

# Project Based Learning on Mathematics Learning in Indonesia: A Systematic Literature Review

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**Abstract:** “Profil Pelajar Pancasila” is a standard of competence for school graduates in Indonesia. The characteristics of “Profil Pelajar Pancasila” are faith, fear of God Almighty, noble character; global diversity, mutual cooperation, creativity, critical reasoning, and independence. The government establishes project-based learning to support the achievement of “Profil Pelajar Pancasila”. Many studies on the implementation of project-based learning have been carried out. However, there is no comprehensive study on implementing project-based learning in mathematics learning. This study aims to comprehensively review project-based learning research on mathematics learning in Indonesia within 5 years, from 2017 to 2021. The method used is a systematic literature review by analyzing 17 articles accredited by Sinta 1 and 2, the Ministry of Research, Technology, and Indonesian Higher Education. The collected data is then classified based on the year of publication, research methods, research subjects, mathematical content, and learning outcomes. The results of the analysis are presented in the form of graphs, tables, or diagrams. Hopefully, this study is expected to be a reference or idea for implementing Project based Learning in mathematics learning to support the achievement of “Profil Pelajar Pancasila”.

**Keywords:** Learning Mathematics, Project Based Learning.

## 1. Introduction

Education must equip students with 21st-century skills, namely communication, collaboration, critical thinking in problem-solving, creativity, and innovation. In addition, the Indonesian government plans to build a 2045 golden generation equipped with 21st-century skills that require three things, including 1) character qualities consisting of religiosity, nationalism, independence, mutual cooperation, and integration; 2) literacy consisting of language literacy, numeracy, science, digital, finance, culture, and citizenship; and 3) competencies consisting of critical thinking, creativity, communication, and collaboration. In line with this, the Indonesian Ministry of Education has set “Profil Pelajar Pancasila” as the standard of graduate competence [1].

“Profil Pelajar Pancasila” is an attempt to improve the quality of education in Indonesia [2]. “Profil Pelajar Pancasila” is the answer to the competencies produced by the Indonesian education system. “Profil Pelajar Pancasila” prioritizes character building and equips students with valuable skills in everyday life. The characteristics of “Profil Pelajar Pancasila” are faith, fear of God Almighty, noble character; global diversity, mutual cooperation, creativity, critical reasoning, and independence.

As a process of achieving “Profil Pelajar Pancasila”, the Indonesian Ministry of Education establishes project-based learning to support these achievement standards. Projects can be based on certain subjects or as integrated learning units of two or more subjects [1]. Project-based learning is contextual learning that interacts with the surrounding environment [2].

Mathematics learning in schools can be used as a forum to develop “Profil Pelajar Pancasila”, namely by implementing project-based learning. Project Based Learning (PjBL) is a student-oriented learning model based

on three constructivist principles [3]. Learning is context-specific; students are actively involved in learning and achieving learning objectives through social interaction and sharing knowledge and understanding.

Project-based learning provides opportunities for students to explore a theme, topic, issue, or problem without any boundaries between subjects [1]. Students are fully involved in planning and completing projects. PjBL can develop students' abilities to learn new concepts independently, consciously, and responsibly [4]. In project based learning, the teacher acts as a facilitator who helps/directs students when needed [5].

Project based learning method is a learning model that focuses on intellectual and mental processes to solve problems and find concepts or generalizations that can be applied in problem-solving [5]. Project-based learning aims to solve problems by promoting daily activities to discover new knowledge related to prerequisite knowledge [6]. One of the benefits of PjBL is showing higher student abilities [7]. In addition, PjBL can improve students' hard skills and soft skills [8].

This study aims to review the implementation of project-based learning in mathematics learning in Indonesia. Specifically, this study aims to describe 1) Trends in PjBL research on mathematics learning, 2) Education level used in PjBL implementation, 3) Subject matter that has been used in PjBL, and 4) PjBL effect on students' mathematics learning achievement. The results of this study are expected to be used as a reference or an idea to apply Project based Learning to mathematics learning as an effort to support the achievement of “Profil Pelajar Pancasila”.

## **2. Method**

The method used in this study is Systematics Literature Review. Systematics Literature Review is a planned review to answer specific research questions using a systematic and explicit methodology to identify, select, and critically evaluate the results of studies included in the literature review [9]. In this study, a literature review was conducted on journals with the highest ranking by the Ministry of Research, Technology, and Higher Education of the Republic of Indonesia, as an achievement of journals with excellent management and publication quality, namely journals that fall into the categories of Sinta 1 and Sinta 2. Article screening was carried out with the following criteria: 1) Articles were searched using the keywords project based learning or project-based learning, 2) Articles published in 2017-2021, 3) Research was conducted on mathematics learning, and 4) articles examined the effect of PjBL on students' mathematics learning outcomes. There are 17 Project Based Learning articles that meet these criteria.

