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The effectiveness of problem-based learning strategy in improving fundamental athletic skills among physical education students: A quasi-experimental study

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ABSTRACT

Mastery of basic athletic techniques is important for physical education students, but learning is often lecture-centered. This study aims to determine the effect of Problem-Based Learning (PBL) on students' mastery of basic athletic techniques. This study used a Pretest–Posttest Control Group Design. A total of 40 students were divided into an experimental group (n = 20) and a control group (n = 20). The experimental group learned with PBL, while the control group used conventional learning. Data was collected through athletic skills tests and analyzed using t-tests and N-Gain at a significance level of 0.05. The experimental group's score increased from 61.35 to 84.70, while the control group's score increased from 60.90 to 73.15. The test results showed a significant difference between the two groups ($p < 0.05$). The N-Gain value of the experimental group (0.61) was also higher than that of the control group (0.31). These results indicate that PBL is more effective than conventional learning in improving mastery of basic athletic techniques through active involvement and problem solving.

Keywords: Problem-Based Learning, athletics, basic techniques, learning outcomes, physical education

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INTRODUCTION

Physical education in higher education plays a strategic role in shaping students' professional competencies, particularly in mastering sports skills that will equip them as future educators and sports practitioners (Em et al., 2026; Østerlie et al., 2025). One of the foundational subjects in sports education is athletics (Wijanarko et al., 2023). Athletics is known as mother of sports Because the basic movements it contains, such as walking, running, jumping, and throwing, form the basis for various other sports (Hartoto et al., 2021) (Akhmad et al., 2021). Therefore, mastering basic athletic techniques is an essential competency that students in physical education and sports programs must possess (Alfarisyi et al., 2025; Reno et al., 2022).

Ideally, the athletics learning process in higher education should not only focus on achieving motor skills but should also develop students' critical thinking, problem-solving, collaboration, and reflection skills (Dwihandaka et al., 2025). The 21st-century learning paradigm demands a transformation from a lecturer-centered learning approach (teacher-centered learning) towards student-centered learning (student-centered learning) In this context, students are expected not only to be recipients of information, but also to actively build knowledge through meaningful and contextual learning experiences (Durmuş, 2025).

However, the reality on the ground shows that athletic learning is still dominated by demonstration methods and repetitive practice (drill method) which places the lecturer as the

primary source of knowledge (Silva, 2023; Santoso et al., 2024). This learning model tends to focus on mechanical mastery of techniques without providing sufficient opportunities for students to understand the scientific reasons behind a movement, analyze technical errors, or find solutions to problems that arise during practice (Wibowo et al., 2022). As a result, students often have difficulty applying technical concepts independently, are less able to evaluate their movement performance, and demonstrate relatively low learning engagement (Kuncoro et al., 2022).

This issue becomes increasingly important given the characteristics of athletic learning, which demands the integration of cognitive, affective, and psychomotor aspects. According to the constructivist theory proposed by (Stoltz et al., 2024), knowledge will be more meaningful when actively constructed by students through experience, social interaction, and authentic problem-solving. From this perspective, students need to be given opportunities to explore real-world problems related to athletic technique so they can develop a deeper conceptual understanding and practical skills.

One learning approach that is relevant to these demands is Problem-Based Learning (PBL) (Ismawan et al., 2024). PBL is a learning model that uses real-world problems as the starting point for the learning process to develop critical thinking, problem-solving, communication, and independent learning skills. Through PBL, students are encouraged to identify problems, seek relevant information, analyze various alternative solutions, and implement the chosen solution (Dupri et al., 2019; Wijaya et al., 2023). In athletics learning, problems can include errors in movement technique, low movement efficiency, or a mismatch between biomechanical principles and the student's technique implementation.

Theoretically, the application of PBL in sports learning can improve the quality of the learning process because students are actively involved in constructing knowledge and skills (Safitri et al., 2023). This model allows students to understand the relationship between theory and practice more comprehensively. Furthermore, the discussion and reflection processes characteristic of PBL can help students develop analytical skills in evaluating movement techniques, thus orienting learning not only toward results but also toward the ongoing process of competency development.

