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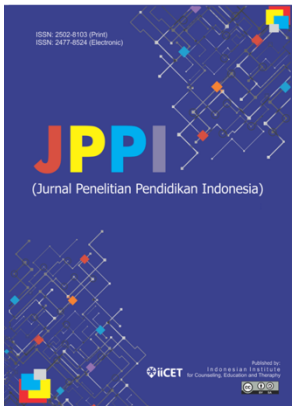

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Improvement of performance through learning motivation on accuracy of forehand service in badminton among students

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ABSTRACT

This study aims to examine the direct and indirect effects of arm muscle strength, eye-hand coordination, and learning motivation on forehand service accuracy in badminton among junior high school students. A quantitative approach with path analysis was used. The sample consisted of 49 male students selected through random sampling. Data were collected using a push-up test for arm muscle strength, a tennis ball throw-and-catch test for eye-hand coordination, a 50-item Likert-scale questionnaire for learning motivation, and a modified forehand service accuracy test. The findings revealed that arm muscle strength (0.393), eye-hand coordination (0.337), and learning motivation (0.278) had significant direct effects on forehand service accuracy. Additionally, arm muscle strength and eye-hand coordination showed indirect effects through learning motivation, contributing 5.2% and 3.7%, respectively. Both physical and psychological factors significantly influence forehand service accuracy. Integrating physical training and motivational strategies is essential to enhance badminton performance.

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Introduction

Badminton is a fast-paced racket sport that requires the integration of physical abilities, technical skills, and cognitive coordination to perform effectively (Muhammad et al., 2024; Sharulnizam et al., 2023). In educational contexts, badminton is widely taught as part of physical education, particularly at the junior high school level where students begin to develop fundamental sport skills. However, observations in school settings indicate that many students still struggle to execute basic techniques accurately, especially the forehand service. This limitation suggests that there are underlying factors influencing skill performance that need to be examined more systematically.

The forehand service is one of the most fundamental techniques in badminton because it initiates play and determines the early control of a rally. A precise and consistent service enables players to place the shuttlecock strategically, while an inaccurate service can immediately reduce competitive advantage. Although it is often considered a basic skill, achieving high accuracy in forehand service

requires more than simple repetition; it demands proper coordination of physical and cognitive elements. Therefore, understanding the determinants of forehand service accuracy is essential, particularly for junior athletes who are still in the of skill development (Nugroho et al., 2025; Yasriuddin et al., 2025).

One of the key physical factors that may influence service accuracy is arm muscle strength. In racket sports, upper limb strength contributes not only to generating force but also to stabilizing movement and controlling stroke execution (Ramli et al., 2021). While strength is commonly associated with power, in the context of service accuracy, it is also related to the ability to regulate movement precision and shuttlecock placement. Previous studies have shown that stronger arm muscles can support better control and consistency in stroke performance (Prajongjai et al., 2021). However, research that directly examines the relationship between arm muscle strength and service accuracy in school-aged badminton players remains limited.

Another important factor is eye-hand coordination, which plays a critical role in executing precise motor skills. Eye-hand coordination allows individuals to integrate visual information with motor responses, enabling accurate timing and positioning during movement (Al-Jaafreh & Almaaitah, 2023; Wiyanto et al., 2026, 2026; Y.-T. Yang et al., 2025). In badminton, this ability is essential during service, as players must accurately judge distance, angle, and contact timing when hitting the shuttlecock. Athletes with better coordination are generally more capable of performing controlled and accurate movements, particularly in tasks that require fine motor precision (Ruslan et al., 2025).

From a motor learning perspective, both arm muscle strength and eye-hand coordination contribute to the quality of movement execution. However, technical performance in sports is not determined solely by physical factors. Psychological aspects, especially learning motivation, also play a crucial role in influencing how skills are acquired and performed. Motivation determines the level of effort, persistence, and attention that individuals invest during practice (Buerero, 2024; Saputra, 2025).

