

IMPROVING LEARNING OUTCOMES FOR SIMPLE GEOMETRIC NETS USING A PROJECT-BASED LEARNING (PJBL) MODEL INTEGRATED WITH DEEP LEARNING IN FIFTH-GRADE PRIMARY SCHOOL

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ABSTRACT

This research is motivated by the low mathematics learning outcomes of fifth-grade students Primary School in Padang, especially on the topic of geometric nets. Preliminary data shows that only 15% of students achieve the minimum completion criteria. This research aims to improve student learning outcomes by implementing the Project Based Learning (PjBL) model integrated with the principles of Deep Learning (Mindful, Meaningful, and Joyful Learning). The methodology used is the Classroom Action Research (CAR) model of Kemmis and McTaggart which consists of planning, implementation, observation, and reflection stages. The research subjects were 20 fifth-grade students. Data collection was carried out through observation, interviews, and tests, which were analyzed using qualitative and quantitative techniques (mixed-methods). The novelty of this research lies in the innovative synergy between the PjBL model and the specific 'Deep Learning' approach mandated by the 2025 education regulations, providing a holistic framework that balances cognitive precision through 'Mindful' practices with emotional engagement through 'Joyful' learning. The results of the study showed a significant increase in the quality of learning and student achievement. Teacher activity scores increased from 86.11% in Cycle I to 94.44% in Cycle II, while student activity increased from 83.33% to 91.67%. Furthermore, the average student learning outcomes increased from 69.5 in Cycle I to 81.13 in Cycle II, with a completion percentage reaching 80%. It can be concluded that the Deep Learning integrated PjBL model effectively improves learning outcomes for Primary School students on spatial nets by transforming abstract concepts into concrete projects.

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INTRODUCTION

Mathematics is a logical reasoning discipline encompassing algebra, analysis, and geometry, with a vital role in developing critical and systematic thinking skills from an early age (Wandini et al., 2021). At the Primary School level, learning aims to improve reasoning and intelligence through understanding concepts relevant to everyday life (Intan, 2022; Syafri Ahmad et al., 2024). Currently, the national curriculum demands a paradigm shift that focuses on critical

thinking, collaboration, creativity, and communication skills (Zainil et al., 2023; Hamimah et al., 2022; Ramadhani et al., 2022).

As an improvement, Minister of Elementary and Secondary Education Regulation Number 13 of 2025 now emphasizes a deep learning approach so that students fully understand concepts. This strategy creates an interactive and in-depth mathematics learning environment (Barokah & Mahmudah, 2025; Mutmainnah, Adrias & Zulkarnaini, 2025). Deep learning is positively correlated with long-term retention through three main principles: mindful, meaningful, and joyful (Barokah & Mahmudah, 2025; Mailani et al., 2025; Nabila et al., 2025). The success of this process is reflected in learning outcomes that include aspects of knowledge, skills, and attitudes (Yandi et al., 2023; Widyasari et al., 2024). For effective learning, teachers must develop structured planning by selecting models and media that are appropriate to students' cognitive development (Yunitasari et al., 2021). The success of this process is reflected in learning outcomes, namely behavioral changes in knowledge, skills, and attitudes (Yandi et al., 2023; Widyasari et al., 2024). Therefore, improving mathematics learning outcomes requires student-centered learning and exploratory activities to achieve in-depth conceptual understanding.

Observations and interviews conducted on October 20-22 in fifth grade Primary Schools revealed fundamental problems in mathematics learning. From a planning perspective, the classroom teacher's In-depth Learning Implementation Plan (RPPM) has not integrated the principles of deep learning and the Project Based Learning model into mathematics learning, while in practice, learning is still teacher-centered with rigid conventional methods. This results in minimal student engagement, leading to students being passive, bored, and having difficulty understanding concepts in depth. This condition has a direct impact on low student learning outcomes, which are below the Learning Objective Achievement Criteria (KKTP), which is 75. Data from the mid-semester I summative results show that most students have not been able to master the material optimally because the knowledge transfer process is not carried out exploratively.

