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Innovating Learning Models: The Impact of Tabata and Rubber Weight on Tapak Suci Kick Speed

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ABSTRACT

Lack of variation in physical training models often leads to performance stagnation, particularly in straight kick speed—a critical technique in Pencak Silat. This study explores innovating learning models to overcome these limitations. This research aims to analyze the impact of Tabata training and rubber weight innovations on increasing the straight kick speed of Tapak Suci Putera Muhammadiyah (PIMDA) 181 students' athletes in Majene Regency. This experimental study utilized two group pretest-posttest designs with a sample of 30 students, selected based on active training and achievement criteria. Data were collected using a 10-second straight kick speed test and analyzed via descriptive, normality, homogeneity, and t-tests. The findings demonstrate a significant effect from the Tabata training model (t_count 4.993 > t_table 2.145; sig. 0.000 < 0.05). Similarly, the rubber weight training model showed a substantial impact with a t_count of 9.808. Integrating these innovative learning models provides a practical contribution for coaches and educators to optimize motor skills and athlete performance within martial arts environments.

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1. INTRODUCTION

Physical education serves as a strategic instrument within the national education system, designed to foster character development, mental resilience, and optimal physical fitness (Aksir et al., 2024; Hasmyati et al., 2024). Within this framework, Pencak Silat stands as a vital pedagogical tool that effectively integrates Indonesia's rich cultural heritage with modern athletic achievement (Hanas et al., 2024; Hasanuddin, 2025). As an internationally recognized intangible heritage, Pencak Silat encompasses four essential dimensions: mental-spiritual, artistic, self-defence, and sporting excellence, making it a comprehensive medium for student development.

In the landscape of competitive sports education, the mastery of fundamental techniques from an early age is considered the bedrock of long-term athletic success (Lloyd et al., 2015; Singh & Parmar, 2023). Among these maneuvers, the straight kick

(tendangan lurus) is paramount, as it offers significantly higher scoring potential and a superior attack range compared to hand-based strikes (Herdiman et al., 2022; Sayfullah et al., 2023). In a match context, the ability to execute this technique flawlessly often determines the competitive edge of an athlete.

However, the practical effectiveness of a straight kick is heavily dependent on explosive leg power and the ability to transition rapidly between attack and defense (Putra & Wahid, 2026; Ramadi & Vai, 2018). Recent observations of Tapak Suci PIMDA 181 student-athletes in Majene Regency have revealed a critical performance gap: insufficient kick speed, particularly during the crucial retraction phase. This technical weakness allows opponents to easily anticipate attacks and execute effective counters, such as catches or sweeps, which ultimately hinders the students' achievement in formal competitions.

This performance stagnation is frequently rooted in the continued use of conventional and monotonous training routines that fail to adequately challenge the students' physiological limits. In the modern era of sports science, innovating learning models is no longer merely an option but a necessity to ensure that training methods evolve alongside global athletic standards (Komalasari, 2023; Olimov & Egamberdiev, 2023). Traditional approaches often lack the high-intensity stimulus required to trigger the neuromuscular adaptations necessary for explosive movements.

The uniqueness of this research lies in the strategic shift from traditional drills to a structured integration of High-Intensity Interval Training (HIIT) via the Tabata method combined with rubber weight training. Tabata is specifically chosen for its proven efficiency in boosting anaerobic capacity and reaction speed within a condensed timeframe (Ambardi et al., 2023; Muhammad et al., 2023; Tang et al., 2026). Simultaneously, the application of rubber weights provides progressive resistance that targets specific muscle contractions, aligning perfectly with the unique biomechanics of the Pencak Silat straight kick (Nubatonis et al., 2024; Rahman & Laksana, 2025).