Learning motivation can be categorized into intrinsic and extrinsic components, both of which are relevant in the context of sports learning. Intrinsic motivation, such as personal interest and enjoyment, encourages deeper engagement in training, while extrinsic motivation, such as rewards and feedback, reinforces behavior and performance. Students who possess higher levels of motivation tend to practice more consistently and show greater commitment to improving their skills. This sustained engagement is essential for mastering technical abilities such as the forehand service (Ferrandez et al., 2021).

Although previous studies have examined the roles of arm muscle strength, eye-hand coordination, and motivation in sports performance, most of them have focused on these variables independently. As a result, there is still limited understanding of how these factors interact simultaneously in influencing specific technical skills. In particular, the potential role of motivation as a mediating variable between physical abilities and performance outcomes has not been adequately explored (Pluta et al., 2020).

In addition, many existing studies tend to focus on elite or adult athletes, leaving a gap in research involving junior high school students. This is important because adolescents are in a stage of rapid physical and psychological development, where both motor skills and motivational characteristics are still evolving. Investigating these variables in a school-based context can provide more relevant insights for improving teaching and training strategies.

To address these gaps, the present study proposes an integrated model that examines both physical and psychological determinants of forehand service accuracy. Specifically, arm muscle strength and eye-hand coordination are treated as independent variables, while learning motivation is positioned as a mediating variable. This approach allows for the analysis of both direct and indirect relationships among variables within a single framework (Sunday et al., 2024).

The conceptual framework of this study assumes that physical abilities directly influence service accuracy while also indirectly affecting performance through motivation. In this context, motivation is expected to enhance the effectiveness of physical capabilities by increasing students' engagement and consistency during practice. Based on this framework, hypotheses are formulated to examine the relationships among the variables.

The novelty of this study lies in its integration of physical and psychological factors in predicting a specific motor skill within a non-elite, school-based population. By applying path analysis, this study not only identifies the direct effects of arm muscle strength and eye-hand coordination but also reveals the indirect influence of learning motivation (Alfiqroam et al., 2025; Hamid & Mousa, n.d.; Wang et al., 2026; Wu & Ali, 2025). The findings are expected to contribute to both theoretical development in sports science and practical applications in physical education, particularly in designing training programs that balance physical conditioning and motivational strategies.

Method

This study employed a quantitative research design using a path analysis approach to examine both direct and indirect relationships among variables. The independent variables were arm muscle strength (X1) and eye-hand coordination (X2), while learning motivation (X3) functioned as a mediating (intervening) variable. The dependent variable was forehand service accuracy in badminton (Y). The proposed model assumes that physical variables influence performance both directly and indirectly through motivation, and this assumption was tested using regression-based path analysis.

The population of this study consisted of all Grade VII students at SMP Negeri 1 Koto XI Tarusan, totaling 199 students (98 male and 101 female). The sample included 49 male students selected using proportionate random sampling. The decision to include only male students was made to control for potential gender differences in physical performance variables such as muscle strength and coordination, thereby increasing internal consistency in the analysis. From each class, approximately 50% of male students were randomly selected using a lottery method to ensure equal representation.

The sample size was determined based on feasibility considerations and the availability of participants within the defined population. Although the sample size is relatively small for complex modeling, it meets the minimum requirement for regression-based path analysis, where each predictor variable maintains an acceptable ratio of observations. However, this limitation is acknowledged and considered in interpreting the results.

Data collection was carried out using standardized and previously validated instruments. Arm muscle strength was measured using a push-up test, where participants performed as many correct push-ups as possible within 60 seconds following standardized procedures. Eye-hand coordination was assessed using a tennis ball throw-and-catch test, in which participants threw a ball against a wall and caught it repeatedly for a fixed duration of 30 seconds at a standardized distance of 2 meters. The total number of successful catches was recorded as the coordination score.

Learning motivation was measured using a Likert-scale questionnaire consisting of 50 items that covered both intrinsic and extrinsic motivation dimensions. The instrument was developed based on established motivational constructs and was tested for validity and reliability prior to data collection. The validity test used item-total correlation, while reliability was assessed using Cronbach's Alpha, yielding a coefficient above 0.70, indicating acceptable internal consistency.

