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# The Effectiveness of the Drill Method in Improving Short-Serve of Young Badminton Athletes

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**Abstract:** This study examines the urgency of developing short-serve skills in young badminton athletes, responding to critical problems in the form of low accuracy and consistency of serve identified in 65% of U-13 athletes. This phenomenon has a significant impact on competitive performance, considering that short-serve is a fundamental element that determines the early momentum of the match. The investigation used a 2x2 factorial experimental design, involving 32 U-13 male athletes from the Sukoharjo badminton club who were selected through purposive sampling. The research subjects were divided into four groups based on exercise methods (mass and distributed) and initial ability levels (high and low). Data collection was carried out using a Fenanlampir short-serve test instrument with a validity of 0.66 and a reliability of 0.70). The Shapiro-Wilk test was used for normality, Levene's test for homogeneity, and hypothesis testing was conducted using a dependent sample t-test with a 5% significance level. The results indicated significant improvements in both training methods, with massed practice demonstrating higher effectiveness (N-Gain Score 57.81% for high ability and 42.6% for low ability) compared to distributed practice (39.69% and 20.89%). No significant interaction was found between the training method and initial skill level, indicating the universality of the effectiveness of the massed method. These findings contribute to the development of evidence-based training methodologies, with practical implications in the form of recommendations for the implementation of massed methods as a core component of young athlete coaching programs.

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## INTRODUCTION

Badminton has long been a source of pride for Indonesia on the international stage, with numerous achievements by national athletes over the years. However, maintaining and enhancing these accomplishments requires special attention to the fundamental aspects of the game, particularly in developing basic techniques among young athletes. One crucial yet often overlooked fundamental skill is the short-serve, which serves as the opening move in badminton and can be a strategic tool to gain points (Hutama & Yuliastrid, 2017). Although seemingly simple, the short-serve demands a high level of precision and consistency. Errors in executing a short-serve can directly benefit the opponent, whether due to the shuttlecock hitting the net, being too high, or going out of bounds. Observations in badminton clubs in Sukoharjo revealed that many U-13 athletes still struggle to perform short-serve consistently and accurately. This aligns with the findings by Hartanto et al. (2017) which indicated that 65% of junior athletes faced difficulties in controlling the trajectory and placement of the shuttlecock during the short-serve.

Short serves, although they appear to be simple movements, are actually complex skills that require a high level of precision and consistency. Failure to make a short serve can give an immediate advantage to the opponent, either because the shuttlecock is stuck in the net, the trajectory is too high, or out of the legitimate area of play. Based on systematic observations made at the Sukoharjo badminton club, it was found that most U-13 athletes still face significant difficulties in making short serves consistently and accurately. These findings are reinforced by research (Araujo et al., 2022) which revealed that about 65%

of junior athletes had difficulty controlling the trajectory and placement of the shuttlecock during short serves.

This problem is becoming even more crucial considering the dynamics of junior level badminton competition which is increasingly competitive. (Lin et al., 2024) In his research, he emphasized that mastery of basic techniques, especially short serve, is a significant differentiating factor in the performance of young athletes. In Sukoharjo, Central Java, Indonesia despite having adequate infrastructure and a substantial number of athletes, the achievements achieved are still not optimal when compared to other districts in the Greater Solo area, especially in regional and national championships.

The gap between the potential and the achievements achieved indicates an urgent need to develop more effective drill training methods, especially in improving the quality of short serves. (Duncan et al., 2023) In his research, he demonstrated that the implementation of a structured and systematic drill training method can improve service accuracy by up to 40% among junior athletes. However, the application of the drill method requires careful consideration of the variation and intensity adjusted to the athlete's initial ability (Lu et al., 2022).

