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Effect of positive reinforcement on underhand passing skills among secondary school students

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Abstract

Learning basic volleyball skills, particularly underhand passing, often presents challenges such as inconsistent movement execution and low student motivation. These issues highlight the need for instructional approaches that support both technical development and engagement. This study examines whether positive reinforcement can improve underhand passing performance among junior high school students. A quasi-experimental pre-test–post-test control group design was applied to 72 students aged 13–14 years, who were assigned to either an experimental or control group. Following tests of normality and homogeneity, paired and independent sample t-tests were used to analyze performance changes. The experimental group showed a 16.43% improvement, compared with 11.50% in the control group, and only the experimental group demonstrated a statistically significant gain. These findings suggest that positive reinforcement, such as verbal praise after correct arm contact or immediate acknowledgement following consistent passing repetitions, may contribute to more stable movement execution, sustained attentional focus, and greater student engagement. By addressing the limited number of experimental studies on reinforcement-based learning in volleyball passing skills, this study extends motor learning theory by providing evidence on how reinforcement supports feedback processing, movement pattern stabilization, and motivational learning environments. Practically, the results offer physical education teachers concrete guidance for integrating reinforcement-based strategies into school-based volleyball instruction.

Keywords: Positive reinforcement, volleyball, underhand passing, learning outcomes, physical education.

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INTRODUCTION

Physical education is crucial for fostering students' physical, social, emotional, and cognitive growth through structured movement activities, and when implemented effectively, it promotes motor competence and long-term healthy lifestyle habits (Parwata, 2021). However, the Indonesian physical education landscape continues to face escalating obstacles. National surveys and school-based assessments consistently reveal diminishing student engagement, erratic motor skill development, and restricted instructional diversity in PJOK classrooms. Many of these issues stem from teacher-centred instructional patterns that rely heavily on technical correction but provide limited psychological support or feedback mechanisms that sustain confidence and perseverance (Adjie Mas Achmad Nur Aulia Arifaen et al., 2020; Giartama et al., 2020; Sudaryanti et al., 2024). In such environments, students often experience performance anxiety, reluctance to try new movement patterns, and low motivation during practice. These challenges underscore the need for instructional approaches that not only improve motor performance but also strengthen students' emotional readiness, self-assurance, and willingness to engage actively in learning.

A fundamental issue underlying these challenges is the insufficient provision of psychological support, which refers to teacher actions that help students regulate emotions, overcome fear of failure, and feel secure when experimenting with skill execution (Litem et al., 2022). Psychological support may include encouraging remarks, reassurance after errors, or error-tolerant guidance. When this support is absent, students tend to experience heightened anxiety, decreased persistence, and inconsistent technical performance. Consequently, there is a clear need for pedagogical strategies that effectively integrate motor learning principles with motivational and emotional support.

One widely supported instructional strategy capable of meeting these needs is positive reinforcement. Positive reinforcement refers to the intentional delivery of affirmative responses such as commendation,

supportive gestures, or encouraging feedback after students perform desired behaviors, thereby increasing the likelihood of repetition (Magill & Anderson, 2024; Wulf & Lewthwaite, 2021). In physical education contexts, reinforcement may appear in the form of verbal affirmations, smiles, approval gestures, symbolic prizes, or teacher support that recognizes students' process-oriented efforts. Recent Indonesian and international studies have shown that reinforcement enhances students' intrinsic motivation, persistence, and readiness to refine skills even when mistakes occur (Peralta et al., 2023; Utama et al., 2023). Global evidence further suggests that regular reinforcement improves coordination, movement precision, and engagement across net games and technical sports (Kurniawan et al., 2022; Lau et al., 2021; Mariati & Nugroho, 2024). Conversely, punitive or error-centric feedback has been shown to increase movement anxiety, reduce exploratory behavior, heighten muscle tension, impede motor planning, and ultimately hinder skill acquisition (Harris et al., 2023; Martinez et al., 2024).