Forehand service accuracy was measured using a modified version of the Scott-Fox (1959) test adapted for badminton service assessment. The test required participants to perform a series of forehand serves directed toward designated target areas on the opponent's court. Each successful placement within the target zone was scored, and the total score represented the participant's service accuracy. The modification involved adjusting the target zones to suit the skill level of junior high school students while maintaining the original scoring principles.

Before hypothesis testing, preliminary analyses were conducted to ensure that the data met the assumptions required for path analysis. Normality was tested using the Shapiro-Wilk test, which is more appropriate for small sample sizes. Linearity between variables was assessed using ANOVA for linearity, and multicollinearity was evaluated using tolerance and Variance Inflation Factor (VIF) values. All variables met the required assumptions, indicating that further analysis could be conducted.

In addition, potential outliers were examined using standardized residual values, and no extreme outliers were found that could significantly distort the results. Although this study did not include

extensive control variables, efforts were made to minimize confounding effects by selecting participants from the same grade level and similar learning environments.

Data analysis consisted of both descriptive and inferential statistics. Descriptive statistics included mean, median, standard deviation, and frequency distributions to describe the characteristics of each variable. Inferential analysis was conducted using path analysis through multiple regression procedures to estimate the direct and indirect effects among variables.

The path coefficients reported in this study are standardized coefficients (beta values), allowing for comparison of the relative contribution of each variable. The coefficient of determination (R^2) was also calculated to assess the proportion of variance in forehand service accuracy explained by the model.

To test the mediating effect of learning motivation, indirect effects were calculated by multiplying the relevant path coefficients. In addition, the significance of the mediation effect was evaluated using the Sobel test to provide statistical confirmation of the indirect relationships.

Results and Discussions

The results of this study present a comprehensive analysis of the effects of arm muscle strength, eye-hand coordination, and learning motivation on the accuracy of forehand service in badminton among junior high school students. The data were analyzed through both descriptive and inferential statistical techniques, including assumption testing (normality, linearity, and multicollinearity), correlation analysis, and path analysis. Each variable's influence both direct and indirect was examined in detail to test the proposed hypotheses. The findings provide empirical evidence supporting the theoretical framework, highlighting the significance of psychomotor and motivational factors in determining technical performance outcomes in badminton service skills.

Table 1. Assumption Tests Summary

Test Type	Result	Conclusion
Normality	All variables are normally distributed (Sig. > 0.05)	Normality assumption is fulfilled
Multicollinearity	No multicollinearity (Tolerance > 0.10 and VIF < 10)	No multicollinearity detected
Linearity	All variables show linear relationships (Sig. Linearity < 0.05)	Linearity assumption is fulfilled

Table 1 presents the results of the assumption tests conducted prior to hypothesis testing, which include normality, multicollinearity, and linearity tests. The normality test, using the Kolmogorov-Smirnov method, indicated that all variables had significance values greater than 0.05, meaning the data are normally distributed. The multicollinearity test showed that all tolerance values were above 0.10 and all VIF values were below 10, suggesting no symptoms of multicollinearity among the independent variables. Finally, the linearity test results showed that all significance values for linearity were less than 0.05, indicating linear relationships between the variables. These results confirm that the data meet the classical assumptions required for further regression analysis.

The results of this study present the findings from descriptive statistics, assumption testing, correlation analysis, and path analysis examining the relationships among arm muscle strength, eye-hand coordination, learning motivation, and forehand service accuracy. The analysis was conducted to test both direct and indirect effects within the proposed model.

Descriptive statistics were calculated to provide an overview of each variable. The results showed that all variables had relatively normal distributions, with mean and standard deviation values indicating moderate variability among participants. No extreme scores were identified, suggesting that the data were suitable for further inferential analysis.