Previous research has identified a significant correlation between athletes' initial skill levels and the effectiveness of a given training program. However, there is still a gap in understanding how different drill training methods can affect the skill development of athletes with varying levels of initial ability. This study seeks to fill this gap by proposing a comprehensive approach that compares the effectiveness of two drill drill training methods: distributed practice and massed practice, by considering the athlete's initial ability as a moderator variable (Luo et al., 2022).

Distributed practice, which applies a training pattern with regular rest intervals, and massed practice, which emphasizes intensive training with minimal rest, each have their own characteristics and advantages in the development of motor skills of young athletes. An in-depth understanding of the effectiveness of these two methods in the context of different initial abilities will make a significant contribution to the development of more adaptive and effective exercise programs (Das Pradhan et al., 2022).

The urgency of this research is further emphasized by the demands of modern badminton which requires every aspect of the game to be carried out efficiently and effectively. An accurate short serve not only serves as a safe game opener but can also be a deadly early attack. In the context of coaching young athletes, the development of these skills is becoming increasingly crucial considering its role as a foundation for the development of advanced skills.

The objectives of this study are to: (1) examine the differences between distributed practice and massed practice methods in improving short-serve skill, (2) identify variations in the improvement of short-serve skill among athletes with high and low initial ability, and (3) analyze the interaction between training methods and initial skill in enhancing short-serve skill among U-13 badminton athletes in Sukoharjo. The expected contribution of this study includes providing an empirical foundation for coaches to select and implement training methods that align with the characteristics and initial abilities of athletes. Practically, the findings can serve as a reference for designing better training programs to enhance short-serve skill among junior athletes. Theoretically, this study enriches the scientific discourse on training methodologies in badminton, particularly in developing fundamental skills in young athletes.

The expected contribution of this research is multidimensional. Theoretically, this research will enrich the scientific literature on badminton training methodologies, especially in the context of developing basic skills in young athletes. The findings of the study are expected to provide a deeper understanding of how the initial ability factor interacts with the training method in influencing the development of athletes' skills. Practically, the results of this study will provide a strong empirical foundation for coaches in selecting and implementing the training method that best suits the characteristics and initial abilities of their athletes. This is especially important given the need to optimize the effectiveness of the exercise program in the context of limited time and available resources.

Furthermore, this research is expected to contribute to the development of a more systematic and evidence-based model for coaching young athletes. By understanding how different drill training methods interact with an athlete's initial ability level, coaches and coaches can design a training program that is more differentiated and responsive to the individual needs of the athlete. The significance of this study

also lies in its potential to improve the efficiency and effectiveness of the overall young athlete coaching program. By optimizing drill training methods based on athletes' initial abilities, it is hoped that a more targeted and sustainable development path can be created for each athlete, which will ultimately contribute to improving the overall achievement of Indonesian badminton (Salleh et al., 2021).

## METHOD

This study employed a 2x2 factorial experimental design to analyze the effects of two training methods and the initial skill level on badminton short-serve skill. As described by Sugiyono (2020), factorial designs involve multiple factors, each with two or more levels. In this context, the study examined two main factors: training method (distributed practice and massed practice) and initial skill level (high and low), resulting in four experimental groups.

A two-way variance analysis used to analyze the interaction between variables. The research was carried out at the GOR Cangkol in Mojolaban Subdistrict, Sukoharjo Regency, over a training program period in July 2023. The target population consisted of all badminton athletes in Sukoharjo clubs, with an accessible population of 40 athletes in 2023. Referring to Sugiyono (2016), the sample was selected using purposive sampling based on specific criteria: (1) male athletes, (2) under 13 years old, (3) with at least one year of training experience, and (4) registered in a Sukoharjo Badminton Club. Based on these criteria, a sample of 32 athletes was selected and divided into four groups using ordinal pairing in the following table.

