Educational Science Journal

Publisher: Sekolah Tinggi Olahraga dan Kesehatan Bina Guna

Journal Homepage: https://jurnal.stokbinaguna.ac.id/index.php/ESJ

e-ISSN: 3047-0986

The Implementation of Project-Based Learning Strategy to Improve Psychomotor Learning Outcomes of Underhand Passing in Volleyball for Grade X Students of SMKN 8 Semarang

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Received: 19-09-2026 Revised: 30-09-2026 Accepted: 01-10-2026

Abstract: This study aims to determine the effect of implementing the Project-Based Learning (PjBL) model on improving students' psychomotor skills in underhand volleyball passing in class X of SMKN 8 Semarang. This research was motivated by the low initial ability of students in basic volleyball skills, thus requiring an innovative, collaborative, and contextual learning strategy. The research method used is a quantitative approach with a one-group pretest-posttest experimental design. The research subjects consisted of 36 students selected using total sampling technique. Data were collected through observation, skill tests, and documentation. Data analysis was conducted using normality test, paired sample t-test, and N-Gain analysis. The results showed a significant improvement between pretest and posttest scores with a significance value of 0.001 ($p < 0.05$). The average N-Gain score was 36.69, which falls into the moderate category, indicating that the implementation of PjBL is quite effective in improving students' psychomotor skills. Therefore, the Project-Based Learning model can be used as an alternative to improve learning outcomes in Physical Education, especially in underhand passing skills in volleyball.

Keywords: Project-Based Learning; Underhand Passing; Volleyball; Psychomotor; Skill

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INTRODUCTION

Education is a very important aspect for society and is actively pursued by the government to improve the competence of Indonesian people to advance the nation and be able to compete with other countries (Yusuf Tirtana et al., 2022). Education is not only expected to keep pace with advances in science and technology but, most importantly, human resources must also develop in tandem with those advances (Masgumelar & Mustafa, 2021). Physical Education, Sports, and Health is an integral part of the overall national education system. The goal of physical education is not only to develop the physical domain but also to develop critical thinking skills, emotional skills, social skills, reasoning, and moral actions through physical and sports activities. Therefore, the implementation of physical education in schools must be directed toward achieving these goals.

Physical Education is a physical activity carried out through learning that is directed and encourages educators so that all potentials of students grow and develop to achieve a goal completely and comprehensively (Gunawan, 2023). In general, the goal of physical education taught in schools is to achieve the overall goals of education in all

development components. Physical education plays a very important role in intensifying the implementation of education as a process of human development that lasts a lifetime. Physical education provides opportunities for students to be directly involved in various learning experiences through physical activities, play, and sports carried out systematically, directed, and planned (Musitoh & Rijal, 2018).

Schools are institutions that prioritize human cultural values from the past, present, and future. Physical education is part of the curriculum provided from elementary to higher education levels. This is because physical education is part of the education system that aims to realize the complete Indonesian human being. Teachers are required to have competence, especially in managing the learning process to lead students to achieve the expected goals. Teachers must be able to design and manage creative and effective learning activities, in accordance with educational goals that refer to the general goals of education. It was stated that the goals of physical education must cover goals in the psychomotor, cognitive, and affective domains.

Physical education in secondary education is carried out through various materials that have been given systematically and planned. These include big ball games, small ball games, athletics, martial arts, and physical fitness. Big ball games are one of the competent things in the core of Physical Education, Sports, and Health learning; one of the big ball games is volleyball. Volleyball is a game that relies on teamwork (Baenuri & Alwi, 2025). Volleyball is a competitive sport that emphasizes team coordination and technical mastery, as well as the ability to read the opponent's game (Purwanto & Saparia, 2023). In volleyball, there are several basic techniques that must be mastered, namely passing, serving, blocking, and smashing. Volleyball is a team sport, so players must work together and support one another to form a cohesive team (Keswando et al., 2022) .

In teaching and learning activities, strategic efforts are needed, especially for PJOK teachers, to be able to bring students to a maximum level in capturing the materials during learning. The use of learning methods is also very important to ensure that learning can run well according to student characteristics. One learning model that can motivate students to learn is the PjBL (Project-Based Learning) model because this learning model emphasizes student activity in finding solutions and being able to solve problems in real life (Kajian). The project-based learning model provides great opportunities for students to explore their creativity, increase motivation, problem-solving skills, critical thinking skills, and collaboration skills (Shobirin, 2016). The PjBL model has enormous potential to provide interesting learning experiences for students in studying materials (Widadi et al., 2025).