Within volleyball instruction, underhand passing is a core motor skill essential for both offensive initiation and defensive continuity. Despite its importance, many Indonesian students struggle to perform the skill consistently. School-based studies indicate that limited individualized feedback, a lack of reinforcement during practice, and learning environments that do not encourage experimentation contribute to inconsistent performance (Syahruddin, 2022). Emerging evidence strengthens this understanding. Utami et al. (2021) found that structured verbal reinforcement reduced movement variability by 12–18% among junior high school students practicing passing. Permana et al. (2025) similarly reported improvements in passing accuracy when reinforcement was provided consistently. These findings demonstrate that reinforcement is not only a theoretical concept but also produces measurable improvements in movement stability.

International evidence from net games further supports this pattern. Reinforcement has been shown to enhance repetition frequency and

accelerate motor adaptation in badminton strokes (Zhao et al., 2024), stabilize footwork and timing in table tennis rallies (Nikolakakis et al., 2020), and improve forehand mechanics while reducing execution errors in tennis (Zhang & Gan, 2025). Collectively, these studies indicate that reinforcement contributes both to motivational processes and technical refinement across net-based sports.

From the perspective of motor learning theory, reinforcement helps learners stabilize movement patterns, enhance biomechanical precision, and reduce execution variability through focused and accurate repetition (Magill & Anderson, 2024; Schmidt & Lee, 2019). Reinforcement also creates psychologically secure learning environments that allow students to make mistakes without embarrassment, maintain concentration, and engage in motor adaptation more effectively (Harahap et al., 2025). These combined dynamics illustrate how emotional readiness, confidence, and attentional focus can translate into improved outcomes in volleyball underhand passing.

Given these conditions, this study aims to investigate the effects of positive reinforcement on underhand passing performance among junior high school students. Using a quasi-experimental design that involves an experimental and a control group, the study examines performance changes and determines whether reinforcement-based instruction leads to measurable improvements. The findings are expected to contribute to motor learning theory by clarifying how reinforcement influences movement pattern stabilization, attentional concentration, and variability reduction. Practically, the study aims to offer physical education teachers concrete, evidence-informed strategies for improving students' technical skills through more supportive, motivating, and humanistic instructional practices.

METHOD

This study employed a quasi-experimental pre-test–post-test design with class-level randomization, a method widely recommended for school-based physical education research where intact classes function as

natural clusters and individual-level randomization is not feasible (Asmawi et al., 2024; Creswell & Clark, 2018). This design enables the clear observation of changes in motor performance before and after treatment, aligning well with motor learning evaluations, where improvements are more readily detected through repeated measurements (Schmidt & Lee, 2019). The methodological structure, therefore, provides a robust foundation consistent with contemporary experimental standards in physical education.

The sample consisted of 72 eighth-grade students from four intact junior high school classes. Cluster random sampling was applied because class structures made individual random assignment impracticable (Koolwijk et al., 2024; Sturm et al., 2021). Two classes, each comprising students aged 13–14 with comparable schedules and previous exposure to volleyball, were selected using a computerized random generator and subsequently assigned randomly to experimental and control groups (36 students per group). Class size, school scheduling, and prior volleyball experience were considered during the sampling process. To ensure that the two groups began from equivalent starting points, baseline equivalence was assessed using independent t-tests for pre-test scores and chi-square tests for demographic variables, all of which revealed no significant differences in age, fundamental volleyball experience, or initial skill level. This sampling procedure strengthens internal validity and maintains ecological relevance for school-based motor skill interventions.

Three instruments were used to assess learning processes and outcomes. Students' perceptions of the learning experience were measured using the Formative Class Evaluation (FCE), an instrument with acceptable internal consistency within Indonesian secondary school populations ($\alpha > .70$) (Cohen et al., 2010). Teaching–learning interactions and behavioral indicators were documented using the Dikjasor structured observation sheet, completed by three trained observers. Inter-observer reliability in this study was calculated using Cohen's Kappa ($\kappa = .82$) and the intraclass correlation coefficient (ICC = .87) based on total session

scores, indicating strong agreement and suitability for physical education contexts (Rink, 2019). Psychomotor performance was evaluated with the Brumbach Forearms Pass Wall–Volley Test, a standardized instrument validated for teenage volleyball players and recognized for its strong test–retest reliability in assessing underhand passing ability (Suriadi & Dewi, 2020).