**Table 1.** Characteristics of Respondents

| Characteristic | Sum | Percentage |
|---|---|---|
| Age 11-12 years | 18 | 56.25% |
| Age 12-13 years | 14 | 43.75% |
| 1-2 year(s) of experience | 20 | 62.5% |
| >2 years of experience | 12 | 37.5% |

The data collection instrument used a modified short serve test from Fenanlampir (2015), with a target zone-based scoring system (3 points for the inner zone, 2 points for the middle zone, 1 point for the outside zone). The validity of the instrument was tested using the product moment method, resulting in a validity coefficient of 0.66, while the reliability was assessed using the split-half method with a coefficient of 0.70, indicating that the instrument had adequate internal consistency.

The research procedure is carried out in systematic stages as illustrated in the flow chart Figure 1. The research procedure was carried out in two main stages: (1) the preparation stage, including obtaining research permits, preparing instruments, and coordinating with relevant parties; and (2) the implementation stage, involving group assignment, pre-testing, training programs execution, and post-testing. All research procedures were documented and implemented according to established protocols to ensure the internal validity of the study.

Data analysis was carried out through a series of statistical tests using SPSS version 25. Preliminary tests included a normality test using Kolmogorov-Smirnov method, with a p-value criterion of > 0.05 for normal distribution, and a homogeneity test using Levene Test to ensure the equivalence of variants across groups (Budiwanto, 2017). Hypothesis testing employed a dependent sample t-test with a 5% significance level to analyze the difference in the effects of training methods and initial skill level (Ghozali, 2016).

Data analysis adopted a quantitative approach, focusing on the interaction between training methods and initial skill levels in improving short-serve skill. Noor (2014) emphasized that factorial design enabled simultaneous analysis of the effects of each variable and their interaction on the dependent variable. The analysis results are expected to provide a comprehensive understanding of the effectiveness of each training method across different skill groups, and the interaction between the two factors in enhancing the short-serve skill of U-13 badminton athletes.

The training program is designed systematically taking into account the principles of progressive

training. The distributed practice group performed exercises with regular rest intervals, while the massed practice group underwent intensive exercises with minimal rest. Each practice session is documented in detail to ensure compliance with research protocols and guarantee the internal validity of the study.

