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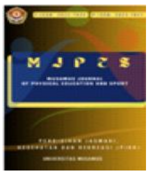

Effects of Shadow and Drill Training on Badminton Forehand Smash Accuracy

Frecillia Agustina[1], Farizal Imansyah[1]*, M. Taheri Akbar[1]

[1]Physical Education Study Program, Faculty of Teacher Training and Education, Universitas PGRI Palembang, Indonesia

Corresponding Author: farizal@univpgri-palembang.ac.id

Abstract
Objectives:
This study aimed to examine the effects of shadow training and drill training on forehand smash accuracy among badminton players at PB Pelangi Club, Simpang District.
Materials and Methods:
A quantitative experimental study using a two-group pretest–posttest design was conducted with 20 badminton players selected from a population of 25 athletes through purposive sampling. The participants were divided into two groups using ordinal pairing: a shadow training group (n = 10) and a drill training group (n = 10). The intervention was implemented over 16 training sessions. Forehand smash accuracy was measured using a badminton smash accuracy test consisting of 20 attempts. Data were analyzed using descriptive statistics, the Shapiro–Wilk normality test, Levene's homogeneity test, paired-sample t-tests, and an independent-sample t-test.
Results:
The shadow training group improved from 50.60 ± 3.20 to 71.10 ± 4.12, with a mean increase of 20.50 points ($t(9) = 66.71$, $p < .001$). The drill training group improved from 49.70 ± 3.13 to 78.80 ± 3.94, with a mean increase of 29.10 points ($t(9) = 105.10$, $p < .001$). The posttest score of the drill group was significantly higher than that of the shadow group (mean difference = 7.70; $t(18) = 4.27$, $p < .001$; Cohen's $d = 1.91$).
Conclusions:
Both shadow and drill training significantly improved forehand smash accuracy. However, drill training produced a greater improvement and can be recommended as a more effective practice method for developing forehand smash accuracy in club-level badminton players.
Keywords: badminton, drill training, forehand smash accuracy, shadow training, technical training

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Introduction

Badminton is a fast, dynamic, and highly demanding racket sport that requires the integration of technical skill, physical fitness, tactical awareness, and perceptual control. Players must perform repeated short-duration actions with high intensity, including lunges, jumps, rapid directional changes, and powerful overhead strokes. Because badminton involves complex movement patterns and quick decision-making, athletes need not only speed and power but also accurate technical execution to control shuttlecock placement effectively (Phomsoupha & Laffaye, 2014).

Among the main offensive techniques in badminton, the forehand smash is considered one of the most decisive strokes. The smash is performed from an overhead position with a downward shuttlecock trajectory, high velocity, and an attacking purpose. However, an effective smash is not determined only by power. Accuracy is equally important because a powerful smash that is directed outside the court, into the net, or toward an easily anticipated area may give an advantage to the opponent. Previous biomechanical research has shown that smash performance depends on coordinated upper-limb muscle activity, timing of impact, racket control, body positioning, and the ability to direct the shuttlecock toward a target area (F. Li et al., 2023; S. Li et al., 2017; Sakurai & Ohtsuki, 2000).

The forehand smash requires a coordinated kinetic chain involving the lower limbs, trunk rotation, shoulder movement, elbow extension, forearm action, and wrist control. Skilled badminton players are generally able to produce faster and more accurate smashes because they demonstrate better body positioning, more efficient segmental coordination, and more consistent impact mechanics than less-skilled players (F. Li et al., 2023; Rusdiana et al., 2021). Therefore, training programs aimed at improving smash accuracy should not focus only on physical strength but also on repeated technical control, movement consistency, and target-directed execution.

In practical coaching contexts, two common training methods used to develop badminton technique are shadow training and drill training. Shadow training is a movement-based practice performed without a shuttlecock. It allows athletes to rehearse footwork, body positioning, racket swing, and stroke patterns without the pressure of shuttlecock speed. This type of practice is useful for building movement memory, improving coordination, and preparing athletes to execute strokes with better posture and balance. Denatara (2024) included footwork and shadow smash as part of a badminton smash training model for young athletes, indicating that shadow-based practice can support the development of smash accuracy when integrated into structured training.

Drill training, on the other hand, involves repeated execution of a specific technical skill using a shuttlecock, usually with a clear target, feeding pattern, or correction from the coach. Drill practice helps athletes build automaticity, consistency, and technical control through repetition. A recent systematic review reported that drill-based methods showed consistent effectiveness in improving badminton smash accuracy, especially when the drills were focused, target-oriented, and designed to resemble real game situations (Hadi & Mashud, 2025). This is supported by motor learning theory, which emphasizes that repeated, structured, and feedback-based practice strengthens movement patterns and improves skill performance over time (Ericsson et al., 1993; Wulf & Shea, 2002).

Initial observation at PB Pelangi Club, Simpang District, indicated that several players still had difficulty directing their forehand smashes accurately. Many smash attempts went wide, hit the net, or landed in areas that were easy for opponents to return. Training

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activities tended to emphasize general physical exercise and game play, while specific smash accuracy practice was not yet systematically implemented. This condition indicates the need for a structured training approach that can improve the accuracy of forehand smash execution.