Various previous studies have shown that PBL has a positive influence on improving learning outcomes in various educational fields. Research in physical education has found that the implementation of PBL can improve students' critical (Ishak & Imran Hasanuddin, 2025) thinking skills, learning motivation, active participation, and understanding of movement concepts. Other studies have also shown that problem-based learning can improve students' ability to identify and correct errors in sports techniques through a systematic process of investigation and reflection (Utami et al., 2025). However, most research still focuses on cognitive and motivational aspects, while studies specifically examining the effect of PBL on students' mastery of basic athletic techniques are still relatively limited (Ningsih et al., 2024).

The limitations of previous research indicate that there is a research gap (research gap) that needs attention. To date, there have been few studies that empirically evaluate the effectiveness of PBL learning strategies in improving mastery of basic athletic techniques among physical education students in Indonesian universities. However, the ability to master basic athletic techniques is an important indicator in developing the professional competence of prospective physical education teachers. Therefore, research is needed that can provide scientific evidence regarding the contribution of PBL to improving the quality of athletics learning.

This research offers novelty (novelty) through the application of learning strategies Problem-Based Learning in the context of learning basic athletic techniques in higher education by integrating movement error identification activities, simple biomechanical analysis, group discussions, and practical reflection. This approach is expected to produce a more meaningful learning experience than the conventional learning methods currently used. In addition to providing theoretical contributions to the development of physical education learning models, this research is also expected to serve as a practical reference for lecturers in designing more innovative and effective learning strategies.

Based on this description, the aim of this study is to analyze the influence of learning strategies. Problem-Based Learning on students' mastery of basic athletic techniques.

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Specifically, this study aims to determine the extent to which the application of PBL can improve students' ability to master basic athletic techniques compared to learning using conventional approaches. The results of this study are expected to enrich the body of knowledge in the field of sports pedagogy and support the implementation of learning that is more adaptive to the demands of 21st-century education.

METHOD

This research uses a quantitative approach with a quasi-experimental method (quasi-experimental research) and design Pretest–Posttest Control Group Design. This design was chosen to test the influence of learning strategies (Sugiyono, 2023). Problem-Based Learning (PBL) on students' mastery of basic athletic techniques by comparing the learning outcomes of the experimental group and the control group.

The research subjects were 40 Physical Education students taking the Basic Athletics course in the even semester of the 2025/2026 academic year. Subject selection was carried out using the purposive sampling with the following criteria: (1) active students registered in the Basic Athletics course, (2) following the entire learning series during the research, and (3) willing to be research respondents. Furthermore, the subjects were divided into two groups that had relatively equivalent initial ability characteristics, namely the experimental group (n = 20) who received learning using the strategy Problem-Based Learning and the control group (n = 20) who received conventional learning based on demonstration and practice (drill).

The study was conducted over eight weeks with a total of 16 meetings. In the initial stage, both groups were given a pre-test (pretest) to measure basic athletic technique abilities before treatment was given. The experimental group then followed activity-based learning. Problem-Based Learning which includes the stages of problem orientation, learning organization, group investigation, solution development and presentation, and reflection and evaluation. Meanwhile, the control group followed conventional lecture-centered learning through lecture methods, technique demonstrations, and repeated practice. After all treatments were completed, both groups were given a final test (posttest) using the same instrument as the initial test.

The research instruments consisted of a basic athletics skills test and a learning implementation observation sheet. The skills test was used to measure mastery of basic techniques in running, jumping, and throwing through a performance assessment rubric covering the initial stance, movement execution, and final stance. Each indicator was assessed on a scale of 1–5, resulting in a quantitative score reflecting the student's level of skill mastery.

The validity of the instrument content is evaluated through expert judgment involving three experts in athletic learning and physical education methodology (Gould et al., 2021; Manshuralhudlori et al., 2025). The analysis results showed Aiken's V values ranging from 0.84 to 0.95, which meet the very valid category. Reliability testing was conducted using Cronbach's Alpha coefficient and obtained a value of 0.91, indicating very high reliability. To ensure the objectivity of the assessment, the skills measurement process was conducted by two assessors who had received training in the use of the assessment rubric.