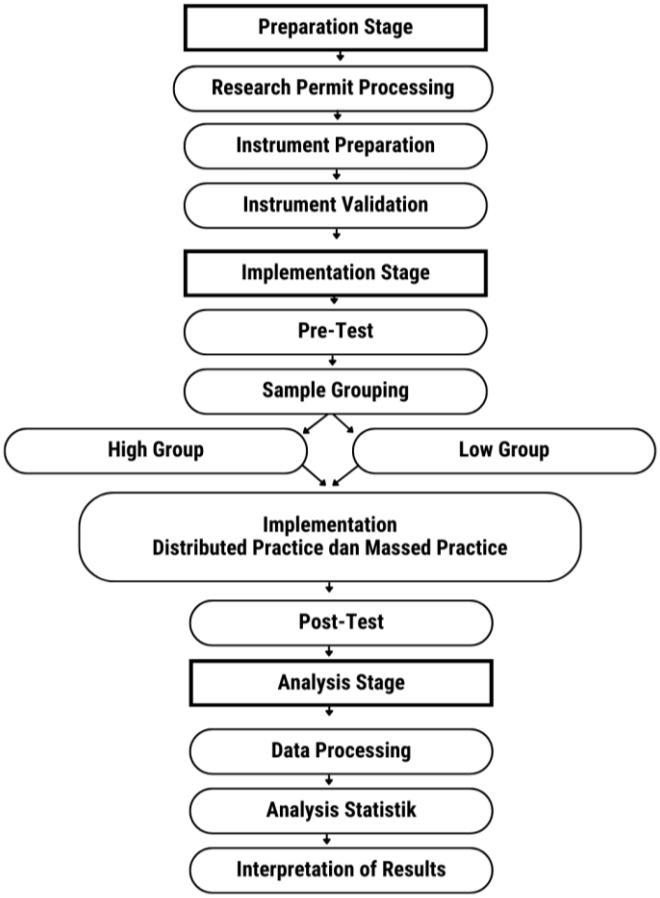


**Figure 1.** Research Procedure Flow Diagram

## RESULTS

This study was conducted to analyze the impact of drill techniques and initial ability on improving short-serve skill in badminton athletes. The study subjects consisted of 32 athletes divided into two main groups based on training methods: the massed practice and the distributed practice group, with 16 athletes in each group. Furthermore, each group was subdivided based on initial ability into high and low ability groups. All research subjects were male athletes under 13 years of age with at least one year of training experience at the Sukoharjo Club.

Data analysis was carried out through several testing stages to ensure the validity of the research results. The following is a comprehensive presentation of the results of the research findings:

### Statistical Description of Short-serve Skill

The measurement results of serve skills in both groups indicate significant variations between the pre-test and post-test, as presented in the following Table 1. Descriptive analysis showed different patterns of improvement in each group. In the massed practice group with low initial ability, there was an average increase from 20.25 (SD=2.05) to 34.00 (SD=3.42). The massed practice group with high initial ability showed an increase from 19.87 (SD=0.99) to 36.62 (SD=1.59). Meanwhile, the distributed practice group with low initial ability increased from 19.12 (SD=1.72) to 27.1 (SD=3.27), and the group with high initial ability increased from 20.37 (SD=2.55) to 34.75 (SD=2.81).

**Table 2.** The Data on Serve Skill Performance of the Massed Practice and Distributed Practice Groups.

| Method | Group | Pre-test | | Post-test | |
|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD |
| Massed Practice | High | 19.87 | 0.99 | 36.62 | 1.59 |
| Distributed Practice | High | 20.37 | 2.55 | 34.75 | 2.81 |
| Massed Practice | Low | 20.25 | 2.05 | 34.00 | 3.42 |
| Distributed Practice | Low | 19.12 | 1.72 | 27.1 | 3.27 |

**Prerequisite Analysis**

1. Data Normality Test

Testing the normality of the data using the Shapiro-Wilk test with a significance level of $\alpha=0.05$ showed the following results:

**Table 3.** Results of the Normality Test for Serve Accuracy

| Method | Group | Significance of Pre-test | Post-test Significance | Conclusion |
|---|---|---|---|---|
| Massed Practice | High | 0.055 | 0.059 | Normal |
| Distributed Practice | High | 0.796 | 0.557 | Normal |
| Massed Practice | Low | 0.542 | 0.516 | Normal |
| Distributed Practice | Low | 0.646 | 0.982 | Normal |

The results of the normality test showed that all data groups had a significance value greater than $\alpha=0.05$, indicating that the data was normally distributed. This satisfies the assumption of normality for subsequent analysis.

2. Homogeneity Test

The homogeneity test was carried out using the Levene Test to evaluate the similarity of variance between the groups:

**Table 4.** Results of the Homogeneity Test for Serve Accuracy

| Method | Group | Meaning | Conclusion |
|---|---|---|---|
| Massed Practice | High | 0.103 | Homogeneous |
| Distributed Practice | High | 0.641 | Homogeneous |
| Massed Practice | Low | 0.085 | Homogeneous |
| Distributed Practice | Low | 0.194 | Homogeneous |

The results of the homogeneity test showed that all groups had a significance value greater than $\alpha=0.05$, confirming the homogeneity of variance between groups.

3. Analysis of the Impact Test of Practice Methods

Hypothesis testing using t-dependent and t-independent tests yielded the following findings:

**Table 4.** Results of the Impact Test for Massed Practice and Distributed Practice Methods

| Method | Group | Compute-t | Table T | Meaning |
|---|---|---|---|---|
| Massed Practice | High | 25.857 people | 2.570 people | 0,000 |
| Distributed Practice | High | 8.455 | 2.570 people | 0,000 |
| Massed Practice | Low | 8.712 people | 2.570 people | 0,000 |
| Distributed Practice | Low | 6.611 people | 2.570 people | 0,000 |

The results of the analysis showed that both training methods had a significant influence on the improvement of short-serve skill, with a t-count value greater than the t-table in all groups and a significance value of $p<0.05$.

