

## SYSTEMATIC LITERATURE REVIEW: PROJECT BASED LEARNING MODEL IN JUNIOR HIGH SCHOOL MATHEMATICS EDUCATION

Miftahul Roiv<sup>1\*</sup>, Anna Fauziah<sup>2</sup>, Viktor Pandra<sup>3</sup>

<sup>1,2,3</sup>Universitas PGRI Silampari, Jl. Mayor Toha, Kelurahan Air Kuti, Kecamatan Lubuklinggai Timur I, Kota Lubuklinggau, Sumatera Selatan, Kode Pos : 31628

E-mail: miftahuloiv4@gmail.com

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### ABSTRACT

Project Based Learning (PjBL) approach encourages students to be more active, independent, and creative problem solvers, thereby fostering character values such as creativity and curiosity. This research applies the Systematic Literature Review (SLR) method to examine the PjBL model in mathematics education at the junior high school level. PjBL as a learning model involves teachers acting as facilitators who present students with project-based problems to solve independently. This approach stimulates students to design processes and frameworks to find solutions to given problems. The study focuses on various mathematical topics including Flat-Sided Spatial Structures (Cube, Rectangular Prism, and Prism), Curved-Sided Spatial Structures (Sphere, Cylinder, Cone), Quadratic Functions, Trigonometry, and Systems of Linear Equations with Two Variables (SLETV). The analysis concludes that the PjBL model enhances mathematical learning by promoting product-oriented learning, student-centered approaches, fostering critical thinking and real-life problem-solving skills, as well as encouraging collaborative abilities and competition among peers. These findings underscore the effectiveness of integrating PjBL into mathematics education and highlight its implications for fostering holistic student development.

*Pendekatan Pembelajaran Berbasis Proyek (PjBL) mendorong siswa untuk menjadi lebih aktif, mandiri, dan kreatif dalam menyelesaikan masalah, sehingga membangun nilai-nilai karakter seperti kreativitas dan rasa ingin tahu. Penelitian ini menggunakan metode Systematic Literature Review (SLR) untuk mengkaji model PjBL dalam pembelajaran matematika di tingkat SMP. Model PjBL melibatkan guru sebagai fasilitator yang memberikan siswa dengan proyek-proyek untuk diselesaikan secara mandiri. Pendekatan ini mendorong siswa untuk merancang proses dan kerangka kerja untuk menemukan solusi dari masalah yang diberikan. Studi ini memfokuskan pada berbagai topik matematika termasuk Bangun Ruang Sisi Datar (Kubus, Balok, dan Prisma), Bangun Ruang Sisi Lengkung (Bola, Tabung, Kerucut), Fungsi Kuadrat, Trigonometri, dan Sistem Persamaan Linier Dua Variabel (SPLDV). Analisis menyimpulkan bahwa model PjBL meningkatkan pembelajaran matematika dengan mendorong pembelajaran berorientasi produk, pendekatan yang berpusat pada siswa, memajukan pemikiran kritis dan keterampilan pemecahan masalah dalam kehidupan nyata, serta mendorong kemampuan kolaborasi dan kompetensi antar individu. Temuan ini menunjukkan efektivitas integrasi PjBL dalam pendidikan matematika dan implikasinya dalam pengembangan holistik siswa.*

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**1. INTRODUCTION**

The "Kurikulum Merdeka" (Independent Curriculum) provides teachers with the opportunity to explore innovative and collaborative teaching methods, tailored to the characteristics of students and their learning environments (Malikah, 2022). One of the subjects taught in schools is mathematics (Nasryah et al., 2020). Mathematics is taught gradually using a spiral approach, starting from concrete, semi-concrete, to abstract concepts (Khairani et al., 2021; Sunismi, 2015). Mathematics is a hierarchical science where one concept is interrelated with another, requiring students to understand concepts well to learn other concepts (Emanuel, 2018; Ula et al., 2019).

