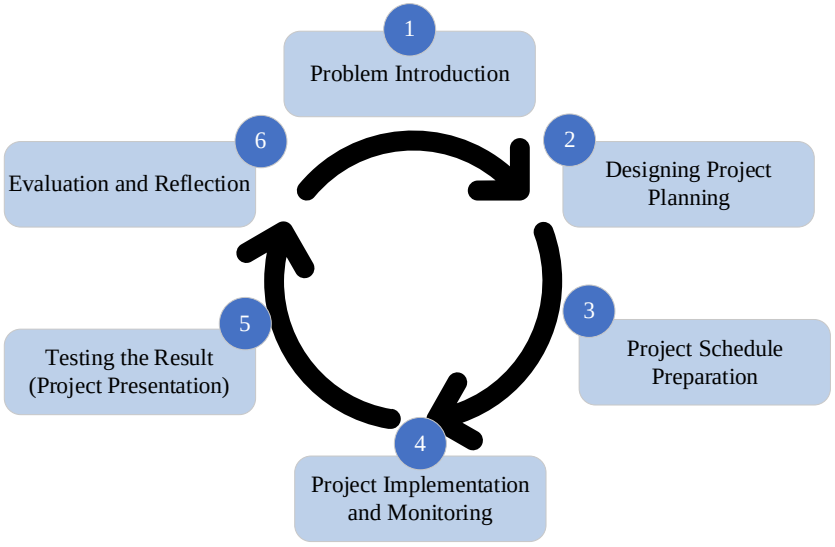



Figure 1. Stages of Implementing PBL

## RESULTS AND DISCUSSION

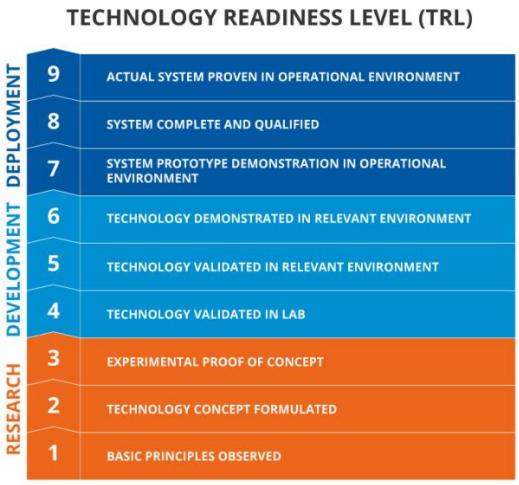
Research subjects who learn to use PjBL carry out project activities, making business proposals and prototypes of technology-based product innovations. Students work in groups (5-6 people), with ten groups. Creativity, innovation, and creative thinking are shown by students in planning product innovation, making business proposals and products, presenting the results of the group's work, and evaluating products.

Business proposals that must be made by students consist of (1) Introduction page: contains business fields/commodities, names and addresses of business actors, nature of business, and others, (2) Situation Analysis: contains business prospects, competition, marketing (market segments), business predictions, and others, (3) Business Description: contains goods/services produced, business size, organization and human resources, background of business actors, (4) Marketing Planning: contains prices, distribution, promotion control, etc., (5) Production Planning: contains all matters regarding input-process-output production, (6) Organizational Planning: contains ownership, management (management team), rules of the game (regulations) , employees, work mechanisms, and others, (7) Financial Planning: contains financial resources, calculation of income statements, balance sheets, cash flow, break event points, etc., (8) Risk Assessment: contains evaluation of obstacles effort, contingency, entry of new technology, etc., (9) SWOT Analysis, and (10) BMC Analysis. Then, based on the product design in the business proposal, it is made into a prototype.

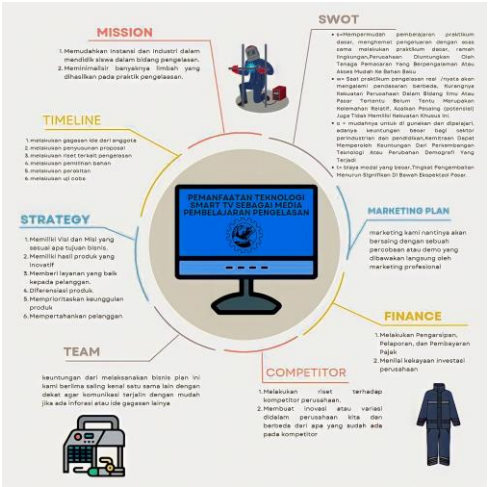
The results of PjBL research conducted in class can be described as follows: Activities available lessons with questions that can assign students to carry out an activity. The topic taken is the reality of the natural world related to creativity, innovation, and entrepreneurship. The activity begins with an in-depth investigation by lecturers and students about what kind of technology-based products are currently needed by consumers in general.

Planning has been carried out collaboratively in project planning activities between lecturers and students. This plan contains project implementation rules and the selection of product innovations for each working group that can support answering essential questions by integrating various supporting knowledge and informing the provision of tools and materials, business proposal components, and prototypes to complete the project.

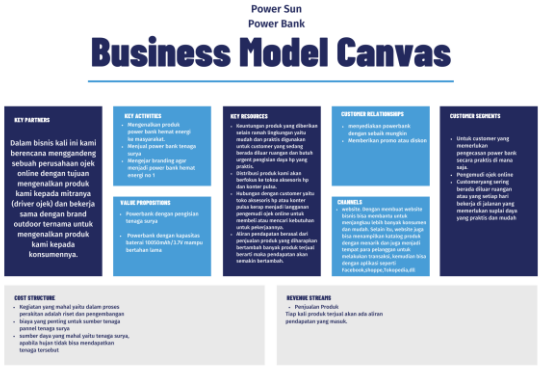
For activities to arrange schedules, lecturers and students collaboratively arrange the schedule for implementing activities in completing the project. Project completion time is conveyed clearly and in detail. For the project to be completed on time, students are given directions to be able to manage the available time. Projects that students work on are projects that take a long time to complete, namely during one semester of lectures, so lecturers ask students to be able to work on projects in groups by taking advantage of time outside class hours. So that class time can be used by students to present the progress of project work.