While various weight training studies have been conducted (Ihsan et al., 2023; Sotiropoulos et al., 2023; Yuan et al., 2025), research specifically examining the synergy of Tabata and rubber weights as an innovative learning model for Tapak Suci athletes remains limited. This study provides a data-driven solution to existing physical performance challenges. By analyzing the impact of Tabata and rubber weights, this research aims to offer a new pedagogical reference for coaches and educators to optimize student-athlete performance in a competitive martial arts landscape.

2. METHOD

This study employed a quantitative approach with a quasi-experimental method to evaluate the impact of Tabata and rubber weight training. The research design utilized a Two-Group Pretest-Posttest Design, which allowed for a rigorous comparison between two innovative learning models. The first group was subjected to the Tabata training protocol, while the second group received Rubber Weight training, both aimed at determining the most effective intervention for increasing the straight kick speed of the athletes.

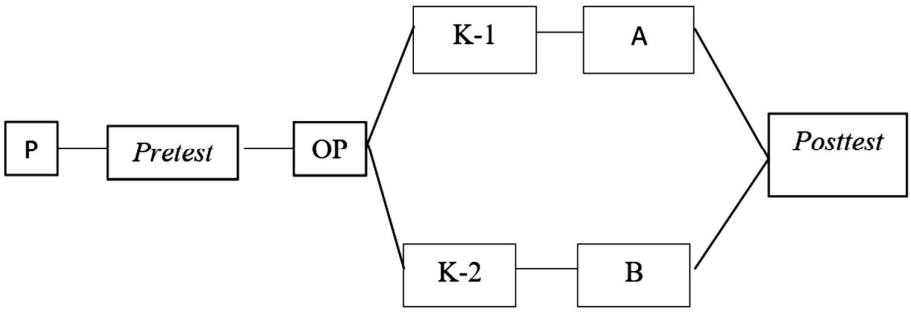

Figure 1. Two Group Pretest Posttest Design

The research population consisted of all student-athletes from Tapak Suci Putera Muhammadiyah (PIMDA) 181, Majene Regency. A purposive sampling technique was applied to ensure data validity, selecting 30 students based on specific criteria: active membership, mastery of basic straight kick techniques, and full commitment to the training program. These participants were then equally divided into two specialized treatment groups, each consisting of 15 students, to maintain a balanced experimental environment.

To measure the dependent variable, a standardized Straight Kick Speed Test was utilized as the primary research instrument. During the procedure, athletes were instructed to execute straight kicks at maximum speed toward a sandbag for a duration of 10 seconds. This test was conducted twice: once as a pre-test to establish a baseline of initial ability, and again as a post-test following the intervention period to measure the performance gains resulting from the innovative training models.

The implementation of the innovative learning models followed two distinct experimental schemes designed to optimize physical performance. The Tabata Model focused on high-intensity intervals consisting of 20 seconds of maximum kicking activity followed by 10 seconds of rest, repeated for 8 cycles. Conversely, the Rubber Weight Model employed resistance bands attached to the athletes' ankles, providing progressive resistance during both the explosive extension and the critical retraction phases of the kick.

Data collected from the experiments were statistically processed using SPSS software through a comprehensive multi-stage analysis. Prerequisite tests, including normality and homogeneity tests, were conducted to ensure the data distribution met the requirements for parametric testing. Finally, hypothesis testing was performed using the Paired Sample T-Test to identify significant internal improvements, while an Independent Sample T-Test was utilized to compare the overall effectiveness of the two innovative models in enhancing kick speed.

3. RESULTS AND DISCUSSION

Results

The statistical analysis of the pretest and posttest results, focusing on the comparative effectiveness of Tabata training and rubber weight interventions in enhancing the straight kick speed of Tapak Suci Putera Muhammadiyah 181 student-athletes in Majene Regency, is systematically detailed in Table 1 below.