The intervention was delivered across five to six sessions of equal duration. The experimental group received structured positive reinforcement in the form of verbal praise, supportive gestures, and symbolic acknowledgement immediately after correct technique execution. In contrast, the control group received the same instructional content without systematic reinforcement, consistent with common school practices (Magill & Anderson, 2024). This ensured that reinforcement was the only differing variable between groups. Observers monitored student behavior and technical performance during each session to maintain fidelity and ensure consistent implementation. The instructional sequence incorporated demonstration, guided practice, repeated drills, and timely feedback, reflecting recognized motor learning principles.

Data analysis followed standard parametric assumptions. Normality was assessed using the Shapiro–Wilk test and homogeneity of variance using Levene's test (Field, 2018). Once assumptions were met, paired sample t-tests were conducted to examine within-group performance changes, while independent sample t-tests compared differences between the two groups. The significance level was set at $\alpha = .05$, and the effect size (Cohen's d) was calculated to provide an estimate of the magnitude of the intervention's impact. Together, these analytical techniques align with established guidelines for evaluating performance changes in physical education research.

RESULT

This section discusses the research results based on the analysis of data contained in the source manuscript. The entire description focuses on numerical findings without including theory or reference citations.

Table 1. Normality test

Variable	Kolmogorov-Smirnov Z	Sig. (2-tailed)
Pre-test	0.899	0.393
Post-test	0.751	0.625

Table 2. Homogeneity test

Variable	Calculated F	F_{table}	Dk	Description
Pre-test	1.099	2.04	70	Homogeneous
Post-test	2,063	2.75	70	Homogeneous

Table 2 displays the outcomes of the homogeneity analysis for pre-test and post-test scores. The Shapiro–Wilk test was employed to evaluate normality in a sample of N = 72 students. The results demonstrated that the pre-test and post-test data in both groups yielded significant values ($p < 0.05$), affirming that the score distributions satisfied the normality assumption. Additionally, the homogeneity test revealed that the computed F-values for the pre-test (F = 1.099) and post-test (F = 2.063) were inferior to the corresponding F-table values, signifying homogeneous variances among groups. The satisfaction of both normality and homogeneity assumptions justifies the application of parametric statistical tests, enabling the use of paired sample and independent sample t-tests for subsequent hypothesis testing.

Table 3. Paired sample t-test

Group	Calculated t	t_{table}	Conclusion
Experimental	6.683	2.02	Significant
Control	0.770	2.02	Not significant

Table 3 presents the results of the paired sample t-test for both groups. In the experimental group, the mean score increased from M = 62.14 (pre-test) to M = 72.34 (post-test), indicating a substantial improvement in underhand passing performance. The paired t-test yielded a t-count of 6.683, which exceeds the t-table value of 2.02, confirming a statistically significant difference. The calculated effect size (Cohen's d = 1.12) falls within the large-effect category, indicating that the positive reinforcement treatment had a strong practical impact on students' skill improvement. In contrast, the control group showed a slight increase from M = 61.87 (pre-test) to M = 63.02 (post-test). The t-count of 0.770, which is smaller than the t-table value of 2.02, indicates that this change was not

statistically significant. These results show that regular instruction without reinforcement did not lead to meaningful improvement in underhand passing ability.

Table 4. Independent sample t-test

Group	Calculated t	t_{table}	Conclusion
Experimental vs. Control	3.222	2.00	Significant

The comparison of the increase between the experimental and control groups shows that the t-value of 3.222 is greater than the t-table value of 2.00, indicating a significant difference between the two groups.

Table 5. Percentage increase in underhand passing ability

Group	**Pre-test**	**Post-test**	**Improvement (%)**	**Conclusion**
Experiment	–	–	**16.43**	High increase
Control	–	–	**11.50**	Low increase

Table 5 presents the percentage increase in underhand passing ability for both groups, calculated using the formula (post-test − pre-test) / pre-test × 100 %. The experimental group achieved an improvement of 16.43%, while the control group reached 11.50%, indicating a noticeably greater gain in the group receiving positive reinforcement. This difference demonstrates that the intervention produced a more substantial progression in skill mastery compared to regular instruction. The higher percentage increase in the experimental group aligns with the study's objective to evaluate whether positive reinforcement could enhance performance outcomes more effectively than conventional learning. These findings reinforce that consistent reinforcement contributed to more meaningful skill development, whereas the control group's lower increase reflects limited improvement without structured motivational support.