Data collection was carried out through preliminary tests (pretest), observation of the learning process, and final test (posttest). The data obtained were then analyzed using descriptive statistics to describe the mean, standard deviation, minimum score, and maximum score. Before hypothesis testing was carried out, the data were first tested for normality using the Shapiro–Wilk test and for homogeneity of variance using the Levene test. The influence of learning strategies Problem-Based Learning on mastery of basic athletic techniques was analyzed using a test Independent Sample t-test on the improvement score (gain score) of both groups at a significance level of 0.05. The magnitude of the effectiveness of the treatment was calculated using Normalized Gain (N-Gain) And Effect Size (Cohen's d) to determine the level of improvement and strength of influence of the applied learning strategies. All data analysis was conducted using SPSS version 27 software.

This research uses a pretest-posttest control group design (Table 1). This design was chosen because it is able to control the influence of external factors, compare changes between groups,

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and produce more convincing empirical evidence regarding the effectiveness of the strategy. Problem-Based Learning towards students' mastery of basic athletic techniques.

Table 1. Research design

Group	Pretest	Treatment	Posttest
Experiment (n=20)	THE_1	PBL (X)	THE_2
Control (n=20)	THE_2	Conventional (C)	THE_4

Note: O_1 and O_3 = Initial test (*pretest*); X = Learning *Problem-Based Learning*; C = Conventional learning; O_2 and O_4 = Final test (*posttest*)

FINDINGS AND DISCUSSION

Findings

This study aims to analyze the influence of learning strategies Problem-Based Learning (PBL) on students' mastery of basic athletic techniques. A total of 40 students participated in the study, divided into an experimental group (n = 20) and a control group (n = 20). Data analysis was conducted on pretest and posttest scores for mastery of basic athletic techniques.

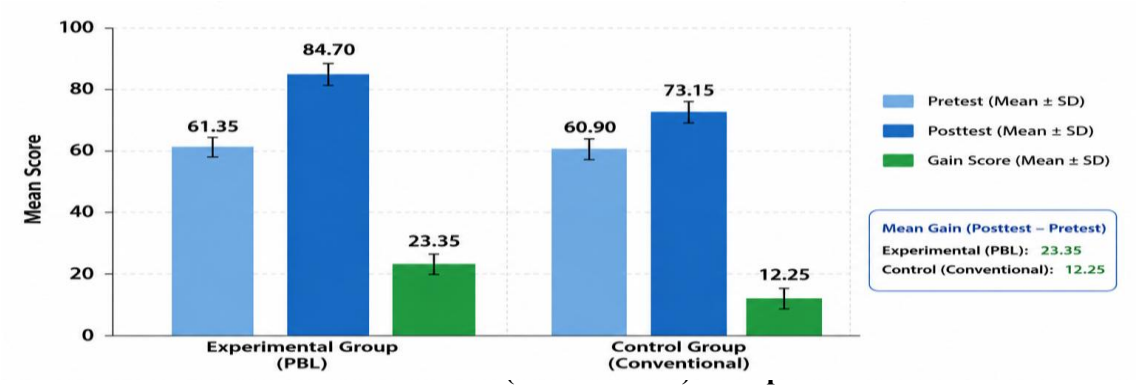
Research data description

The results of the descriptive analysis showed an increase in basic athletic technique abilities in both groups, but a higher increase occurred in the experimental group which received treatment using the strategy (See Table 2).

Table 2. Descriptive statistics of basic athletic technique mastery scores

Group	N	Pretest (Mean ± SD)	Posttest (Mean ± SD)	Gain Score
Experiment (PBL)	20	61.35 ± 6,24	84,70 ± 5,82	23,35
Control (Conventional)	20	60,90 ± 5,97	73,15 ± 6,41	12,25

Based on Table 2, the average pretest score for the experimental group was 61.35 and increased to 84.70 in the posttest. Meanwhile, the control group's score increased from 60.90 to 73.15. These results indicate that the experimental group's basic athletic technique skills improved significantly compared to the control group.



Prerequisite analysis test results

Before hypothesis testing is carried out, the data is first tested for normality and homogeneity.

Normality test

The normality test using Shapiro–Wilk shows that all data has a significance value greater than 0.05 so that it is normally distributed.

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Table 3. Normality test results

Variables	Say
Experiment Pretest	0,211
Experiment Posttest	0,186
Pretest Control	0,238
Posttest Control	0,154

The significance value of all groups is greater than 0.05 so that the data meets the assumption of normality.