Although shadow training and drill training are commonly used in badminton practice, there is still a need to compare their effects within the same training context and participant group. Therefore, this study aimed to examine: (1) the effect of shadow training on forehand smash accuracy, (2) the effect of drill training on forehand smash accuracy, and (3) the difference in effectiveness between shadow and drill training among badminton players at PB Pelangi Club, Simpang District.

Materials and Methods

Study Design

This study used a quantitative experimental approach with a two-group pretest–posttest design. Two experimental groups were formed: one group received shadow training and the other group received drill training. Both groups completed a pretest before the intervention and a posttest after the intervention. This design was used to determine the effect of each training method and to compare the post-intervention outcomes between groups.

Study Participants

The population consisted of 25 badminton players registered at PB Pelangi Club, Simpang District. A total of 20 players were selected using purposive sampling based on their availability, active participation in training, and suitability for the study program. The selected players were divided into two groups of 10 participants each using ordinal pairing to help balance initial ability between groups. Group A received shadow training, while Group B received drill training.

Study Organization

The instrument used in this study was a badminton forehand smash accuracy test. The test required players to perform forehand smashes toward predetermined target areas on the badminton court. Scores were given based on the accuracy of shuttlecock placement. Higher scores indicated better forehand smash accuracy.

Intervention Procedures

The research procedure consisted of three main stages: pretest, treatment, and posttest. First, all participants completed a forehand smash accuracy pretest to determine their initial ability. Second, participants received training according to their assigned group. The shadow training group practiced badminton movement patterns and forehand smash movements without a shuttlecock, focusing on footwork, body position, racket swing, balance, and movement rhythm. The drill training group practiced repeated forehand smashes using shuttlecock feeding, target areas, and technical correction from the coach. Third, after the treatment period, all participants completed a posttest using the same forehand smash accuracy test.

Statistical Analysis

Data were analyzed using descriptive statistics to determine the minimum score, maximum score, mean, standard deviation, and variance. The Shapiro–Wilk test was used to examine normality because it is commonly recommended for small sample sizes

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(Shapiro & Wilk, 1965). Levene's test was used to examine the homogeneity of variance between groups. A paired sample t-test was used to determine the improvement within each group from pretest to posttest. An independent sample t-test was used to examine the difference in posttest scores between the shadow and drill training groups. The significance level was set at $p < .05$. Effect interpretation was supported by statistical reporting recommendations emphasizing the importance of reporting both statistical significance and practical magnitude (Cohen, 1992; Fritz et al., 2012; Lakens, 2013).

Results

Descriptive Statistics

The descriptive results showed that both training groups experienced improvement after the intervention. The shadow training group increased from a pretest mean score of 50.60 to a posttest mean score of 71.10. The drill training group increased from a pretest mean score of 49.70 to a posttest mean score of 78.80.

Table 1. Descriptive Statistics of Forehand Smash Accuracy

Group	Test	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Shadow Training	Pretest	10	46	56	50.60	3.204	10.267
Shadow Training	Posttest	10	65	78	71.10	4.122	16.989
Drill Training	Pretest	10	45	55	49.70	3.129	9.789
Drill Training	Posttest	10	73	85	78.80	3.938	15.511

The shadow training group improved by 20.50 points on average, while the drill training group improved by 29.10 points on average. This indicates that both methods improved forehand smash accuracy, but the improvement in the drill training group was greater.

Table 2. Mean Improvement from Pretest to Posttest

Group	Pretest Mean	Posttest Mean	Mean Improvement
Shadow Training	50.60	71.10	20.50
Drill Training	49.70	78.80	29.10

Normality Test

The Shapiro–Wilk test showed that all pretest and posttest data were normally distributed because all significance values were greater than .05.

Table 3. Shapiro–Wilk Normality Test

Group	Variable	Statistic	df	Sig.
Shadow Training	Pretest	0.981	10	0.970
Shadow Training	Posttest	0.979	10	0.961
Drill Training	Pretest	0.983	10	0.979
Drill Training	Posttest	0.974	10	0.928

Homogeneity Test

The Levene's test result showed that the posttest data between the two groups had homogeneous variance because the significance value based on the mean was 0.917, which was greater than .05.

Table 4. Levene's Test of Homogeneity of Variance

Variable	Levene Statistic	df1	df2	Sig.	Variable
Posttest Score Based on Mean	0.011	1	18	0.917	Posttest Score Based on Mean
Posttest Score Based on Median	0.011	1	18	0.919	Posttest Score Based on Median
Posttest Score Based on Trimmed Mean	0.011	1	18	0.917	Posttest Score Based on Trimmed Mean

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Paired Sample t-Test

The paired sample t-test showed that both shadow training and drill training significantly improved forehand smash accuracy. The shadow training group showed a significant increase with $t = 66.706$ and $p < .001$. The drill training group also showed a significant increase with $t = 105.097$ and $p < .001$.