Mathematics is a logical science that discusses shapes, order, quantities, and related concepts (Malikah, 2022). Additionally, mathematics serves as the foundation for the development of other sciences (Jeheman et al., 2019; Rahayu et al., 2018). Therefore, mathematics is a crucial subject in schools, from elementary to higher education levels, and is even taught informally in kindergartens (Indriani, 2018; Saraswati et al., 2020). Mathematics plays an essential role in the education system because it encourages students to think logically, critically, and broadly. This aligns with the national education goals of preparing young generations to face dynamic life changes with directed and critical thinking abilities (Astuti, 2021).

However, in reality, students often struggle to master mathematics (Khotimah et al., 2019; Safithri et al., 2021; Saputro et al., 2020). This difficulty is evident when students are given practice questions, where many are still confused about making conjectures and performing mathematical manipulations. The low mathematical ability of students is reflected in their lack of skills in making conjectures, providing evidence, drawing conclusions, and finding patterns in mathematical phenomena to make generalizations (Leniati et al., 2021; Suryaningtyas, 2017). One of the causes is the dominance of teacher-centered learning models, which makes students tend to receive information directly without going through the discovery process. As a result, students struggle to summarize the material that has been taught and are reluctant to solve problems posed by the teacher on the blackboard. If this situation continues, the learning process will not achieve the desired level of effectiveness and optimality (Rani et al., 2021).

One of the learning steps that can address these problems is the implementation of Project-Based Learning (PjBL). PjBL is a learning method where students use projects or activities as the core of learning (Izati et al., 2018; Muskania et al., 2017). They engage in exploration, assessment, interpretation, and synthesis of information to produce various learning outcomes. The project-based learning approach uses problems as the starting point to gather and integrate new knowledge based on practical experiences (Elisabet et al., 2019; Mahendra, 2017). With PjBL, students conduct in-depth investigations into real-world topics. The stages of implementing PjBL involve determining fundamental questions, planning projects, creating schedules, monitoring, testing results, and evaluating experiences. This method emphasizes relatively long-term, holistic,

interdisciplinary learning activities integrated with real-world practices and issues. In PjBL, students learn in the context of real-world problem situations, which can produce deeper knowledge and organize projects in learning. The PjBL approach encourages students to be more active, independent, and creative in solving problems, thereby building character values such as creativity and curiosity (Safitri et al., 2018).

Based on the aforementioned background, this article aims to conduct a Systematic Literature Review (SLR) on the Project-Based Learning model in mathematics education at the junior high school level. SLR is a structured and comprehensive research approach to identify, evaluate, and synthesize previous studies relevant to a specific research topic. By presenting a detailed literature review, it is expected to provide valuable insights for educators, researchers, and education practitioners in understanding the potential and benefits of Project-Based Learning in developing students' skills at the junior high school level. This research will further discuss the Project-Based Learning model at the junior high school level, based on an analysis of survey results from various research articles. The main goal is to understand the concept of the Project-Based Learning model and its relation to mathematics education at the junior high school level. The results of this study are expected to serve as a guide for classroom teaching to achieve well-accepted and effective learning objectives for students.

## 2. METHODS

The research method applied is the Systematic Literature Review (SLR). SLR is a literature review method that identifies, assesses, and interprets all findings related to a research topic to answer specific research questions (Nursalam et al., 2020). The aim of an SLR study is to gather and integrate similar studies related to specific research questions, using detailed, transparent, and structured procedures (Juandi, 2021). Simply put, literature that has been carefully selected based on research keywords is reviewed, and relevant journals are identified according to the procedures outlined in the Systematic Literature Review (SLR) method, as described by Triandini et al. (2019). This study follows the three stages of Systematic Literature Review (SLR) as outlined by Choifah et al. (2022), which are:

### *Planning*

In developing the research protocol using the Systematic Literature Review (SLR) model, the first step is planning. During this stage, the research topic, which pertains to the Project-Based Learning (PjBL) model in mathematics education, is established. Following this, the criteria for article selection are defined, focusing on sources from Google Scholar within the time frame of 2016 to 2023. The keywords employed in this research include Project-Based Learning in the context of mathematics education.