(a) TRL




(b) Mind map




(c) Business model canvas

Figure 2. Business Proposal Advancement Components

Supervising the course of the project is carried out by facilitating students in each process. Lecturers have also prepared an online shared room to monitor project work progress because the lecturer is responsible for monitoring student activities while working on it to complete the project. The monitored progress components are presented in Figure 2. Some components that must be assisted in its preparation are the Technology Readiness Level (TRL), a mind map of the business to be proposed, and the creation of a business model canvas.

TRL is a systematic measurement method that supports the assessment of the maturity or readiness of a particular technology. It is hoped that students will be able to measure the TRL of product innovations that will be made so that it can train students in determining product innovation. This result aligns with a study by Héder (2017), who examined the Technology Readiness Level (TRL) scale as an innovation policy tool. As well as a further study by Bruno et al. (2020) states that TRL and its extensions can be used to assess the potential of new and existing digital technologies to promote innovation.

*Mind mapping* is a technique that combines the right and left hemispheres of the brain to receive novel ideas. Visuals constructed in mind mapping can help students to organize the information they have just received and determine the main themes in the discussion. Learning can determine the ability to think creatively from students. According to the research results conducted by Polat & Aydın (2020), it was revealed that mind-mapping activities could significantly improve adolescents' critical thinking skills, and enormous group mind-mapping learning is more effective in developing adolescents' critical thinking skills compared to individual mind-mapping learning. In addition, according to Astriani et al. (2020), mind mapping can be integrated with learning models to encourage students' abilities to map thoughts, produce bright ideas, stimulate creative thinking, and improve students' thinking skills. Another study results by Sari et al. (2021) indicate that the mind map tool has an impact on improving critical thinking skills and learning motivation.

The Business Model Canvas (BMC) is a management strategy designed to translate ideas and concepts of a business into a visual form. In simple terms, BMC is a management framework that creates it easier to catch an overview of business ideas and their realization quickly. With this analysis, students can explore their creativity. The result is reinforced by the results of research from Hutasuhut et al. (2020) that applying the BMC in entrepreneurship learning can be a positive response from students and can improve entrepreneurial learning outcomes. Entrepreneurship learning with BMC contructs it easier for students to understand a business comprehensively. In addition, research from Lestari et al. (2021) indicated that students experienced increased creativity after applying the Teaching Factory-based BMC application model, which is effectively used to increase student creativity.

An assessment of the products produced by students has been carried out, namely based on the business proposals that have been prepared, the prototypes that have been made, and the presentation of the results by presenting the final results. The products that students have made are presented in Figure

3, and the implementation of the results is presented in Figure 4. The assessments carried out assist lecturers in developing other learning strategies, provide feedback on the level of understanding that students have achieved, play a role in evaluating each student's progress, and can measure the achievement of student project standards.

Figure 3. Result of Product Innovation

Figure 4. Presentation of Project Results

At the end of the learning process, an evaluation was carried out, where lecturers and students reflected on the implementation of activities for making business proposals and product prototypes. At this stage, students are asked to express their responses, suggestions, criticisms, and experiences while completing this group project.

The practical creativity skills cover four aspects. In the first stage of launching the project, creativity performance is observed that students have understood the purpose of giving the project to encourage the innovation process. This is presented from the product results that each group has a clear

and creative goal of constructing technology-based product innovations. In the second stage, build knowledge, understanding, and skills. Students' creativity and innovation performance indicates that each group has a different and creative perspective during the discussion. In the third stage, develop and revise ideas and products. It is observed that each cooperative group carries out discussions to generate and develop some original ideas. The fourth stage presents the product and answers to the questions asked. Each group showed creativity and innovative performance through entertaining, lively, and exciting presentations.

The benefit of the PjBL learning model can have an impact on creativity and innovation skills based on the technology utilized by students. The results of this study indicate that learning employing PjBL can explore students' creativity, innovation, and creative thinking abilities. This finding was similar to that in the related literature. The PjBL learning approach can encourage students' creative thinking, especially about the fluency and flexibility of various creative thinking tools that must be provided to take advantage of the habit of developing creative thinking habits (Chen et al., 2022). Through the PjBL learning method, appropriate guidance, and stimulation, engineering students' creative and innovative ideas and precise and flexible thinking can be expanded to achieve extraordinary imagination and creativity (Wu & Wu, 2020).

The weakness of this study is that there is no comparison class as a control for the comparison of results. This is due to the limited Creativity, Innovation, and Entrepreneurship classes. Thus, in the future, further research will be carried out to compare results between classes that apply PjBL and classes that do not apply PjBL.

## CONCLUSION

Project-based learning can help improve student skill development, such as creativity, innovation, and creative thinking. The activities of carrying out project activities in groups can facilitate students in obtaining meaningful learning optimally and increase student motivation to learn and achieve better results. The products produced in this project demonstrate that students try to complete business proposals and creative and innovative product prototypes that introduce novel product innovations with technological elements to solve problems in everyday life. Students construct project assignments by preparing business proposals and technology-based product innovations by the problem-solving goals to be achieved by each group. Creativity and creative thinking in completing projects are essential to achieving these goals.

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