Table 1. Descriptive Statistics Results

	N	Range	Minimum	Maximum	Sum	Mean	Std. Deviation
Tabata pretest	15	2.24	7.25	9.49	127.52	8.5013	.71897
Tabata posttest	15	2.27	7.00	9.27	118.68	7.9120	.81740
Rubber weight pretest	15	2.21	7.32	9.53	127.66	8.5107	.67144
Rubber weight posttest	15	1.95	6.09	8.04	105.35	7.0233	.56175
Valid N (listwise)	15						

The descriptive statistical analysis presented in Table 1, the Tabata training group (N=15) demonstrated a measurable shift in performance metrics between the testing phases. The pre-test data revealed a mean kick speed of 8.5013 with a standard deviation of 0.71897, ranging from a minimum of 7.25 to a maximum of 9.49. Following the intervention, the post-test results for this group showed a mean of 7.9120 and a standard deviation of 0.81740, with scores distributed between 7.00 and 9.27, indicating an overall change in the athletes' explosive speed consistency.

In comparison, the rubber weight training group (N=15) exhibited a more pronounced transition in their performance data. The initial pre-test mean was recorded at 8.5107 with a standard deviation of 0.67144, spanning a range of 2.21. After the administration of the innovative rubber weight model, the post-test mean decreased significantly to 7.0233 with a tightened standard deviation of 0.56175. This reduction in the numerical time value—coupled with a narrowed range of 1.95—reflects a substantial improvement in the velocity and efficiency of the students' straight kick execution.

Table 2. Data Normality

Group		Kolmograv- Samirnov			Information
		Statistics	Df	Sig.	
Tabata	Pretest	0,153	15	0,200	Normal
	Posttest	0,173	15	0,200	Normal
Loaded with train	Pretest	0,149	15	0,200	Normal
	Posttest	0,105	15	0,200	Normal

To ensure the validity of the subsequent parametric analysis, a normality assessment was conducted using the Kolmogorov-Smirnov test for the Tabata training group. The pre-test results yielded a test statistic of 0.153 with an asymptotic significance (Asymp. Sig.) of 0.200, while the post-test data produced a value of 0.173, also maintaining a

significance level of 0.200. Since both p-values exceed the standard threshold (P > 0.05), it is statistically confirmed that the data for both testing phases within the Tabata intervention group follow a normal distribution.

In a similar vein, the data distribution for the rubber weight training group was evaluated to verify its suitability for hypothesis testing. The Kolmogorov-Smirnov test for this group's pre-test data resulted in a value of 0.149 with an associated significance of 0.200 (P > 0.05), while the post-test data similarly aligned with normal distribution parameters. These findings indicate that the datasets for both innovative learning models meet the required assumptions of normality, allowing for a robust and reliable comparison of their impact on the athletes' straight kick speed.

To further validate the data set, a homogeneity of variance test was conducted using the Levene statistic to ensure consistency across the experimental groups. The analysis yielded a Levene value of 0.588 with a significance of 0.450 for the Tabata training group, while the rubber weight training group produced a value of 0.995 with a significance of 0.327. Given that both probability values significantly exceed the alpha = 0.05 threshold (95% confidence level), it is concluded that the variance across the training variable data is homogeneous, satisfying the necessary assumptions for robust comparative analysis.

Table 3. Tabata Group Difference Test

		Paired Differences					T	df	Sig. (2-tailed)	t-tabel
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
					Lower	Upper				
Pair 1	Pre test tabata – Post test tabata	.58933	.45714	.11803	.33618	.84249	4.993	14	.000	2,145

The hypothesis testing for the Tabata training intervention was conducted using a paired t-test to determine the significance of the performance gains. The statistical analysis yielded a t_count value of 4.993, which significantly exceeds the t_table threshold of 2.145, accompanied by a p-value of 0.000 (P < 0.05). These metrics provide strong evidence of a significant difference between the pre-test and post-test results, confirming that the intervention produced a measurable shift in the athletes' physical output.

Consequently, since the calculated t value is greater than the critical table value, the null hypothesis (H_0) is rejected in favor of the alternative hypothesis. This result demonstrates that the Tabata training model has a significant positive effect on increasing the straight kick speed of Tapak Suci PIMDA 181 student-athletes in Majene

Regency. This finding underscores the effectiveness of high-intensity interval innovations in optimizing explosive motor performance within a martial arts context.