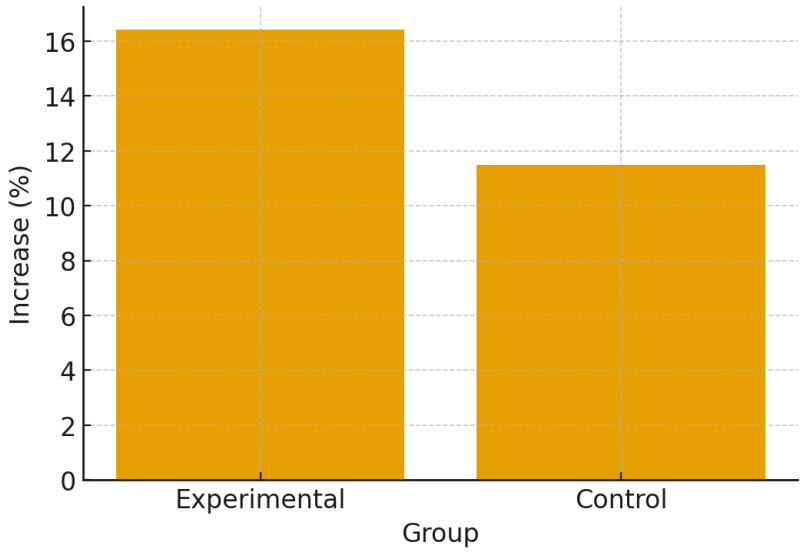

Figure 1. Graph of Improvement in Underhand Passing Results

The graph illustrates the percentage enhancement in underhand passing performance for both groups, corroborating the numerical findings displayed in the table. The experimental group exhibited a 16.43% rise, whereas the control group displayed an 11.50% increase, leading to an absolute difference of 4.93 percentage points between the groups. This disparity signifies that pupils who received positive reinforcement exhibited a more substantial enhancement compared to those who underwent standard teaching. In addition to visual comparison, the significance of this rise is practically relevant in physical education learning, as an enhancement of approximately five percentage points indicates substantial improvements in movement consistency and technical execution throughout practice sessions. This rise is expected to be evident in actual educational environments, underscoring the intervention's practical significance. The integrated display of the table and graph offers compelling evidence that positive reinforcement led to a more significant enhancement in underhand passing performance than traditional learning methods.

Overall, the results showed a consistent pattern of improvement in the group that received positive reinforcement. From the normality test,

homogeneity test, paired t-test, to the between-groups t-test, all analysis results supported the main finding that positive reinforcement had an effect on the effectiveness of underhand passing learning.

DISCUSSION

The results showed that the experimental group improved their underhand passing performance by 16.43%, compared with an 11.50% rise in the control group. This trend indicates that learning strategies incorporating positive reinforcement may meaningfully contribute to technical improvements by influencing key motor-learning processes. Reinforcement guides students' attention toward task-relevant cues, reduces unnecessary movement variability, and supports the maintenance of correct motor patterns through repeated successful execution (Anderson et al., 2021; Wulf & Lewthwaite, 2021). When verbal or nonverbal rewards are delivered immediately after accurate movements, students become more motivated to repeat efficient techniques, resulting in more stable and refined performance over time. Reinforcement also aids the detection and correction of errors by helping students distinguish effective from ineffective movement patterns, allowing them to adjust their execution more precisely in subsequent attempts. These patterns align with evidence that supportive feedback environments enhance intrinsic motivation and sustain learner engagement throughout physical education tasks (Peralta et al., 2023). The improvements observed in the experimental group, therefore, reflect an adaptive motor response shaped by heightened attentional focus, emotional readiness, and better-quality practice opportunities promoted through positive reinforcement.