Prior to hypothesis testing, several assumption tests were conducted. The normality of the data was assessed using the Shapiro-Wilk test, which indicated that all variables were normally distributed ($p > 0.05$). Linearity between variables was confirmed using ANOVA for linearity, where all relationships

showed significant linear patterns ($p < 0.05$). Multicollinearity was evaluated using tolerance and Variance Inflation Factor (VIF) values, with tolerance values above 0.10 and VIF values below 10 for all predictors, indicating that multicollinearity was not present. These results confirm that the data met the necessary assumptions for regression-based path analysis.

A correlation matrix was generated to examine the relationships among variables. The Pearson correlation coefficients indicated strong positive relationships between all independent variables and the dependent variable. However, although the correlations were high, they remained within acceptable limits and did not indicate problematic redundancy among variables.

The results of the path analysis are presented in Table 1, which summarizes the standardized regression coefficients (β), t-values, significance levels (p-values), and the coefficient of determination (R^2).

Table 2. Direct Effects of Independent Variables on Forehand Service Accuracy

Independent Variable	Path Coefficient	Sig.	Pearson Correlation	Conclusion	
Arm Muscle Strength (X1)	0.393	0.000	0.930	Significant effect	direct
Eye-Hand Coordination (X2)	0.337	0.002	0.922	Significant effect	direct
Learning Motivation (X3)	0.278	0.001	0.892	Significant effect	direct

Table 2 summarizes the direct effects of the three independent variables arm muscle strength (X1), eye-hand coordination (X2), and learning motivation (X3) on the dependent variable, forehand service accuracy (Y). The path coefficients obtained through SPSS analysis show positive and significant relationships for all three predictors. Arm muscle strength has the highest direct effect (0.393), followed by eye-hand coordination (0.337), and learning motivation (0.278). All significance values are well below the 0.05 threshold, indicating strong evidence to reject the null hypotheses. Furthermore, the Pearson correlation coefficients for each variable exceed 0.89, reflecting very strong relationships with the dependent variable. These findings indicate that improving each of these factors can significantly enhance forehand service accuracy.

Table 3. Indirect Effects via Learning Motivation

Causal Path	Path Coefficient Formula	Indirect Effect (%)	Conclusion
X1 to X3 to Y	(0.393 × 0.485 × 0.278)	5.2%	Significant indirect effect
X2 to X3 to Y	(0.337 × 0.401 × 0.278)	3.7%	Significant indirect effect

Table 3 displays the results of the indirect effect analysis, specifically examining how arm muscle strength (X1) and eye-hand coordination (X2) influence forehand service accuracy (Y) through the mediating variable, learning motivation (X3). The path analysis reveals that X1 indirectly affects Y with a magnitude of 5.2%, while X2 shows an indirect effect of 3.7%. These values were calculated by multiplying the corresponding path coefficients and converting them to percentages. The significance levels of the individual paths (X1 to X3 and X2 to X3) are both below 0.05, indicating that these indirect effects are statistically significant. Therefore, it can be concluded that motivation plays a mediating role in strengthening the influence of arm muscle strength and eye-hand coordination on forehand service accuracy.

The present study aimed to examine how arm muscle strength, eye-hand coordination, and learning motivation contribute to forehand service accuracy among junior high school students. The findings indicate that both physical and psychological factors play important roles in shaping performance. However, these relationships should not be interpreted in a simplistic manner, as technical skill development in badminton involves a complex interaction between motor ability, practice behavior, and learning conditions.

Arm muscle strength was found to have the strongest direct effect on forehand service accuracy. This result is consistent with previous studies that emphasize the role of upper limb strength in supporting stroke execution (Dewi, 2021; Haryanto et al., 2025). However, the contribution of strength should not be understood solely in terms of power generation. In the context of service accuracy, strength likely contributes to movement stability and control, allowing players to regulate force output more precisely. From a biomechanical perspective, better muscular control may help maintain consistent racket positioning and shuttle contact, which are essential for accurate placement.