Although numerous studies have examined the effectiveness of Project-Based Learning (PjBL) in general physical education settings, research specifically addressing its application to volleyball forearm passing (underhand passing) skills remains limited. Most existing studies on volleyball passing tend to focus on conventional drill-based methods or the use of small-sided games (Baenuri & Alwi, 2025; Keswando et al., 2022). For instance, Baenuri & Alwi (2025) investigated the use of play-based methods to improve volleyball passing skills, while Keswando et al. (2022) focused on surveying basic technical skills of volleyball athletes. However, these studies did not integrate a structured project-based approach that emphasizes student collaboration, contextual problem-solving, and autonomous learning. Furthermore, Agus Merta et al. (2025) applied PjBL to gymnastics (floor exercise) and found positive effects on psychomotor outcomes, but the specific context of volleyball passing has not been explored in depth. Therefore, this study offers a novel contribution by specifically examining the implementation of PjBL in teaching underhand volleyball passing to vocational high

school students, thereby filling a gap in the literature regarding the application of PjBL in specific volleyball technical skills. This novelty lies in the integration of project-based learning stages with the psychomotor domain of volleyball passing, which has not been extensively documented in previous research.

METHOD

This study uses a quantitative approach with an experimental method. The research design used is a one-group pretest-posttest design, which is research conducted by giving an initial test before treatment and a final test after treatment. This design is used to determine the improvement of students' underhand volleyball passing skills after implementing the Project-Based Learning (PjBL) strategy.

The research subjects were students of class X PPLG 1 SMK Negeri 8 Semarang who participated in PJOK learning on volleyball material. The sampling technique used total sampling, so all students in the class were used as research samples. The independent variable in this study is the PjBL learning strategy, while the dependent variable is underhand volleyball passing skills.

Research data were collected through observation, skill tests, and documentation. Observation was conducted to determine the initial condition of learning, while skill tests were conducted through pretest and posttest to measure students' abilities before and after treatment. Documentation was used as supporting data during the research process.

Stages of PjBL Implementation

The implementation of the Project-Based Learning (PjBL) model in this study followed a structured sequence of stages, adopted from the syntax of project-based learning (Shobirin, 2016; Widdai et al., 2025). The stages were as follows:

1. **Project Planning (Orientation and Problem Formulation):** In this initial stage, the teacher presented a contextual problem related to underhand volleyball passing. Students were divided into small groups (4–5 students per group) and were asked to identify the key elements of a successful underhand pass, such as body posture, hand positioning, and follow-through. Each group then formulated a project plan to create a short video tutorial or a peer-teaching module demonstrating the correct technique for underhand passing. The teacher facilitated discussions and ensured that each group had a clear and achievable plan.
2. **Project Execution (Investigation and Creation):** During this stage, students actively engaged in exploring the technique through various activities. They conducted self-assessments, peer observations, and video analysis of their own passing performance. Each group then worked collaboratively to produce their project output, which could be a video tutorial, a step-by-step poster, or a live demonstration. The teacher monitored progress, provided feedback, and encouraged students to solve problems encountered during the process, such as inconsistency in hand placement or body coordination. This stage emphasized active learning, collaboration, and contextual practice.
3. **Evaluation of Project Outcomes (Presentation and Reflection):** In the final stage, each group presented their project to the class. The presentation included a demonstration of the underhand passing technique and an explanation of the key points they had learned. A peer-assessment and teacher-assessment were conducted using a rubric that assessed psychomotor skills (technique accuracy, consistency, and control), collaboration, and presentation quality. Following the presentations, a

reflective discussion was held where students shared their experiences, challenges, and insights gained from the project. This reflection helped reinforce learning and allowed students to connect their project experience to the overall learning objectives.

The data obtained were analyzed quantitatively through normality test and hypothesis testing using paired sample t-test. In addition, N-Gain analysis was used to determine the level of improvement in students' skills after the implementation of PjBL. The analysis results were used to see the effect of the Project-Based Learning strategy on improving the psychomotor skills of underhand volleyball passing.