Table 4. Difference Test of Rubber Loaded Groups

		Paired Differences					T	df	Sig. (2-tailed)	t-tabel
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
					Lower	Upper				
Pair 1	Pre-test rubber load – post-test rubber load	1.48733	.58732	.15165	1.16208	1.81258	9.808	14	.000	2,145

The hypothesis testing for the rubber weight intervention revealed a highly significant impact on performance, as evidenced by a t_count value of 9.808, which substantially exceeds the t_table value of 2.145. With a recorded significance value of 0.000 ($P < 0.05$), the null hypothesis (H_0) is rejected, confirming that the application of progressive resistance through rubber weights provides a statistically significant improvement in the straight kick speed of Tapak Suci PIMDA 181 athletes in Majene Regency.

Table 5. Test of differences between Tabata Training and Rubber Weight Training

Variable	T-Test			Difference	Information
	Count	df	Sig.		
Tabata Training Pretest-Posttest	4.993	14	0,000	0,58933	Significant
Rubber Weight Training Pretest-Posttest	9.808	14	0,000	1,48733	Significant

Comparative analysis of the paired t-test results reveals that both innovative learning models significantly enhance performance, though their degree of impact varies. The Tabata training group achieved a mean difference of 0.58933, while the rubber weight training group showed a substantially higher mean difference of 1.48733. With a significance value of 0.000 ($P < 0.05$) for both interventions, the data confirms that both methods are effective in increasing the straight kick speed of Tapak Suci PIMDA 181 athletes.

However, a closer evaluation of the difference values indicates that rubber weight training exerts a more profound influence on explosive motor performance compared to the Tabata method. The larger improvement margin observed in the rubber weight group suggests that progressive resistance training is highly effective in optimizing the biomechanical efficiency and speed of the straight kick. Consequently, while both models represent valuable innovations in learning, the rubber weight intervention offers a superior impact for athletes seeking maximum gains in striking velocity.

Discussion

The findings of this study confirm that the implementation of innovative learning models—specifically through Tabata training and rubber weight interventions—significantly enhances the straight kick speed of Tapak Suci PIMDA 181 students-athletes. These results underscore the importance of integrating evidence-based physical training into the martial arts curriculum to overcome performance stagnation.

Tabata Training as a HIIT Innovation

The implementation of the Tabata method as a High-Intensity Interval Training (HIIT) innovation proved to be a statistically significant driver of performance, yielding a t_count of 4.993 ($P < 0.05$) and a mean improvement of 0.58933. This efficacy is rooted in the protocol's ability to stimulate both aerobic and anaerobic metabolic pathways simultaneously through 20-second maximal intensity bursts. By pushing athletes to their physiological limits in short durations, this model facilitates rapid neuromuscular adaptations and enhances the recruitment of fast-twitch muscle fibers, which are essential for the explosive power required in Pencak Silat straight kicks.

These findings align with the foundational theories of Izumi Tabata, which suggest that high-intensity intermittent exercise is superior to traditional steady-state training for improving anaerobic capacity and peak oxygen debt (Foster et al., 2015; Tabata, 2019). Previous studies in combat sports have similarly demonstrated that HIIT protocols significantly improve reaction time and strike velocity by simulating the high-intensity physiological demands of a competitive match (Vasconcelos et al., 2020). By applying this innovative learning model, students achieve higher muscle contraction speeds, supporting the theory that structured interval training is a potent catalyst for optimizing explosive motor performance in martial arts.