Eye-hand coordination also showed a significant contribution to service accuracy, supporting the idea that motor control is closely linked to perceptual abilities (AS & Wasan, 2024; Chen et al., 2024). In badminton, the ability to coordinate visual input with hand movement is crucial, particularly during the moment of shuttle contact. Players must accurately judge distance, timing, and angle, and then translate this information into precise motor actions. The findings reinforce the importance of coordination training, especially in early skill development, where consistency and timing are still being established.

Learning motivation was another important factor influencing performance, although its direct effect was smaller compared to the physical variables. This finding aligns with previous research suggesting that motivated learners tend to engage more actively in practice and demonstrate greater persistence in skill acquisition (Co-Bar et al., 2025; Ihsan et al., 2024). However, motivation does not directly produce technical accuracy; rather, it influences the quality and consistency of practice, which in turn affects performance outcomes. This distinction is important in understanding how psychological factors operate in sports learning.

The mediating role of motivation provides additional insight into the interaction between physical and psychological variables. The indirect effects of arm muscle strength and eye-hand coordination through motivation, although statistically significant, were relatively small. This suggests that motivation plays a supportive rather than dominant role in linking physical capacity to performance. These findings are in line with sport psychology perspectives that position motivation as a facilitating factor that enhances the utilization of physical abilities (Mangun & Subarkah, 2024; Triansyah et al., 2023).

Despite these findings, several aspects need to be interpreted with caution. The very high correlation values observed among variables may indicate overlapping constructs or similarities in measurement methods, which could inflate the strength of relationships. In addition, the relatively small sample size may limit the stability of the estimates and increase the risk of overestimating effect sizes. Therefore, the results should be viewed as indicative rather than definitive, and further studies with larger samples are needed to confirm these relationships.

Another important consideration is the context of the participants. This study involved junior high school students who are still in a developmental stage, both physically and psychologically. Their performance may be influenced not only by strength, coordination, and motivation, but also by factors such as prior experience, frequency of practice, and instructional quality. These variables were not included in the model, which represents a limitation but also an opportunity for future research to build a more comprehensive framework.

In terms of practical implications, the findings suggest that training programs should not focus exclusively on physical conditioning. While strength and coordination are clearly important, motivational aspects also need to be considered in designing effective learning environments. Coaches and teachers can enhance motivation through strategies such as goal setting, constructive feedback, and creating engaging practice sessions (Efrilia et al., 2025; González-Peño et al., 2024; Suwardi et al., 2025; Y.-T. C. Yang et al., 2025). By integrating physical training with motivational support, it is more likely that students will achieve consistent improvements in forehand service accuracy.

Conclusions

This study concludes that arm muscle strength, eye-hand coordination, and learning motivation each have a significant and positive influence on the accuracy of forehand service in badminton. Both

physical and psychological factors contribute not only directly but also indirectly through motivational pathways. The integration of physical conditioning and motivational development is therefore essential for improving technical performance in young athletes. These findings emphasize the importance of a holistic training approach that addresses both the physical capabilities and internal drive of students to optimize skill acquisition and performance outcomes in badminton.

References

Al-Jaafreh, O. J., & Almaaitah, M. N. Y. (2023). Comparing The Impact Of Using The Command And The Reciprocal Style On The Accuracy Of The Backhand Low Serve Skill In Badminton Game. Revista Iberoamericana de Psicología Del Ejercicio y El Deporte, 18(4), 431–436.

Alfiqroam, A. K., Alben, A. S. C., Effendi, H., Pramadita, Y., Aprilia, C. R., & Douw, R. U. (2025). The Effectiveness of Badminton Learning Through the Badminton Stroke Technique Learning Method for Students of Universitas Bung Hatta. Indonesian Journal of Sport Management, 5(1), 125–135.

AS, J., & Wasan, A. (2024). Effectiveness of Virtual Reality-Based Forehand Smash Training Model for Table Tennis Athletes Performance. Pakistan Journal of Life & Social Sciences, 22(2).