4. Analysis of Difference in Effectiveness between Training Methods

The comparison of effectiveness between the two exercise methods was analyzed using a t-independent test:

**Table 5.** Results of the Test for Differences in the Effectiveness of Exercise Methods

| Group | Compute-t | Table T | Meaning |
|---|---|---|---|
| Massed practice (low)-Distributed practice (low) | 6.371 people | 2.160 | 0.000 |
| Massed practice (high)-Distributed practice (high) | 2.182 people | 2.160 | 0.047 |

Analysis of the effectiveness of the method using N-Gain Score gave the following results:

**Table 6.** N-Gain Score Test Results

| Method | Group | N-Gain Score |
|---|---|---|
| Massed Practice | High | 57.81% |
| Distributed Practice | High | 39.69% |
| Massed Practice | Low | 42.6% |
| Distributed Practice | Low | 20.89% |

5. Factor Interaction Analysis

A two-way variance analysis was conducted to evaluate the interaction between the training method and the initial ability level:

**Table 7.** Results of Research Factor Interaction Analysis

| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 413.250A | 3 | 137.750 people | 16.751 people | .000 |
| Intercept | 35112.500 | 1 | 35112.500 | 4269.924 | .000 |
| A (Method) | 153.125 people | 1 | 153.125 people | 18.621 people | .000 |
| B (Group) | 210.125 years | 1 | 210.125 years | 25.553 people | .000 |
| A*B | 50.000 | 1 | 50.000 | 6.080 people | .000 |
| Error | 230.250 | 28 | 8.223 | | |
| Total | 35756.000 | 32 | | | |
| Corrected Total | 643.500 | 31 | | | |

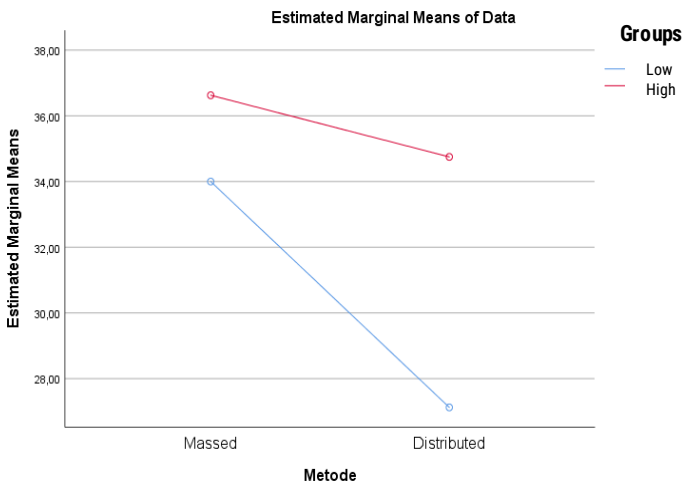


**Figure 2.** Diagram of Method Improvement with High Low Groups

A visualization of the interaction between the training method and the initial ability level is shown in the following graph on Figure 2. The results of the analysis showed that there was no line crossing on the interaction graph, indicating that there was no significant relationship between the training technique and the initial skill level. The massed practice method consistently showed better results than distributed practice, both in the high and low initial skill groups. Based on the overall results of the analysis, it can be concluded that both training methods affect the improvement of short-serve skills, with the massed practice method showing higher effectiveness than distributed practice. The initial skill level also affects the final result, but there is no significant interaction between the training method and the initial ability level.