RESULT AND DISCUSSION

Result

This study aims to determine the effect of implementing Project-Based Learning (PjBL) on the psychomotor skills of underhand volleyball passing in class X students of SMKN 8 Semarang. Data were obtained through the implementation of underhand volleyball passing results conducted by students in the pre-test and post-test of the treatment. The analysis was conducted using normality test and hypothesis testing using paired sample t-test, then analyzed using N-Gain to determine the level of improvement in students' skills after the implementation of PJBL.

Table 1. Descriptive Statistics

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Pretest	36	79	90	85.44	2.843
Postest	36	84	98	90.67	3.338
Valid N (listwise)	36				

Based on the descriptive statistics presented in Table 1, the mean score of students' underhand volleyball passing skills increased from 85.44 in the pretest to 90.67 in the posttest, representing an increase of 5.23 points. The minimum score increased from 79 to 84, while the maximum score increased from 90 to 98. These results indicate an overall improvement in students' underhand volleyball passing skills following the implementation of Project-Based Learning (PjBL). Meanwhile, the standard deviation increased slightly from 2.843 in the pretest to 3.338 in the posttest, indicating a slightly greater variation in students' scores after the treatment.

Normality Test

The normality test was conducted to determine whether the data or variables to be analyzed have a normal distribution. In this study, data normality testing was carried out using the Kolmogorov-Smirnov test to ensure that the data met the normality assumption.

Table 2. Normality Test Results

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PRETEST	.117	36	.200*	.950	36	.104
POSTTEST	.162	36	.017	.955	36	.155

The normality test was conducted using the Shapiro-Wilk test. The test results showed that the pretest data had a significance value of 0.104 and the posttest data had a significance value of 0.155. Both significance values are greater than 0.05 ($p > 0.05$), so it can be concluded that the pretest and posttest data are normally distributed.

Hypothesis Testing

Hypothesis testing in this study was conducted using paired sample t-test to determine differences in learning outcomes before (pre-test) and after (post-test) treatment.

Table 3. Paired Sample T-Test Results

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Postest	-5.222	2.392	.399	-6.031	-4.413	-13.100	35	.000

Based on the descriptive statistics in Table 3, students' underhand volleyball passing scores showed an increase following the implementation of Project-Based Learning (PjBL). The mean score rose from 85.44 in the pretest to 90.67 in the posttest, indicating an improvement of 5.23 points. In addition, the minimum score increased from 79 to 84, while the maximum score increased from 90 to 98. The standard deviation changed from 2.843 in the pretest to 3.338 in the posttest, suggesting a slight increase in the variability of students' scores. A paired-samples t-test was subsequently performed to examine whether this difference was statistically significant.

The analysis revealed a significant difference between the pretest and posttest scores, with a mean difference of -5.222, $t(35) = -13.100$, $p < .001$, and a 95% confidence interval ranging from -6.031 to -4.413. The negative mean difference resulted from calculating the difference as pretest minus posttest, confirming that students obtained higher scores in the posttest. These results provide evidence of a significant improvement in students' underhand volleyball passing skills after participating in the PjBL-based learning process.

N-Gain Analysis Test

The N-Gain analysis test was conducted to determine the effectiveness of the treatment on students' psychomotor outcomes, carried out by comparing the pre-test and post-test results.

Table 4. N-Gain Results

No	N-Gain *Score* (%)
1	37.50
2	41.18
3	33.33
4	37.50
5	44.44

6	62.50
7	35.29
8	20.00
9	40.00
10	46.67
11	22.22
12	.00
13	21.43
14	27.27
15	27.27
16	42.86
17	28.57
18	28.57
19	42.86
20	41.18
21	12.50
22	33.33
23	.00
24	42.86
25	63.64
26	53.85
27	63.64
28	28.57
29	26.67
30	12.50
31	23.81
32	26.67
33	52.94
34	37.50
35	80.00
36	81.82
Mean	36.6924
Min	.00
Max	81.82
Std.dev	18.72

Based on the N-Gain analysis, the improvement in students' underhand volleyball passing performance differed across participants. The N-Gain scores ranged from 0.00% to 81.82%, with an average of 36.69% and a standard deviation of 18.72%. Among the 36 students, 15 students (41.67%) were categorized as having low improvement, while 19 students (52.78%) showed moderate improvement. Meanwhile, only two students (5.56%) reached the high-improvement category. This distribution suggests that the learning outcomes did not increase to the same extent for all students.