Homogeneity test

The results of the Levene test showed a significance value of 0.417 ($p > 0.05$), which means that the variance of the two groups was homogeneous.

Once the assumptions of normality and homogeneity are met, the analysis can be continued using parametric tests.

Hypothesis test results

Hypothesis testing is carried out using Independent Sample t-tests on the improvement score (gain score) of both groups.

Table 4. Results of independent sample t-Test

Variables	t	Sig. (2-tailed)
Gain Score	5,873	0,000

The analysis results showed a significance value of 0.000 ($p < 0.05$). Thus, there was a significant difference between the experimental and control groups in mastery of basic athletic techniques after treatment.

These results indicate that the learning strategy Problem-Based Learning provides a significant influence on improving students' mastery of basic athletic techniques compared to conventional learning.

N-Gain analysis

To determine the level of learning effectiveness, an N-Gain analysis was carried out.

Table 5. N-Gain results

Group	N-Gain	Category
Experiment (PBL)	0,61	Medium-High
Control (Conventional)	0,31	Currently

The N-Gain value of the experimental group was 0.61, indicating higher learning effectiveness compared to the control group, which obtained an N-Gain value of 0.31.

Analisis effect size

The magnitude of the influence of learning strategies is calculated using Cohen's d.

Table 6. Hasil effect size

Variables	Cohen's	Interpretation
Gain Score	1,42	Big Influence

Cohen's d value of 1.42 indicates that the learning strategy Problem-Based Learning has a big influence on improving students' mastery of basic athletic techniques.

Overall, the research results show that students who participate in learning use strategies Problem-Based Learning achieved greater improvements in basic athletic technique skills

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compared to students who participated in conventional learning. This finding was demonstrated by improved posttest scores, higher N-Gain values, and statistical test results showing significant differences between the two groups.

Further research results

Improving mastery of basic athletic techniques based on indicators

Further analysis was conducted to determine the improvement in mastery of basic athletic techniques in each indicator, including running, jumping and throwing.

Table 7. Comparison of scores for each basic athletics technique indicator

Indicator	N	Pretest	Posttest	Gain
Running Technique	Experiment	62,10	86,25	24,15
	Control	61,85	74,30	12,45
Jumping Technique	Experiment	60,85	84,60	23,75
	Control	60,40	72,85	12,45
Throwing Technique	Experiment	61,10	83,25	22,15
	Control	60,45	72,30	11,85

Based on Table 7, all indicators improved after the treatment. The highest improvement in the experimental group occurred in running technique, with a gain of 24.15 points, followed by jumping technique with 23.75 points, and throwing technique with 22.15 points. Meanwhile, the control group showed lower improvements in all indicators. These findings indicate that the strategy *Problem-Based Learning* provides a greater impact on mastery of basic athletic movement skills than conventional learning.

Visualization of learning outcome improvement

A comparison of the average pretest and posttest scores of the two groups showed different patterns of improvement. The experimental group experienced a sharper improvement than the control group.

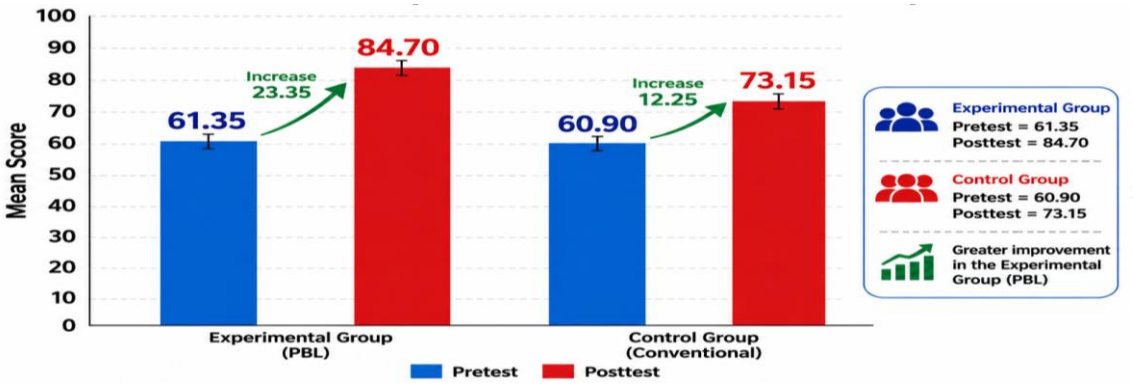


Figure 2. Comparison of Pretest and Posttest Scores between the Experimental and Control Groups

The experimental group receiving Problem-Based Learning showed a greater improvement in athletics basic technique mastery than the control group receiving conventional instruction.