## DISCUSSION

### Effectiveness of Drill training methods in Improving Short Service Skills

This study revealed important findings regarding the effectiveness of drill training methods in improving short-serve skills, as demonstrated by U-13 badminton athletes. The analysis results showed that both training methods, massed practice and distributed practice, significantly influence the improvement of short-serve skills. However, the massed practice method showed higher effectiveness compared to distributed practice, as evidenced by the larger N-Gain Score values in the massed practice group (57.81% for the high group and 42.6% for the low group). These findings align with the research by Rafli Marwan et al. (2022), which revealed that intensive training with high repetition (massed practice) can optimize motor memory formation in young athletes. The significant improvement in the massed practice group can be explained through motor learning theory, which stated that intensive repetition of movements in a single training session allowed athletes to develop more consistent and automatic movement patterns (Wafil & Hidayat, 2014).

### Interaction between Drill Training Methods and Initial Skill Level

A comprehensive evaluation of the interaction between training methods and initial skill level has revealed noteworthy findings. While initial skill level was found to influence the final outcome, no significant interaction between these two variables was identified. This observation aligns with the research by Li & Jawis (2024), which underscores the importance of initial skill level in the process of athletes adapting to training programs. The massed practice method consistently demonstrates superiority, regardless of the athlete's initial skill level. This phenomenon can be explained through the perspective proposed by Edel et al. (2024), which emphasizes that technical movements requiring high precision tend to benefit optimally from concentrated training.

### Theoretical and Practical Implications

These findings are consistent with the research conducted by Rafli Marwan et al. (2022), which revealed that intensive training with high repetition (massed practice) can optimize motor memory formation in young athletes. The significant improvement observed in the massed practice group can be explained through motor learning theory, which states that intensive repetition of movements within a single training session enables athletes to develop more consistent and automatic movement patterns (Wafil & Hidayat, 2014).

The findings of this study make a significant contribution to the theoretical understanding of motor learning in the context of precision sports. The more substantial improvement in performance within the massed practice group reinforces the motor learning theory proposed by Cui et al. (2024), which highlights the critical role of intensive repetition in the formation of movement patterns. From a practical perspective, these results underscore the importance of integrating the massed practice method as a fundamental component in the technical skill development programs for young athletes.

### Comparative Analysis of Exercise Methods

The factor of initial skill also proved to influence the final outcome of short-serve skills. This is confirmed by Setiawan et al. (2020), which found that baseline skill level plays a crucial role in determining an athlete's adaptation to a training program. Interestingly, although both groups of early ability showed improvement, no significant interaction was found between the training method and the initial ability level. The higher effectiveness of the massed practice method can be linked to the technical characteristics of

short-serve, which requires high precision and consistency. Pranata (2022) emphasized that technical movements requiring high precision often benefit more from concentrated practice compared to distributed practice. This is reflected in the higher average post-test score of the massed practice group.

Although distributed practice showed relatively lower effectiveness, it still resulted in significant improvements, especially in groups with high initial skills. (Yılmaz, 2022) explains that rest intervals in distributed exercise can serve as a mechanism to prevent physical and mental fatigue, albeit with the consequence of more gradual progress. These findings indicate the need for careful consideration in the selection of drill training methods based on the individual characteristics of athletes and the specific objectives of the training program.

**Advantages and Limitations of the Research**

This study has several significant methodological advantages. First, the use of a 2x2 factorial design allows simultaneous analysis of the effects of the training method and the initial ability level. Second, the implementation of a controlled research protocol with validated instruments (validity coefficient 0.66 and reliability 0.70) ensures the credibility of the findings. Third, the use of comprehensive statistical analysis provides an in-depth understanding of the relative effectiveness of the two exercise methods (Ma et al., 2024a).

Several limitations need to be considered in the interpretation of the results of this study. First, the relatively short duration of the study limited the observation of the long-term effects of both exercise methods. Second, a limited sample of U-13 male athletes from one club limits the generalization of the findings. Third, this study did not control external variables such as physical activity outside the training program and athletes' psychological factors.