Low student learning outcomes require improvements in learning planning and implementation to align with the Merdeka Curriculum standards. Teachers need to choose learning models that actively engage students and foster critical reasoning skills in problem-solving (Malikah et al., 2022). One way teachers can address this issue is through the use of appropriate, innovative models. One model that can be used in Primary Schools is the Project-Based Learning (PjBL) model. Project-based learning is generally conducted by groups of students working together toward a common goal (Safitri, 2024). Project-Based Learning (PjBL) is a form of learning based on constructivist findings that students gain greater knowledge and understanding of material when they actively construct understanding through working and using ideas. By implementing the PjBL model in the mathematics learning process, it is hoped that PjBL can increase motivation, problem-solving skills, collaboration, and create a more enjoyable learning environment (Keguruan Dan, 2018).

However, despite the extensive literature on PjBL, a significant research gap persists regarding its explicit integration with the 'Deep Learning' approach (Mindful, Meaningful, and Joyful) mandated by the 2025 regulations. Most previous studies focus primarily on the procedural completion of projects, yet frequently overlook the essential synergy required to master abstract concepts like geometric nets through deep cognitive and emotional engagement. This study addresses this gap by operationalizing PjBL within the Deep Learning framework to overcome the persistent low learning outcomes observed at SDN 21 Bandar Buat.

As a solution, the Project Based Learning (PjBL) model integrated with deep learning is applied to stimulate creativity and conceptual understanding through real experiences (Mahendra, 2017; Isnaniah, 2017). Through PjBL, the material on geometric nets is learned concretely through the creation of real products that foster group cooperation and curiosity. Based on this urgency, researchers see the need to conduct action research to improve the quality of learning in grade V of Primary School. The use of the Project Based Learning (PjBL) model integrated with deep learning is expected to not only improve student learning outcomes cognitively, but also motivate teachers to apply more dynamic learning models.

METHODS

This study uses a qualitative and quantitative approach (mix-methods) with the type of Classroom Action Research (CAR). This research cycle model has four components, namely planning, implementation, observation and reflection. This research was carried out in two cycles, namely cycle I consisting of two meetings, and cycle II consisting of one meeting. The study was conducted in one of the Primary Schools in Padang City, with research subjects of 20 fifth grade students, consisting of 11 male students and 9 female students.

Data were obtained from teachers and fifth-grade students at SDN 21 Bandar Buat. The research data were collected through observation of learning activities and evaluation tests at the end of each cycle to measure cognitive learning outcomes based on the revised Bloom's Taxonomy. Additionally, Project Worksheets (LKP) were used to assess student skills, followed by group activities to create geometric nets. Data were analyzed descriptively to determine increases in activity and average learning outcomes. The study was deemed successful if at least 80% of students achieved a minimum grade point average (KKTP) of 75.

Quantitative data analysis techniques were used to analyze student learning outcomes, as outlined by the Ministry of Education and Culture (2016:47), as follows:

$$Score = \frac{\text{scores obtained}}{\text{score Maximal}} \times 100$$

With the following success criteria: Very Good (SB) = $89 < A \leq 100$, good (B) $79 < B \leq 80$, sufficient $70 \leq C \leq 79$, Need guidance (D) $D \leq 70$. The percentage of results of observations of learning practices in the Ministry of Education and Culture (2017) is as follows:

$$Score = \frac{\text{scores obtained}}{\text{score Maximal}} \times 100$$

With the following success criteria: Very Good (SB) $90 < SB \leq 100$, good (B) $80 < B \leq 90$, sufficient (C) $70 < C \leq 80$, needs guidance (D) ≤ 70 .

RESULTS AND DISCUSSION

Result

This classroom action research was carried out in two cycles, where each cycle consisted of two meetings for planning, implementation, observation, and reflection.

Cycle I Meeting I

1. Planning

The In-depth Learning Implementation Plan (RPPM) design was collaboratively developed between the researcher and the fifth-grade teacher of SDN 21 Bandar Buat. Prior to the RPPM, the researcher and the class teacher first analyzed the chapters and core materials developed based on the independent curriculum in fifth-grade Semester II. In cycle I, the first meeting discussed cube nets using the steps of the Project Based Learning model integrated with deep learning.