### *Conducting*

The conducting phase is the execution stage in Systematic Literature Review (SLR) research. During this phase, the search for articles that meet the criteria and match the keywords begins. A total of 40 articles that met the keyword criteria were identified as the research population. After applying the inclusion and exclusion criteria to this population, 20 articles were selected. The inclusion criteria included academic proceedings, journal publications within the last 7 years, qualitative studies, development-focused research, and studies at the junior high school level. The exclusion criteria included irrelevant titles, lack of full text, irrelevant abstracts, and unclear research conclusions. Once the selection process was completed, the next stage was data

synthesis, aimed at analyzing and evaluating the research findings from various articles. The data synthesis in this study will be presented narratively.

**Table 1.** Types of Scientific Article Publications

Types of Publication	Number of Articles
Accredited National Journal Sinta 1-2	1
Accredited National Journal Sinta 3-4	5
Accredited National Journal Sinta 5-6	5
Non-accredited National Journal Sinta	9

### **Reporting**

The reporting stage constitutes the final step in the SLR method. During this phase, researchers describe the results of their analysis and evaluation of journal reviews in written form, following the predefined format.

## **3. RESULTS AND DISCUSSION**

This section presents findings from various publications as evidence related to understanding the Project Based Learning (PjBl) model in middle school mathematics education. Research findings are organized using a Systematic Literature Review (SLR) approach, analyzing articles on the Project Based Learning model in middle school mathematics education, considering conceptual frameworks, connections to Project Based Learning, and research levels. This aims to evaluate the PjBl model concept in the context of mathematics education and its application to middle school curriculum. From the article analysis, 20 studies were identified that evaluate the PjBl model concept and its application to middle school mathematics.

### **Concept of Project Based Learning Model**

The analysis of 20 articles yielded 9 relevant articles on the concept of Project Based Learning models in the context of mathematics education. The subsequent section will discuss the importance of identifying and validating previous research, as well as its relevance to prior data and studies in the aforementioned context.

In this literature review, the cited experts (Nopita et al., 2020) define Project Based Learning as an innovative approach that encourages students to collaboratively investigate and develop solutions to environmental issues. For instance, students may generate innovative ideas to address environmental pollution and implement them in everyday life contexts.

Santayasa et al. (2019) identified key characteristics of Project Based Learning, including student orientation, project realism, constructive approach, tangible outcomes, relevance to real-world issues, investigative processes, and focus on key concepts. Additionally, Fajri et al. (2024) highlight that this model not only enhances critical thinking and creativity but also improves students' communication and collaboration skills.

According to Krismona et al. (2021), a critical evaluation of project-based learning indicates that this approach integrates various types of student intelligence within their environmental project contexts. Research findings confirm that the use of Student Worksheets adopting Project Based Learning approaches meets standards for instructional materials, fostering dynamic and innovative learning environments.

Ayuningtyas et al. (2018) emphasize that Project Based Learning is effective in enhancing students' mathematical literacy by combining theory with practical experiences in real-world situations.

Herlina (2022) underscores that Project Based Learning allows students to engage in various cognitive activities such as exploration, assessment, interpretation, synthesis, and information processing to achieve learning outcomes closely aligned with real-world contexts. This model motivates students by placing them at the center of learning, promoting independence and active engagement.

In Yulianti et al.'s study (2023), it was concluded that the concept of Project Based Learning (PjBL) has the potential to enhance students' higher-order thinking skills, including analysis, synthesis, and evaluation. PjBL engages all students actively in the learning process, providing them ample time to solve problems independently or in groups according to the theories, concepts, and information they have learned.

Sari et al. (2019) stated that Project Based Learning (PjBL) is an approach where students are engaged in projects or activities as the primary focus of learning. This approach begins with identifying a problem that prompts students to gather new knowledge through direct learning experiences, generating essential questions that guide them in collaborative projects. PjBL emphasizes students' activities in producing products that they present, based on real experiences they have encountered.

On the other hand, Lestari (2022) explores that Project Based Learning is a student-centered learning approach, starting from identifying a problem as the background for carrying out a real project. This process challenges students to address contextual constraints and develop investigation and problem-solving skills, thus achieving the desired competencies in attitudes, knowledge, and skills. In the context of mathematics learning, the author advocates the use of PjBL to bring real-world situations into learning, providing relevant and concrete learning experiences for students.