The articles that have been collected are then classified based on the year of publication, research methods, research subjects, mathematical content, and learning outcomes. Furthermore, the data were analyzed by meta-analysis, which is a statistical method to integrate the results of selected studies included in a systematic literature review [9]. After that, the data is then presented in the form of a diagram for each criterion and described to show the potential contribution of the article to each criterion.

## **3. Result and Discussion**

### **3.1 The trend in PjBLs' Research on Mathematics Learning in Indonesia**

Based on 17 articles reviewed from 2017-2021, research related to PjBL in mathematics learning experienced a drastic increase in 2021. From 2017 to 2019, the number of publications associated with PjBL in mathematics learning tended to be stable. Whereas in 2020, publications decreased, namely, there was one article publication. The trend of PjBL research on mathematics learning can be seen in Graph 1 below.



Graph 1: PjBLs' Research on Mathematics Learning in Indonesia

Based on Graph 1, the graph will increase in 2021. This shows that the PjBL model has been widely applied in mathematics learning. The application of the PjBL method is intended to support and provide 21st-century learning experiences and skills to students so that in the future, students can compete in the global world.

In terms of research methods, 29% of the research methods used are quasi-experimental [5], [10]–[13], 17% descriptive-qualitative [7], [14], [15], 12% experiment [16], [17], and validation study methods [6], research and development [4], correlational study [18], descriptive-quantitative [19], survey research [20], design research [14] and meta-analysis [21] each 6%. The distribution of PjBL research methods can be seen in Diagram 1 below.



Diagram 1: PjBL Research Method on Mathematics Learning in Indonesia

The quasi-experimental research conducted is on creative thinking skills and learning outcomes using a project-based learning model based on the STEM approach in the experimental group, compared to the application of a project-based learning model only [5]. The implementation of the project based learning model with the STEM approach has an influence on the creative thinking skills and learning outcomes of students. The same research is integrating the project based learning model with STEM [12] to determine the effectiveness of mathematics learning in terms of critical thinking skills and collaborative attitudes. The results showed that the STEM-based PjBL model was effective in improving critical thinking skills and collaborative attitudes.

### 3.2 PjBL research subjects

PjBL can be implemented for students from primary school to the university level [22, 23, 3]. The percentage of PjBL implementation in mathematics learning is shown in diagram 2 below.

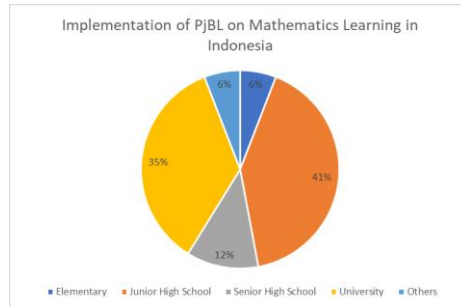


Diagram 2: Implementation of PjBL on Mathematics Learning in Indonesia

Based on diagram 2, PjBL research at the elementary school level is still limited and needs to be improved. This is intended so that students starting at the elementary school level are familiar with project-based learning. Students in elementary school can develop content knowledge and group work skills that support project-based learning [3].

Most research is carried out at the university level. Higher education enacts a vital role in realizing learning outcomes by implementing a curriculum that can improve and develop the cognitive, skills, and affective domains of learners. Studies at universities are carried out to prepare qualified graduates or prospective educators [12]. In addition, survey research is conducted at universities to determine pre-service teachers' perception of the implementation of PjBL in mathematics classes [20].

### 3.3 Subject Matter used in PjBL

Innovation in learning in schools is needed. One form of learning innovation is to apply learning methods that support students' life skills. However, certain learning models are not necessarily effective if applied to all mathematics materials in schools [11]. So that learning objectives are achieved optimally, it is necessary to analyze the characteristics of the material and appropriate learning methods. Project-based learning creates projects that are suitable for everyday life [6]. It is intended that students experience meaningful learning directly. The following are some of the mathematics materials applied in PjBL learning.

TABLE I. Subject matter of PjBL on Mathematics Learning in Indonesia

No	Subject Matter	Authors
1.	Statistics	Poppy Trianti Rahayu, Ratu Ilma Indra Putri Erlina Dwi Prasekti dan Marsigit Rahmazatullaili, Cut Morina Zubainur, Said Munzir
2.	Social Arithmetic	Poppy Trianti Rahayu, Ratu Ilma Indra Putri Elisa Mayang Sari, Ratu Ilma Indra Putri
3.	Space Geometry	Raoda Ismail Nurmi, Alfi Yunita, Radhya Yusri, Hafizah Delyana Sukma Mawaddah, Ali Mahmudi
4.	Plane Geometry	Muchlis
5.	Linear Programming	Decy Pramita Sari Yusna, Bahrn, M. Duskri
6.	Direct proportion	Elisa Mayang Sari, Ratu Ilma Indra Putri
7.	Tangent to circle	Restu Lusiana, Vera Dewi Susanti, Tri Andari

Based on the table above, the subject matters supporting project-based learning application are statistics and spatial geometry. Statistical content is applied in making fruit salad recipes [6]. In this study, students were given a specific nominal capital and then had the chance to provide ingredients to make salads independently. As the final result of the study, students were asked to convey the results of their group projects.