The paired sample t-test analysis reinforces this pattern, revealing a significant change in the experimental group's pre-test and post-test scores. In contrast, the control group showed no comparable progress. Mean scores increased from M = 62.14 to M = 72.34 in the experimental group but shifted minimally from M = 61.87 to M = 63.02 in the control group. This outcome suggests that conventional instruction lacking reinforcement procedures struggles to produce meaningful performance

gains within a short instructional timeframe. Motor learning research suggests that students require positive feedback to enhance motor planning and progressively correct technical inaccuracies (Burton et al., 2021). Without such reinforcement, learners practice without clear information about the correctness of their execution, limiting their capacity to develop effective motor programs and reduce execution errors. This interpretation is supported by national studies showing that repetitive, monotonous instruction with limited variation in feedback contributes to decreased motivation and weak progress in technical actions, such as underhand passing (Purnama et al., 2023). The minimal improvement in the control group is therefore consistent with learning environments that fail to provide adequate informational and motivational stimuli needed to support motor development.

The independent sample t-test further demonstrated a significant difference in improvement between groups, suggesting that the reinforcement-based approach may contribute to better proficiency in underhand passing. Although the findings do not establish direct causality, the pattern aligns with previous research showing that frequent positive reinforcement can enhance movement accuracy and motor coordination by strengthening correct responses through quick feedback cycles (Zhou et al., 2021). In this study, higher Formative Class Evaluation (FCE) scores and clearer behavioral indicators such as more stable arm positioning, improved footwork control, and reduced hesitation during ball contact offer empirical indications of the mechanism at work. These behavioral markers reflect increased confidence and reduced error-related anxiety, enabling students to execute skills with greater precision. Such outcomes align with evidence that emotionally supportive learning environments foster better repetition quality and expedite skill acquisition (Gonz & Zurita-ortega, 2019). Taken together, the performance discrepancy between groups represents an interaction of cognitive, emotional, and behavioral factors encouraged by positive reinforcement, rather than the influence of the intervention alone.

This study presents encouraging evidence regarding the potential advantages of positive reinforcement in improving underhand passing skills, yet several limitations must be considered when interpreting the findings. The short intervention duration prevented an examination of long-term retention, leaving uncertainty about whether gains would persist over time. Conducting the study in a single school also introduces contextual constraints, as variations in student characteristics, school culture, and instructional quality may limit generalizability. Furthermore, the absence of effect size and confidence interval reporting restricts the precision of interpreting the magnitude of the treatment effect, and the lack of locally validated reliability data reduces certainty regarding measurement consistency. Despite these limitations, the findings suggest that reinforcement-based techniques support the development of technical volleyball skills and provide a valuable foundation for physical education teachers seeking to integrate reinforcement strategies into their instructional practice. Future research should explore different reinforcement schedules (e.g., intermittent vs. continuous, verbal vs. symbolic), extend intervention duration to assess retention, and consider longitudinal or mixed-methods designs to investigate deeper cognitive and emotional mechanisms involved in motor learning. Broader applications across various volleyball skills, such as serving, overhead passing, and smashing, also warrant further exploration.

CONCLUSION

This study suggests that positive reinforcement may support meaningful improvements in students' underhand passing performance, as reflected by a 16.43% gain in the experimental group compared with an 11.50% increase in the control group. These findings suggest that reinforcement-based instruction may contribute to the stabilisation of movement patterns, reduction of unnecessary variability, and enhanced attentional focus during practice. Observable behavioral indicators such as more consistent technique execution and higher post-test scores further

illustrate the potential contribution of reinforcement to students' technical development.

Several limitations should be considered. The short intervention period prevented the examination of long-term retention, and conducting the study within a single school limits the generalizability of the findings. The absence of effect size and confidence interval reporting also reduces the precision of interpreting the magnitude of improvement, and the lack of locally validated reliability indices warrants cautious interpretation.

Despite these constraints, the overall evidence suggests that positive reinforcement may be a beneficial instructional strategy in school-based physical education. Future studies should investigate varied reinforcement modalities, longer intervention durations, and more diverse research designs (e.g., longitudinal or mixed-methods) to understand better the cognitive, emotional, and behavioral mechanisms underlying reinforcement-driven motor learning. Such work may inform the refinement and broader application of reinforcement strategies across additional volleyball skills and ball game competencies.

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