2. Implementation

Implementation of cycle I Meeting I of the learning process is carried out in accordance with the steps of the Project Based Learning model proposed by Hosnan, namely 1) Students determine projects based on projects, 2) Planning the steps for completing the project, 3) Preparation of a project implementation schedule, 4) Completion of the project with teacher facilities and monitoring, 5) Preparation of reports and presentations/publications of project results, 6) Evaluation of the process and results of the project.

The integration of deep learning into PjBL is carried out through the pillars of meaningful to ensure the relevance of the material, mindful to train students' accuracy when measuring nets, and joyful to build motivation through enjoyable group work. The integration of these three pillars ensures a more interactive and in-depth knowledge construction process.

3. Observation

Observations were conducted in each cycle I meeting I where the results obtained were the In-depth Learning Implementation Plan (RPPM) assessment sheet, the observation sheet for the implementation process of learning Simple geometric nets on the teacher and student aspects. RPPM in cycle I meeting I obtained a score of 31 with a percentage of 87.5% (B). Furthermore, the assessment of teacher activity in implementing learning obtained a score of 27 with a percentage of 84.37% (B), and the assessment of student activity obtained a score of 30 with a percentage of 83.3%.

Table 1. Table of Research Results Cycle I Meeting I

Nu	Aspects observed	Evaluation
1.	In-depth Learning Implementation Plan	83,3%

	(RPPM)	
2.	Teacher aspect	87,5%.
3.	Student Aspect	83,3%.

Source: Research data, 2026

Cycle I Meeting II

1. Planning

Based on observations of the In-depth Learning Implementation Plan (RPPM) in cycle I meeting II, a score of 31 out of 36 maximum scores was obtained with a percentage of 87.5% (B). This indicates that the teacher's ability to plan learning using the Project Based Learning model integrated with deep learning is classified as good. In cycle I meeting II, the discussion on cuboid nets was carried out.

2. Implementation

The implementation of cycle I Meeting II of the learning process of simple geometric nets was carried out in accordance with the steps of the Project Based Learning model proposed by Hosnan (2017:302). And the integration of deep learning in each step of the PjBL was realized through the meaningful pillar so that students understand the essence of each fold of the cuboid net they made. In addition, the mindful pillar was applied to train students' focus and accuracy when taking measurements so that the results were precise, while the joyful pillar ensured that the classroom atmosphere remained lively and fun through creative group activities. The synergy of these three pillars aims for students not only to follow procedures, but to truly absorb the geometric concept in depth.

3. Observation

Observations were conducted in every cycle I meeting II where the results obtained were the RPPM assessment sheet, the observation sheet of the implementation process on the teacher and student aspects filled out by the sixth grade teacher as an observer. RPPM in cycle I meeting II obtained a score of 19 with a percentage of 87.5% (B). The assessment of teacher activity in the implementation of simple geometric net learning obtained a score of 32 with a percentage of 88.89% (SB) and the assessment of student activity obtained a score of 32 with a percentage of 88.89% (SB).

Table 2. Table of Research Results Cycle I Meeting II

Nu	Aspects observed	Evaluatio
1.	RPPM	95,83 %
2.	Teacher Aspect	88,89%
3.	Student Aspect	88,89%

Source: Research data, 2026

Cycle II

1. Planning

Based on observations of the In-depth Learning Implementation Plan (RPPM) in cycle II, the score was 23 out of 24, a maximum of 95.83% (SB). This indicates that the teacher's ability to plan lessons using the Project Based Learning model integrated with deep learning is very good. Cycle II discussed nets of cubes and cuboids.

2. Implementation

Implementation of cycle II of the implementation of the Learning Action of Simple spatial nets of mathematics learning using the Project Based Learning model according to Hosnan (2017) is 1) Students determine projects based on projects, 2 Planning project completion steps, 3) Preparation of project implementation schedules, 4) Completion of projects with teacher facilities and monitoring, 5) Preparation of reports and presentations/publications of project results, 6) Evaluation of the process and results of the project. From the observation of the implementation of teacher activities in the cycle II research, it can be seen that the results of observations of teacher activities obtained a total score of 34 with a percentage of 94.44% (SB) with

a very good classification. And the student activity aspect obtained a score of 31 with a percentage of 91.67%.