Discussion

The results of the study show that the learning strategy Problem-Based Learning significantly influence students' mastery of basic athletic techniques. This finding is indicated by the difference in posttest scores between the experimental and control groups, the higher N-Gain value in the experimental group, and the statistical test results showing a significant difference at the $\alpha = 0.05$ level.

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The improvement in mastery of basic athletic techniques in the experimental group can be explained through the perspective of constructivism theory, which states that knowledge is actively constructed by students through learning experiences and interactions with the environment. In problem-based learning, students not only receive information from lecturers but also engage in the process of identifying movement problems, analyzing the causes of technical errors, finding solutions, and testing those solutions through direct practice. This process allows for deeper knowledge construction, making the acquired skills more meaningful and lasting.

The findings of this study indicate that students who learn using strategies Problem-Based Learning Students are better able to understand the principles of basic athletic techniques than students who participate in conventional learning. The group discussion, movement observation, reflection, and problem-solving activities that are key characteristics of PBL provide students with the opportunity to connect theoretical concepts with direct practical experience. As a result, students not only learn how to perform a movement but also understand the biomechanical reasons behind its execution.

The greatest improvement was found in running technique indicators. This indicates that the problem-based approach helps students identify and correct movement errors more effectively. When students are confronted with real-world problems, such as incorrect body position during acceleration or incorrect arm-leg coordination, they are encouraged to critically analyze and find appropriate solutions through discussion and field practice.

The results of this study are in line with various recent studies which report that Problem-Based Learning can improve students' learning outcomes in sports skills, critical thinking skills, and problem-solving abilities. Recent research in physical education shows that PBL encourages students' active engagement in the learning process, increases intrinsic motivation, and strengthens reflective skills in evaluating movement performance. Furthermore, PBL implementation has also proven effective in developing 21st-century competencies including collaboration, communication, creativity, and critical thinking.

From a sports pedagogy perspective, the success of a strategy Problem-Based Learning This study demonstrates that athletics learning can no longer be achieved solely through demonstrations and repetitive exercises. Students need to be involved in learning situations that require exploration, analysis, and problem-solving so that the technical skills acquired are not merely mechanical but are accompanied by a strong conceptual understanding. Therefore, the application of PBL can be an alternative, innovative learning strategy that supports improving the quality of physical education in higher education.

Practically, the findings of this study imply that athletics instructors need to integrate problem-solving, motion analysis, and reflection into the learning process. This approach can improve the quality of students' learning experiences while strengthening their mastery of basic athletic techniques more effectively than conventional approaches. Therefore, this strategy Problem-Based Learning is recommended as a learning model that can be applied in athletics courses to improve the competence of physical education students.

CONCLUSION

This research proves that learning strategies Problem-Based Learning (PBL) significantly influences students' mastery of basic athletic techniques. The results showed that the experimental group receiving PBL-based learning experienced a higher increase in learning outcomes compared to the control group receiving conventional learning. The average score of the experimental group increased from 61.35 in the pretest to 84.70 in the posttest, while the control group increased from 60.90 to 73.15. This difference indicates that the implementation of PBL is more effective in improving students' mastery of athletic skills.

Improvements were seen across all athletic skill indicators, including running, jumping, and throwing techniques, with the highest improvement found in running techniques. These findings indicate that problem-based learning can encourage students to more actively identify, analyze, and correct technical errors through investigation, discussion, reflection, and hands-on

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practice. Thus, learning not only improves psychomotor skills but also strengthens students' conceptual understanding and critical thinking skills.

Theoretically, this study reinforces the constructivist view that sports skills develop more optimally when students are actively involved in authentic problem-solving processes. Practically, the research results provide empirical evidence that Problem-Based Learning can be used as an innovative learning strategy in athletics courses to improve the quality of learning processes and outcomes in higher education. Therefore, physical education lecturers are advised to integrate a problem-based approach into athletics learning to support the development of more comprehensive student competencies in line with the demands of 21st-century learning.

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