Psychometric Study of the Influence of Project-Based Learning Models on Student Creativity in Industrial Robot Practicum Course 1

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Abstract: The setting of this research is applying a project-based learning model in industrial robot practicum course 1. Specifically, this research aims to increase the creativity of industrial electrical engineering students. The number of samples in this research was 48 students. A one-shot case study design was used to see the influence provided. The data analysis technique uses descriptive percentage analysis. This research uses the creative thinking scale (CTS) product observation sheet instrument. The research proves that the average student score is 84 in terms of creativity in producing products in the form of flowcharts. This value is in the very high category. This means that applying project-based learning models is appropriate to increase student creativity, especially in the industrial robot practicum I course.

Keywords- Psychometric Study, Learning Models, Industrial Robot Practicum

INTRODUCTION

In the last few decades, the industrial era has increasingly shown significant progress, marked by the increasing number of human roles that robots can replace in several dimensions of life, especially in the industrial world. Some human roles can be replaced by robots, such as assembly, welding, soldering, and several other engineering fields (Arigela & Ch R, 2022). This increasingly advanced technological development also needs to be balanced by the capabilities of its human resources. Efforts to improve the quality of human resources can be made through training or education activities (Lieu Tran et al., 2019).

Improving students' critical thinking skills must apply a learning approach that allows them to make observations and explorations to build their knowledge. Philosophically, constructivist knowledge must be constructed by the students themselves, and lecturers act as facilitators whose specific task is to create an interesting learning atmosphere (Saenab et al., 2019). In a constructivist class, the lecturer does not teach students how to solve problems, but the lecturer presents a case of a problem and encourages students to find their way to solve it. Learning that does not support efforts to improve critical thinking skills, of course, emphasises rote learning. Students very easily forget material that has been previously studied (Sanova et al., 2023). Therefore, an educator, especially a lecturer, must be able to discover, explore and develop students' talents, ultimately leading to students having certain skills. In this case, it includes critical thinking skills built or constructed by applying appropriate approaches, models or methods in the learning activities.

According to Afrizon, there are several indicator criteria in critical thinking: the first is basic classification, the second is decision-making, the third is the ability to conclude a problem, the fourth is advanced or special classification, and the fifth is the ability to make assumptions and alignment. At this time, in general, the model applied uses the teacher-centred learning model; this model is not quite right because, in this learning model, there is no interaction between lecturers and students, so students' critical thinking skills cannot be developed, especially in Robot Industry I practicum courses (Nehru et al., 2019; Ore et al., 2020).

Therefore, to improve the ability of D4 Industrial Electrical Engineering Department students, the Department of Electrical Engineering, Padang State University, needs to provide a case study-based project-based learning model to develop its students' skill competencies. Regarding project-based learning, it must be applied because this model can be believed to develop students' critical thinking skills simultaneously. Apart from that, another reason for choosing this model is that students have different interests and ways of learning, so this model provides students with the opportunity to explore learning material in various ways so that learning becomes more meaningful and students become creative (Fauzi et al., 2022; Ikhwan & Yuhendri, 2023).

Project-based learning benefits students more than just developing their knowledge and critical-thinking abilities. However, it can also improve communication, teamwork, and problem-solving abilities. The case study research approach excels at helping us grasp a difficult subject. It can strengthen what is already understood via earlier research, and the project-based learning model must be consistent with this method (Guan et al., 2023).

A case study is not a methodological choice but a choice of what will be studied. This case study method will help students understand the Industrial Robot Practicum course I because it is conditioned by an attractive learning atmosphere by providing interesting cases and by student interests, such as discussing project cases so that students become more enthusiastic about participating in the learning (Jahnke et al., 2017). The case study teaching method (case study) is one of the student-centred teaching methods (student-centred learning) that has begun to be practised to overcome limitations in teacher-centred teaching methods (teacher-centred learning). Based on learning outcomes Field, the case study method is considered appropriate for achieving educational goals (Li et al., 2022).

According to Veronica (2016), the need to allow participative democratisation in the learning process, 2) the need to adapt changes in work competencies that occur very quickly and call for more flexible learning materials and procedures, and 3) the rapid growth of science and technology with a variety of facilities for accessing it. As a result, student-centred learning (SCL) will be supported in the future. With the expectation that learning outcomes for graduates would be met through a process of instruction that prioritises developing creativity, ability, personality, and student needs as well as building independence in seeking and acquiring knowledge (Prabhu et al., 2014).