Table 3. Cycle Research Results II

No	Aspek yang diamati	Penilaian
1.	RPPM	95,83%
2.	Aspek guru	94,44%
3.	Aspek Siswa	91,67%

Source: Research data, 2026

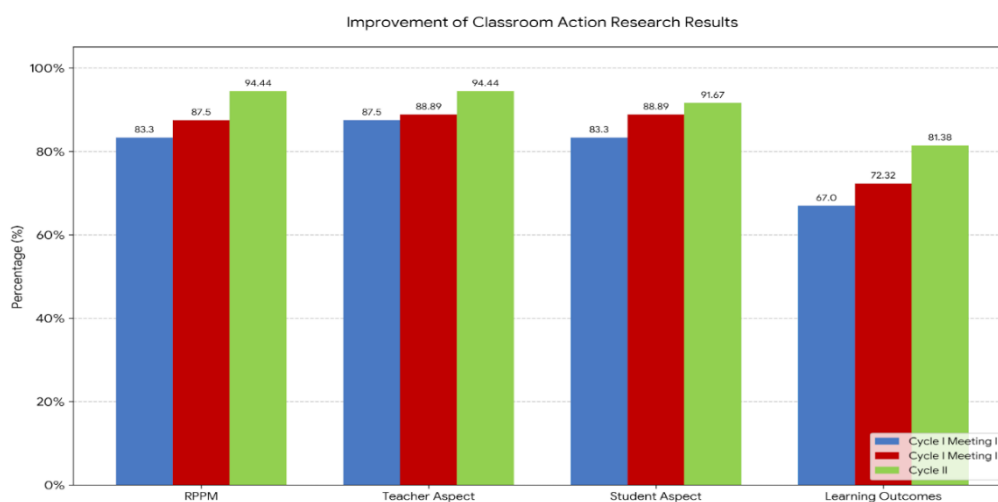
Based on the Recapitulation of Improvement in Learning Outcomes of Simple Spatial Nets Using the Project Based Learning (PjBL) Model integrated with Deep Learning, the implementation of actions in Cycle I and Cycle 2 obtained the following assessment data and learning outcomes:

Table 4. Recapitulation

Nu	Evaluation	Cycle 1 Meeting		Average cycle 1	Cycle 2
		1	2		
1	RPPM	83,3%	87,5%	85,4%	95,83%
2	Teacher	87,5%	88,89%	88,19%	94,44%
3	Student	83,3%	88,89%	89,05%	91,67%
4	Learning outcomes	67%	72,32%	69,66%	81,38%

Source: Research data, 2026

For images and graphs, captions are displayed below the graph or image with a single space. For further clarification, it is as follows.



Based on Table 4 & imagine, the research results show a significant improvement in all observed aspects. In Cycle I, the RPPM reached a score of 87.5% , teacher activity was 84.37% , and student activity was 83.3%. The average learning outcome in this cycle was 69.66. In Cycle II, there was a significant increase where the RPPM score reached 95.83% , teacher activity 94.44% , and student activity 91.67%. Overall, learning

outcomes increased to an average of 81.38 in Cycle II , with a completion percentage reaching 80%.

Discussion

The significant improvement in learning outcomes from an average of 69.66 in Cycle I to 81.38 in Cycle II is empirical evidence of the successful integration of the Project-Based Learning (PjBL) model with the Deep Learning method. In this study, PjBL acts as a systematic model or framework that guides students through six operational steps, from project determination to outcome evaluation. Meanwhile, Deep Learning is present as an integration method that gives "life" to each step, so that the project of creating a geometric net is not merely a physical activity, but a process of constructing in-depth understanding. The change in the completion rate from the initial data of 15% to 80% proves that the appropriately integrated PjBL model is able to address the challenge of low mathematics learning outcomes.