Based on the findings and limitations identified, several recommendations for further research can be submitted. First, longitudinal investigations are needed to understand the long-term effects of both exercise methods. Second, research with a more diverse sample, covering various age groups and genders, will provide a more comprehensive understanding. Third, studies that integrate the analysis of psychological and physiological variables can provide a holistic perspective on the effectiveness of exercise methods. Finally, research on the optimal combination of massed practice and distributed practice in long-term training programs can provide valuable insights for the development of more effective training methodologies.

However, it is important to note that despite distributed practice showing lower effectiveness, this method still resulted in significant improvement, particularly in the high initial skill group. This finding is supported Putri (2022) which indicated that variations in rest intervals in distributed practice can help prevent mental and physical fatigue in young athletes, albeit with a trade-off of more gradual progress. The practical implications of these findings suggest that coaches should consider using the massed practice method as the primary approach for improving short-serve skills, especially during the basic technique learning phase. However, its application needs to be adjusted to the individual characteristics of athletes and the specific training goals to be achieved.

The practical implications of this study highlight the importance of training periodizing that integrates massed practice as a core component in the development of fundamental technical skills. However, the study is limited by the duration of observation and the age variation of the subjects. Future research is suggested to explore the longitudinal effects of combining both training methods and to investigate their impact on different age groups and in competitive match contexts.

In answering the third research question about the interaction between the exercise method and the initial ability level, the results of the analysis revealed that there was no significant interaction between the two variables. This observation implies that the superior effectiveness of the massed practice method is universal, independent of the athlete's initial ability level. These findings provide a solid empirical foundation for the development of more structured and evidence-based training programs. The practical implications of this study include several crucial aspects in the development of young athletes. First, coaches and coaches can optimize the development of short serve skills through the implementation of the massed practice method as a core component of the training program. Second, although early ability affects the rate of progression, the consistency of the effectiveness of massed practice indicates that this method can be universally applied in junior athlete coaching programs. Third, understanding the

absence of significant interactions between drill training methods and initial abilities allows for the preparation of more efficient and standardized training programs.

The study was limited by the influence of uncontrolled external variables, such as previous training experience and early childhood psychological factors. Future research needs to strengthen the experimental control of external variables such as training experience and physical condition.' Recommended to extend this line of inquiry by investigating the effectiveness of Massed and Distributed practice on other fundamental badminton skills beyond the short serve, For the development of further research, several recommendations can be submitted. First, longitudinal studies are needed to evaluate the sustainability of training effects and potential plateaus in skills development. Second, investigation of additional moderator variables such as psychological factors, physiological readiness, and biomechanical characteristics can provide a more holistic understanding of the effectiveness of exercise methods. Third, the exploration of the optimal ratio between massed practice and distributed practice in long-term training programs can contribute to the development of a more comprehensive training methodology. Finally, a comparative study across age groups and genders can expand the applicability of the findings of this study in the context of broader athlete coaching. In conclusion, this study not only provides empirical validation of the superior effectiveness of the massed practice method in the development of short serve skills, but also provides a solid conceptual framework for the development of a more systematic and evidence-based coaching program for young badminton athletes. These findings make a significant contribution to the body of knowledge in the field of sports training methodology, especially in the context of developing fundamental technical skills in junior athletes.

## CONCLUSION

The study revealed the differential effectiveness of drill training methods in developing short-serve skill. The massed practice method demonstrated superiority in improving serve accuracy and consistency, with a significant improvement of 57.81% observed in the high-ability group. These findings expand the theoretical understanding of motor learning in the context of precision sports, confirming and strengthening motor learning theory regarding the role of intensive repetition in motor memory formation. The theoretical contribution of this study lies in the identifying distinct adaptation patterns among the ability groups, despite the absence of significant interaction between training methods and the initial ability level. This provides a new perspective on training differentiation theory, which has traditionally assumed a strong interaction between methods and athletes' baseline abilities.

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