Buerero, A. (2024). Brand Love And Its Impact On Product Sustainability In The Market. Journal of Current Research in Business and Economics, 3(1), 379–421.

Chen, Y., Li, L., & Li, X. (2024). Correlation analysis of structural characteristics of table tennis players' hitting movements and hitting effects based on data analysis. Entertainment Computing, 48, 100610.

Co-Bar, A. G. C., Dimarucot, H. C., Rodil, A. M. T., & Alig-Reyes, L. Q. (2025). Kinematic analysis of pickleball forehand return and skill transfer of accuracy from badminton and tennis players. Journal of Physical Education and Sport, 25(6), 1124–1130.

Dewi, D. W. P. (2021). BADMINTON SMASH SKILL TRAINING MODEL FOR HIGH SCHOOL BEGINNERS STUDENTS. Gladi: Jurnal Ilmu Keolahragaan, 12(04), 237–247.

Efrilia, D., Utamayasa, I. G. D., & Kusuma, A. I. (2025). THE EFFECT OF TARGET PRACTICE DRILLON THE ACCURACY OF BADMINTON FOREHAND SERVICE TECHNIQUE IN EXTRACURRICULAR COURSES AT SMA AL-ISLAM KRIAN. Journal Sports Exercise Science International (SESI), 1(1), 1–8.

Ferrandez, C., Marsan, T., Poulet, Y., Rouch, P., Thoreux, P., & Sauret, C. (2021). Physiologie, biomécanique et blessures au tennis de table: une revue systématique. Science & Sports.

González-Peño, A., Simon-Chico, L., Prieto, L., & Franco, E. (2024). A technology-based experience to improve badminton skills: A challenge-based learning application. Proceedings of the Institution of Mechanical Engineers, Part P: Journal of Sports Engineering and Technology, 238(2), 126–133.

Hamid, M. S., & Mousa, S. A. (n.d.). The Effectiveness of Using Play Positions in Learning the Motor Performance of The Skill of The Front Foot Badminton. Rivista Italiana Di Filosofia Analitica Junior, 14(2), 2023.

Haryanto, J., Drenowatz, C., Nikolakakis, A., Luicacova, T., Suryadi, D., & Sari, D. P. (2025). Impact of wall drill training on drive stroke performance in table tennis. Journal of Physical Education and Sport, 25(6), 1141–1148.

Ihsan, F., Nasrulloh, A., & Nugroho, S. (2024). Analysis of key factors affecting the achievement of badminton athletes at the international level: A systematic review. Fizjoterapia Polska, (2).

Mangun, F. A., & Subarkah, A. (2024). The Effect Of Hand-Eye Coordination And Confidence On Badminton Smash Shot. Gladi: Jurnal Ilmu Keolahragaan, 15(02), 187–198.

Muhammad, J., Rahanyaan, O. C. F., Nasruddin, N., Sinaga, F. S. G., Mandosir, Y. M., CS, A., Paisei, A. M., & Meage, F. (2024). The Effect Of Basic Movement Training Methods On Increasing Badminton Forehand Long Service Hitting Ability In PB Children FIK. Indonesian Journal of Physical Activity, 4(1), 37–46.

Nugroho, S., Komari, A., Dwihandaka, R., Pambudi, D. K., Sulistiyono, S., Ihsan, F., & Hidayat, R. A. (2025). The Effectiveness of Accuracy Training to Improve Badminton Athletes' Service Skills. Proceedings of the International Seminar of Sport and Exercise Science (ISSES 2024), 81, 152.

Pluta, B., Galas, S., Krzykała, M., & Andrzejewski, M. (2020). The motor and leisure time conditioning of young table tennis players' physical fitness. International Journal of Environmental Research and Public Health, 17(16), 5733.