### 3.4 Learning Outcomes

The implementation of Project based Learning in Indonesia has a positive impact on student learning outcomes. Of the 17 articles analyzed, there are 13 articles that mention learning outcomes, namely: Collaboration ability (LO-1), creativity (LO-2), Creative thinking (LO-3), Logical-mathematical intelligence (LO-4), Achievement/ learning outcomes (LO-5), problem-solving skill (LO-6), mathematical attitude (LO-7),

interpersonal skill (LO-8), critical thinking (LO-9), self-confidence (LO-10), mathematical communication (LO-11), and motivation (LO-12). The distribution is listed in the following table.

TABLE II: Learning Outcomes

No	Author	LO-1	LO-2	LO-3	LO-4	LO-5	LO-6	LO-7	LO-8	LO-9	LO-10	LO-11	LO-12
1.	Poppy Trianti Rahayu, Ratu Ilma Indra Putri	x											
2.	Siti Khoiruli Ummah, Akhsanul In'am, Rizal Dian Azmi		x										
3.	I Wayan Widana, Kadek Lisa Septiari			x		x							
4.	Decy Pramita Sari Yusna, Bahrun, M. Duskri				x								
5.	Erlina Dwi Prasekti dan Marsigit					x	x	x					
6.	Ida Trisnadati					x			x	x			
7.	Raoda Ismail					x	x				x		
8.	Vera Rosalina Bulu, Femberianus	x								x			
9.	Rahmazatullaili, Cut Morina Zubainur, Said Munzir			x			x						
10.	Restu Lusiana, Vera Dewi Susanti, Tri Andari											x	
11.	Nurmi, Alfi Yunita, Radhya Yusri, Hafizah Delyana					x							
12.	I Wayan Eka Mahendra					x							x
13.	Sukma Mawaddah, Ali Mahmudi											x	

Based on the table above. The most studied learning achievement is learning achievement/outcome (LO-5). Research related to learning outcomes is the integration of PjBL learning models based on the STEM approach [5], the use of ICT-integrated PjBL-based Student Worksheets [19], realistic learning approaches with PjBL models [16], and PjBL model contains ethnomathematics (Mahendra, 2017). The four studies stated that the PjBL model was effective in terms of students' mathematics learning outcomes.

Collaboration ability (LO-1) is an effect of the integration of PjBL with PMRI based on Lesson Study for Learning Community [6] and PjBL based on STEM [12]. Collaboration, which is one of the 21st-century skills, is at the core of the project [24]. Through project-based learning, students work together in teams to plan and complete projects. Creativity (LO-2) is an effect of project-based learning [7]. Creative thinking ability is an effect of the PjBL model [17] and the PjBL based on the STEM approach [5].

A study related to students' mathematics learning outcomes and problem-solving skills was carried out by comparing the effectiveness of using the PjBL method with PBL [10], [11], stating that the PBL method was more effective in terms of learning outcomes and problem solving skills. In problem-based learning, students are more directed to a problem, so students have a lot of experience in problem-solving [10]. Problem-based learning teaches students to apply their knowledge or find the knowledge needed to solve problems [25], resulting in the integration of knowledge in students. While in project-based learning, the main focus of learning is directed at the given project tasks. The PjBL and PBL methods are recommended to be used continuously [10].

The PjBL method that is integrated with the STEM approach can affect student learning outcomes [5]. Internally, PjBL based on the STEM approach, motivates students to study mathematics seriously. In addition, STEM-based PjBL can have an influence on the learning environment and learning atmosphere that can trigger students' enthusiasm for learning.

#### 4. Conclusion

Based on the study results, it can be concluded that studies related to PjBL will increase dramatically in 2021. Most subjects are carried out at the tertiary level. The implementation of project based learning in

elementary school mathematics learning needs to be improved. The subject matter of mathematics that has been taught using project-based learning includes statistics, spatial geometry, plane geometry, linear programming, comparisons of values, and tangents to circles. The implementation of project-based learning is effective for learning outcomes: collaboration skills, creativity, creative thinking, logical-mathematical intelligence, learning achievement/outcomes, problem-solving skills, mathematical attitudes, interpersonal skills, critical thinking, self-confidence, mathematical communication, and learning motivation. The implementation of PjBL needs to be expanded and developed for other materials, but still, pay attention to the characteristics of the material so that the learning outcomes can be achieved maximally.with

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