The implementation of the Meaningful pillar as an integrated method within the PjBL steps successfully transformed the abstract nature of net material into something more concrete and relevant for fifth-grade students. Through the PjBL model, students are facilitated to construct knowledge independently by creating real products. This synergy ensures that each stage of creating nets for cubes and cuboids is understood in essence, rather than simply following procedural instructions. The result, a significant increase in learning completion, shows that when the PjBL model is integrated with meaningful learning methods, students' knowledge retention of geometric concepts becomes more stable and long-lasting.

The integration method through the Mindful pillar specifically strengthens the monitoring and evaluation stages in the PjBL model, which has an impact on increasing students' cognitive accuracy. In Cycle I, students' haste in measuring the edges of the nets often becomes an obstacle, but with the Mindful method, students are trained to pay full attention and precision to each step of the work. This is reflected in the increase in student activity scores reaching 91.67% and teacher activity of 94.44% in Cycle II. PjBL provides a work structure, while the Mindful method instills depth of focus, so that visualization errors in the material of geometric nets can be significantly minimized.

Furthermore, the Joyful pillar integration method within the PjBL model successfully revitalized the psychological state of students who previously felt bored and passive due to conventional methods. The collaborative nature of the PjBL model combined with a joyful atmosphere has been proven to reduce math anxiety and increase students' intrinsic motivation. Dynamic social interactions in group work make the learning process at SDN 21 Bandar Buat more interactive and student-centered. This analysis confirms that the Joyful integration method is the lubricant that ensures the PjBL model engine runs optimally to achieve the expected learning completion standards.

Overall, this research provides an important contribution to learning practices in Primary Schools in accordance with Minister of Education Regulation Number 13 of 2025. The use of PjBL as a model and Deep Learning as an integrated method offers a holistic solution that balances students' cognitive, skill, and attitudinal aspects. The success in achieving the 80% completion target confirms that this integration is highly relevant to the demands of the Independent Curriculum, which emphasizes deep and meaningful conceptual understanding. Therefore, the PjBL model integrated with the Deep Learning framework (Mindful, Meaningful, Joyful) deserves to be recommended as a superior instructional strategy to improve the quality of mathematics learning at the Primary School level.

CONCLUSION

The learning planning of simple geometric nets using the PjBL model was designed in 2 cycles. Cycle I consisted of 2 meetings and cycle II consisted of 1 meeting. The results of observations of the In-depth Learning Implementation Plan (RPPM) cycle I meeting 1 obtained a value of 83.3% with good qualifications (B), increasing in cycle I meeting 2, namely with a value of 87.5% with good qualifications (B). The increase occurred in cycle II to 95.83% with very good qualifications (SB).

The implementation of simple geometric net learning using the PjBL model consists of preliminary activities, core activities, and closing activities. The implementation of learning is carried out using PjBL steps integrated with deep learning based on observations made using teacher and student activity observation sheets. The results of observations of teacher and student activities from cycle I to cycle II have increased. The implementation of cycle I meeting I on teacher activities obtained a percentage of 87.5% with good qualifications (B), and student activities obtained a percentage of 83.3% with good qualifications (B). Increased in cycle I meeting 2 on teacher activities obtained a percentage of 88.89% with good qualifications (B), and on student activities obtained a percentage of 88.89% with good qualifications (B). An increase also occurred in cycle II on teacher activities obtained a percentage of 94.44% with very good qualifications (SB), and on student activities obtained a percentage of 91.67% with very good qualifications (SB).

The improvement in learning outcomes of simple geometric nets can be seen from the knowledge and skill scores. In cycle I, meeting 1, the average knowledge and skill score was 67% with the predicate need guidance (D). It increased in cycle I, meeting 2, namely the average knowledge and skill score was 72.32% with the predicate (C). The increase also occurred again in cycle II, namely the average knowledge and skill score was 81.38% with the predicate (B). Based on this explanation, the RPPM, teacher and student activities, and learning outcomes of simple geometric nets using the PjBL model increased from cycle I to cycle II.

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