Based on the above, the researcher develops a learning model that will be developed by building syntax for developing a learning model where this learning model can provide solutions for developing student learning skill competencies in the Industrial Robot Practicum Course I. Likewise, meetings in class will be designed with a learning model that refers to the Project-Based Learning (PJBL) learning model (Su & Young, 2018). This is expected to help students learn more about programming languages as the basis of Industrial Robot Practicum I in an object-oriented manner so existing students can master Industrial Robot Practicum I with a good concept. Developing the Industrial Robot Practicum I learning model is one of the efforts to solve learning problems (You, 2021).

Meanwhile, based on the results of observations in the Industrial Robot Practicum Course I in the D4 Department of Industrial Electrical Engineering, Department of Electrical Engineering, no alternative learning medium is designed specifically for the learning process (Zhou, 2012). Therefore, it is necessary to design and develop a case study-based project-based learning model in the Industrial Robot Practice I course (Hairunisa et al., 2019), which presents teaching materials, practice questions, and correspondence facilities. This development aims to develop a new learning model and alternative learning resources.

METHODOLOGY

A One-Shot Case Study design was used to create this study. 48 Industrial Electrical Engineering Study Program students served as the study's research subjects. The learning procedure in this study focused more on project-based learning to produce flowcharts. The ability of students to think creatively and translate flowcharts into media or instructional materials, such as teaching aids, is evident in their work. A product observation sheet served as the study's main tool. The observed data is presented as a creative thinking scale (CTS) to measure the project's creative design process. The received data was analysed using Sari's (2018) suggested percentage calculation.

$$Na = \frac{X}{Xm}$$

Information:
Na = effective value
X = Score obtained
Xm = Maximum score

The criteria for assessing creativity were adopted and modified from Sari (2018), as shown in Table 1 below.

Table 1. Student Creativity Criteria

%	Creativity Criteria
81-100	Very High
61-80	High
41-60	Currently
21-40	Low
1-20	Very Low

RESULTS

Based on the results of the research that has been done, the creativity of students in developing flowcharts through project-based learning shows the expected props. These products are assessed using the Creative Thinking Scale (CTS). The following is the average value of student creativity in processing waste into teaching aids, as shown in Table 2 below.

Table 2. The Average Value of Student Creativity

No	Observed Aspects	Average Score	Category
1	Planning	85,5	Very High
2	Implementation	86	Very High
3	Report	80,5	High
The Average Percentage of Student Creativity		84	Very High

Based on Table 2 above, it can be seen that the average value of student creativity through PjBL learning is in the very high category, with an average value of 84. In the planning aspect, an average value of 85.5 is obtained with a very high category where the assessment indicator is the preparation of tools and materials and working drawings. Whereas in the implementation aspect, an average value of 86 is obtained with a very high category, where the indicators for evaluating the implementation aspect are work attitudes, use of tools, materials, artistry, assembly, and finishing.

The report aspect, nevertheless, falls into the top group with an average value of 80.5. The performance and suitability of the generated items serve as the assessment indicators in this section of the report. Students have exceptionally high levels of creativity, according to the average score of the creative thinking scale. The project-based learning (PjBL) approach can help students become more creative. The PjBL learning paradigm helps students' creativity in processing trash (unwanted items) become more concentrated and distinct. According to the research findings, students can improve their creativity in their work by using the PjBL learning paradigm. The high economic worth of the created goods offers pupils the chance to cultivate an entrepreneurial mentality. In other words, the PjBL learning model develops abilities that rely on “learning by doing”.

This aligns with Nugraha (2018) claim that PjBL allows students to learn about, plan, design, and reflect on technological projects. Additionally, Rati (2017) contends that the PjBL paradigm can help SMK 2 Blora pupils become more creative learners. In order to foster creative thinking in a PjBL, it is necessary to embrace new evaluation techniques, such as portfolios based on student projects, in addition to altering teaching strategies and learning environments. The portfolio will demonstrate the skills students have developed in questioning, analysing, synthesising, and problem-solving by coming up with fresh ideas and designing and building a brand-new, unique product. The portfolio also demonstrates how students engage with one another intellectually, emotionally, and socially.

CONCLUSION

According to the research findings, the project-based learning (PjBL) learning approach has been shown to boost students' creativity in the robotic practicum I course in the Industrial Electrical Engineering study program. With an average grade of 84, student inventiveness in turning flowcharts into teaching aids in the first robotic practicum course is quite good.

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