Prajongjai, V., Woravutrangkul, S., Pongsiri, T., & Charoenpanich, N. (2021). The Analysis of Force

Transfer between Feet during Backhand Short Serve in Elite Badminton Players. International Journal of Human Movement and Sports Sciences, 9(5), 1011–1018.
Ramli, A. S. S., Kamalden, T. F. T., Sharir, R., Harith, H. H., Hanafi, M., Gasibat, Q., & Samsudin, S. (2021). Mechanical interaction within badminton forehand shot technique: A review paper. International Journal of Kinesiology and Sports Science, 9(3), 28–37.
Ruslan, R., Rusli, R., Sarifin, S., Surur, A. A. Z., & Anggraeni, A. S. D. (2025). The Influence Of The Forehand Grip On Short Service Ability In Badminton. COMPETITOR: Jurnal Pendidikan Kepelatihan Olahraga, 17(1), 272–277.
Saputra, D. (2025). Efforts To Improve Backhand Service And Long Forehand Service Results In Badminton Through Playing Methods In Students of SMP Negeri 3 Palembang. COMPETITOR: Jurnal Pendidikan Kepelatihan Olahraga, 17(2), 1317–1323.
Sharulnizam, S. I. M., Shuib, R. S., Jusoh, M. A. M., Abdullah, S. C., & Nasir, N. (2023). Analysis of Muscle Activation of Badminton Player's Forward Serving Technique Using sEMG. International Conference on Innovation and Technology in Sports, 81–89.
Sunday, K., Li, Y., Sun, J., Wehbe, R., Neyedli, H., Batmaz, A. U., & Machuca, M. D. B. (2024). Pinging between worlds: Training table tennis novice players in real environment for virtual reality competitions. 2024 IEEE International Symposium on Mixed and Augmented Reality (ISMAR), 652–661.
Suwardi, S., Badaru, B., Hasanuddin, M. I., Fahrizal, F., Badar, M., & Mulyadi, M. (2025). Interactive Duel Service Game Training to Improve Badminton Backhand Serve at SMPN Gollek School No 34 Selayar Islands. Jurnal Perjuangan Dan Pengabdian Masyarakat: JPPM, 1(3), 57–65.
Triansyah, Y., Suharjana, S., & Rahmatullah, M. I. (2023). The influence of exercise and coordination methods hand eye coordination on the accuracy of badminton service. Advances in Health and Exercise, 3(2), 38–45.
Wang, T.-C., Liu, T.-Y., Pan, C.-Y., Tseng, Y.-T., Tang, T.-W., & Tsai, C.-L. (2026). Effects of mixed reality-based instruction on visual attention and stroke performance in novice badminton players. Journal of Exercise Science & Fitness, 200465.
Wiyanto, A., Pratama, D. S., & Wantoro, J. (2026). Analysis of the Physical Performance of Young Badminton Players Through the Role of Technology in the Development of Sustainable Movement. 8th International Conference on Education and Social Science Research (ICESRE 2025), 418–429.
Wu, Y., & Ali, H. M. (2025). Comparative Effects of Physical Training, Cognitive Imagery, and Verbal Stimuli on Selected Fundamental Badminton Skills among Novice Players. International Journal of Contemporary Education and Teaching Research, 4, 1–11.
Yang, Y.-T. C., Chang, H.-H., Gan, Y.-Z., & Wang, J.-S. (2025). Leveraging AIoT Technology in Badminton Instruction: Effects on Badminton Skills Learning and Sports Motivation in Junior High School Students. Proceedings of the 2025 9th International Conference on Education and Multimedia Technology, 256–261.
Yang, Y.-T., Chang, H.-H., & Wang, J.-S. (2025). Merging Sport Science and Bilingual Education: A Quasi-Experimental Study on AI-Supported Badminton Instruction. Society for Information Technology & Teacher Education International Conference, 1201–1207.
Yasriuddin, Y., Muhammadong, M., Hasan, M. S., Hudain, M. A., & Dermawan, D. (2025). The Impact of Wrist Flexibility, Eye-Hand Coordination, and Motivation on Long-Service Skills in Badminton. COMPETITOR: Jurnal Pendidikan Kepelatihan Olahraga, 17(1), 308–316.