Overall, based on the review of several research articles, it can be concluded that Project Based Learning (PjBL) is a project-based learning approach that encourages students to design processes and frameworks to solve given problems. Teachers act as facilitators who present project-based problems, encouraging students to develop solutions relevant to real-life situations and produce products that they can present.

### **The Relationship of Project Based Learning Model in Junior High School Mathematics Material**

The literature review analyzed 20 articles, identifying 6 relevant ones discussing the concept of PjBL models in the context of mathematics education. The next section will discuss the importance of discovering and assessing previous research and its relevance to the established situation.

The experts cited in this study (Azizah et al., 2019) explain that Project-Based Learning (PjBL) allows students to develop concrete projects as an integral part of the learning process. This approach promotes student independence in understanding mathematical concepts such as cube and block networks. In this context, the role of the teacher shifts to that of a facilitator who grants students the freedom to explore and understand concepts independently. This freedom stimulates the development of understanding, broadens insights, and enhances students' responsibility and active engagement.

Panjaitan (2023) highlights the importance of quadratic function learning in the 2013 curriculum for junior high school. This includes explanations of quadratic functions through tables, graphs, and equations, as well as their relationship with coefficients and discriminants. Despite its importance, most students struggle with graphing quadratic

functions, indicating their inadequate understanding of this concept. The PjBL model is implemented to enhance students' understanding of this concept through contextual approaches.

Herlina (2022) conducted research revealing an increase in learning motivation among Grade IX-G students at SMPN 2 Jatinangor in the subject of mathematics, particularly in understanding curved surface solid geometry, after implementing the Project Based Learning (PjBL) model. This was evidenced by achievement indicators surpassing the research targets. High levels of student and teacher learning activity, aligned with learning steps such as posing fundamental questions, product planning, production scheduling, project monitoring, and result testing, further substantiate these findings.

The study by Kabu et al. (2021) evaluated the development of learning resources in geometry, specifically focusing on the topic of prism solid geometry, utilizing an ethnomathematics-based approach. Testing of learning resources was conducted on both small and large scales using the PjBL model. At the small scale, students were grouped to design prism-shaped teaching aids from cardboard, while at the large scale, the PjBL model was implemented in experimental classes. Group activities involved creating nets of the prism from provided shapes by the teacher, followed by documentation on Student Worksheet (LKS) and surface area calculations based on these nets.

Research by Qomariyah (2019) indicated that the use of Project Based Learning (PjBL) in teaching mathematics, particularly in Trigonometry, can enhance student learning achievements and engagement in all assessment aspects, including active participation, responsibility towards tasks, willingness to ask questions, and active participation in discussions during project implementation.

On the other hand, Manurug et al. (2024) found that the application of the PjBL model in teaching systems of linear equations with two variables for Grade VIII-2 at SMP Negeri 4 Pematang Siantar was significant ( $p = 0.000$ ), with a t-value of 6.314 exceeding the t-table value of 2.048, thus accepting the hypothesis. This study demonstrated that the PjBL model significantly positively impacted student learning outcomes by 58.7%.

Overall, based on a review of several research articles above, it can be concluded that the Project Based Learning (PjBL) model is highly relevant to middle school mathematics topics, particularly in the context of curved surface solid geometry. These geometries have numerous real-world applications, making them suitable for project-based learning designs. This analysis reaffirms that PjBL not only enhances the achievement of set success indicators in research but also increases student and teacher learning activity levels in line with structured learning steps.

#### **4. CONCLUSION**

The analysis concludes that the Project Based Learning (PjBL) model is a project-centered learning approach where projects are implemented in real-world contexts. The PjBL model in the context of mathematics education emphasizes several key concepts: generating learning products, focusing on students, promoting critical thinking and problem-solving skills relevant to real life, and encouraging collaboration and healthy competition. Specifically, the application of PjBL in middle school mathematics includes topics such as Flat-faced Polyhedrons (such as Cubes, Rectangular Prisms, and Prisms), Curved-faced Polyhedrons (such as Spheres, Cylinders, and Cones), Quadratic Functions, Trigonometry, and Systems of Linear Equations with Two Variables. Therefore, it is strongly recommended to implement the PjBL model consistently in mathematics education, considering its alignment with the curriculum to achieve effective learning goals.

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