The Impact of Rubber Weight Innovation

The introduction of rubber weights as an innovative learning model demonstrated exceptional effectiveness in enhancing motor performance, as evidenced by a t_count of 9.808, which significantly exceeds the t_table of 2.145. This model is uniquely advantageous because it provides constant, progressive resistance throughout the entire range of motion, requiring the leg muscles to maintain high tension during both the extension and retraction phases. By specifically addressing the weakness of sluggish leg withdrawal identified in initial observations, this innovation trains the neuromuscular system to remain explosive under load, ultimately resulting in a more lethal and rapid striking capability for the athletes.

These results are consistent with the theory of progressive resistance training and biomechanical specificity, which posits that applying resistance that mimics the movement pattern of a specific skill leads to superior transfer of strength to speed (Stone et al., 2022). Previous studies by Zatsiorsky and Kraemer on the "dynamic effort method" support the idea that training against elastic resistance increases the rate of force development (RFD), allowing athletes to overcome inertia more effectively (Blazevich et al., 2020). By integrating rubber weights into the training curriculum, this

study confirms that targeted resistance innovation not only strengthens the primary movers but also refines the technical efficiency of the kick, echoing earlier findings that elastic loads are highly effective for optimizing the rapid contraction-relaxation cycles essential in high-level martial arts.

Comparison of Model Effectiveness

The comparative analysis between the two innovative learning models highlights a clear distinction in their physiological impact, with the rubber weight training model proving superior in generating sheer speed gains. This superiority is quantitatively supported by a mean difference of 1.48733, which more than doubles the 0.58933 recorded for the Tabata group. The primary factor behind this discrepancy is the "sport-specific" nature of rubber resistance; while the Tabata method focuses on systemic anaerobic endurance and metabolic conditioning, rubber weights provide targeted resistance that directly challenges the specific muscle groups and biomechanical pathways required for a Pencak Silat straight kick.

This finding aligns with the principle of "Specific Adaptation to Imposed Demands" (SAID), which suggests that the body adapts specifically to the type of stress applied during training (Guard, 2025). According to theories of neuromuscular adaptation, elastic resistance—such as rubber weights—enhances the stretch-shortening cycle (SSC) more effectively for localized movements than generalized interval training (Zhao et al., 2026). Previous research by Fleck and Kraemer supports this, indicating that resistance training which closely mimics the kinetic chain of a specific athletic movement leads to more significant improvements in explosive velocity (Enes et al., 2025; Kraemer & Ratamess, 2025). Thus, while Tabata improves the athlete's overall work capacity, the rubber weight innovation acts as a specialized catalyst for increasing striking speed by refining the biomechanical efficiency of the leg's extension and retraction.

Overall, these findings confirm that moving beyond conventional routines toward innovative learning models is crucial for athletic development. The integration of these measurable physical training approaches into the extracurricular curriculum provides a data-driven solution to technical stagnation. For coaches and sports educators, these results offer a clear roadmap: utilizing rubber weights for specific technical speed and Tabata for metabolic conditioning can synergistically optimize the competitive performance of Tapak Suci students in any school or club environment.

4. CONCLUSION

The innovative learning model through weight training has had a positive impact on Tapak Suci student athletes. The Tabata training model innovation has been proven to significantly increase the straight kick speed of Tapak Suci PIMDA 181 Majene students with a calculated t-value of 4.993 > t-table 2.145. The use of rubber weights showed a significant effect on increasing straight kick speed with a calculated t-value of 9.808 > t-table 2.145. Both training models are effective in improving student performance, but rubber weight training has a greater level of effectiveness than Tabata.

This is evident from the mean difference (mean difference) for rubber weight training of 1.48733, while Tabata training was 0.58933.

As a recommendation, for educators and coaches, it is recommended to integrate the innovative rubber weight training model into the routine training curriculum, especially to improve students' leg-pulling technique and kicking speed. For Student Athletes, it is hoped that students can independently utilize simple media such as rubber (resistance bands) to improve physical quality and kicking techniques to achieve higher performance. Given that this study was limited to a male sample, future researchers are advised to test the effectiveness of this model on female groups or combine both methods in one training cycle to see the resulting synergistic effect

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