Table 5. Paired Sample t-Test Results

Group	Mean Difference	Std. Deviation	Std. Error Mean	t	df
Shadow Training	20.500	0.972	0.307	66.706	9
Drill Training	29.100	0.876	0.277	105.097	9

Independent Sample t-Test

The independent sample t-test was used to compare the posttest scores of the two groups. The result showed a significant difference between the shadow training group and the drill training group, with $t = -4.271$, $df = 18$, and $p < .001$. The mean posttest score of the drill training group was higher than that of the shadow training group.

Table 6. Independent Sample t-Test of Posttest Scores

Comparison	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% CI Lower	95% CI Upper
Shadow vs Drill Posttest	-4.271	18	< .001	-7.700	1.803	-11.487	-3.913

Discussion

The results of this study showed that shadow training significantly improved the forehand smash accuracy of badminton players. The mean score increased from 50.60 in the pretest to 71.10 in the posttest. This improvement suggests that shadow training can help players develop better movement organization, body balance, swing pattern, and preparation before executing the smash. In badminton, accurate smash performance depends on the coordination of footwork, trunk rotation, upper-limb action, racket positioning, and timing of shuttlecock contact (Sakurai & Ohtsuki, 2000; Rusdiana et al., 2021). Shadow training provides an opportunity for players to rehearse these movement patterns repeatedly without the pressure of shuttlecock speed, allowing them to focus on technical form and movement consistency.

This finding is consistent with the motor learning perspective that repeated movement rehearsal can strengthen motor coordination and improve technical execution. Wulf and Shea & Morgan (1979) emphasized that complex motor skills require practice conditions that support coordination, feedback, and task-specific control. In the context of this study, shadow training helped players build the basic movement structure required for the forehand smash. However, because shadow training does not involve actual shuttlecock contact, the transfer of movement to target accuracy may be less direct than in shuttlecock-based practice.

The drill training group also showed a significant improvement, with the mean score increasing from 49.70 in the pretest to 78.80 in the posttest. This improvement was greater than that of the shadow training group. Drill training likely produced stronger improvement because it combined repeated technical execution with real shuttlecock contact, target direction, and feedback. Drill practice allows players to develop a direct relationship between racket movement, shuttlecock trajectory, and target placement. This supports Schmidt's schema theory, which explains that repeated practice under relevant task conditions helps athletes refine movement parameters and improve response accuracy.

The superiority of drill training in this study is also supported by previous badminton research. Hadi & Mashud (2025) reported that drill-based methods were among the most consistent training approaches for improving badminton smash accuracy. Denatara (2024) also highlighted the importance of varied smash training models, including footwork, shadow smash, plyometric, and drill-based activities, to improve smash accuracy among young badminton athletes. In this study, drill training may have been more effective because the athletes repeatedly practiced the actual skill under conditions that were closer to game demands. This type of practice promotes automaticity, technical consistency, and confidence in directing the shuttlecock.

The independent sample t-test confirmed a significant difference between the two groups' posttest scores. The drill training group achieved a higher mean posttest score than the shadow training group. This indicates that although both methods were effective, drill training had a stronger effect on forehand smash accuracy. From a coaching perspective, this result suggests that shadow training is useful as a foundational method for developing movement patterns, while drill training is more directly effective for improving hitting accuracy because it includes shuttlecock contact and target-based repetition.

These findings also align with the principle of deliberate practice. Ericsson et al. (1993) argued that expert performance develops through structured, effortful, and feedback-oriented practice. Drill training in this study reflected these characteristics because athletes repeatedly performed smash actions with a clear technical goal and measurable target outcome. In addition, the role of repeated practice in improving skill consistency is consistent with contextual and motor learning theories, which indicate that practice structure influences skill acquisition, retention, and transfer (Shea & Morgan, 1979; Wulf & Shea, 2002).

However, this study has several limitations. First, the sample size was relatively small, involving only 20 badminton players from one club. Therefore, the findings should be generalized cautiously to broader populations. Second, the study focused only on forehand smash accuracy and did not measure other performance variables such as smash speed, tactical decision-making, or match performance. Third, the intervention was conducted in a club-based setting, so external factors such as training motivation and previous experience may have influenced the results. Future studies should involve larger samples, longer training periods, and additional performance indicators such as shuttlecock velocity, biomechanical analysis, and match-based effectiveness.

Overall, this study provides practical evidence that both shadow and drill training can be used to improve badminton forehand smash accuracy. Coaches may use shadow training at the early stage to develop movement patterns and technical readiness, followed by drill training to improve target accuracy, consistency, and game-related execution.

Conclusions

This study concluded that shadow training and drill training both had significant effects on improving forehand smash accuracy among badminton players at PB Pelangi Club, Simpang District. The shadow training group improved from 50.60 to 71.10, while the drill training group improved from 49.70 to 78.80. The comparison between groups showed that drill training was more effective than shadow training, as indicated by the higher posttest mean score and significant independent sample t-test result. Therefore, drill training can be recommended as a practical and effective method for improving forehand smash accuracy, while shadow training remains useful for strengthening basic movement patterns and technical preparation.

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Conflict of Interest

The authors declare no conflict of interest.

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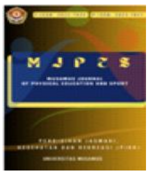

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