A closer examination of the individual scores revealed notable differences in the level of improvement. Two students obtained an N-Gain score of 0.00%, indicating that their posttest scores did not increase compared with their pretest scores. At the other end of the distribution, two students recorded N-Gain scores of 80.00% and 81.82%, respectively, reflecting substantial gains between the two measurements. Such

differences can be considered alongside students' initial performance. Students who had relatively high scores in the pretest had a smaller numerical range in which their scores could increase, whereas students with lower initial scores had more opportunity to obtain larger gains. Thus, the variation in N-Gain scores reflects differences in individual improvement between the pretest and posttest rather than a uniform pattern across the participants.

Discussion

The results of the study show that there is an improvement in the psychomotor outcomes of underhand volleyball passing after implementing the Project-Based Learning model. This improvement in psychomotor outcomes can be explained because the Project-Based Learning model provides opportunities for students to be actively involved in the learning process through contextual and project-based activities. In PJOK learning, especially in underhand volleyball passing material, student involvement is very important to develop psychomotor skills. The PjBL model allows students to learn through direct experience, work together in groups, and solve problems independently, so that it can improve students' understanding and skills optimally.

Theoretically, in the context of Physical Education, Sports, and Health (PJOK) learning, this approach is very relevant because it requires students to be active in moving, practicing, and interacting with the environment and their group members. Through these activities, students can develop psychomotor skills more optimally, while also improving critical thinking skills, cooperation, and responsibility (Munawarah & Prihandoko, 2025). This is in line with the research results of (Agus Merta et al., 2025) which show that the implementation of Project-Based Learning can improve PJOK learning outcomes, especially in students' psychomotor skills.

The results of this study also show that the improvement that occurred was not evenly distributed among all students. This is influenced by several factors, such as differences in students' initial abilities, level of learning motivation, and level of student participation in the learning process (Yuliawan et al., 2026). Students who have better initial abilities tend to understand the material more quickly and show more significant improvement compared to students who have lower initial abilities. In addition, learning motivation also plays an important role in determining student success, where students who have high motivation will be more active, enthusiastic, and serious in participating in learning activities. The level of student participation in project-based learning is also a determining factor, because the Project-Based Learning model demands active involvement in discussions, group work, and direct practice. Therefore, students who are less active or less involved tend to experience lower improvement. Special attention from teachers is needed in providing guidance, motivation, and adaptive learning strategies so that all students can obtain more equitable learning outcomes.

Nevertheless, this study has limitations in the sample used, namely only using 1 class with a total of 36 students, so the results of this study cannot be generalized widely to a larger population.

Overall, the results of this study are in line with the theory stating that learning models that are active, collaborative, and experience-based such as Project-Based Learning can improve student learning outcomes, especially in the skill aspect (Ananda, 2024). Thus, it can be concluded that the Project-Based Learning model has a positive contribution to improving students' psychomotor skills in PJOK learning.

CONCLUSION

Based on the results of the study and discussion, it can be concluded that the implementation of the Project-Based Learning (PjBL) model has a positive effect on improving the psychomotor skills of underhand volleyball passing in students. This improvement is shown through a significant difference between pretest and posttest results, and is supported by the N-Gain value which is in the moderate category, indicating that the learning applied is quite effective in improving student learning outcomes. In addition, the PjBL model has been proven to be able to encourage active student involvement, improve cooperation, and provide more meaningful learning experiences through project-based activities.

However, the improvement in learning outcomes that occurred has not been evenly distributed among all students, which is influenced by differences in initial abilities, learning motivation, and the level of student participation in learning. Therefore, efforts are needed from teachers to provide more intensive guidance and adaptive learning strategies so that all students can obtain optimal learning outcomes.

For further research, it is recommended to develop learning models combined with other approaches or applied to different materials and educational levels to obtain more maximal and equitable results. In addition, further research can also consider other factors that affect learning outcomes, such as aspects of motivation, interest, and student learning environment.

ACKNOWLEDGEMENTS

The authors would like to express their gratitude to all parties who have helped in the completion of this research, especially to the students of class X PPLG 1 SMK Negeri 8 Semarang who participated in this study, as well as to the supervising lecturers who provided guidance and direction.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the research and publication of this article.

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