

Development of a Speed, Agility, and Quickness Training Program to Improve Kicking Skills in Youth Novice Taekwondo Athletes

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Abstract

Background and Aim: Youth need to undergo physical training when learning Taekwondo because it is a sport with a high level of competition intensity. If young people lack physical fitness, they will find it difficult to effectively engage in this sport. Therefore, teachers should focus on physical training while teaching Taekwondo to youth, adopting effective measures to meet the goals of physical training. So, the main objective of this research was to study the effect of a speed, agility, and quickness training program to improve kicking skills for youth novice taekwondo players in a taekwondo club.

Methodology: This research employed a mixed-method design to develop a speed, agility, and quickness training program aimed at improving the kicking skills of youth novice taekwondo players. The populations were 150 male taekwondo athletes aged 14–16 years, who were surveyed to determine the current situation and training needs. From this group, 30 male taekwondo athletes were selected for the experiment. Research instruments included a questionnaire (IOC=0.89), in-depth interviews with coaches (IOC=1.00) and experts, a focus group outline, and a connoisseurship outline. Independent sample t-tests to compare between-group differences, while repeated measures ANOVA was employed to compare within-group differences across testing phases. Qualitative data was analyzed through content analysis.

Results: 1) After eight weeks of implementing the speed, agility, and quickness training program, the pre-test results showed no significant differences between the control and experimental groups in Front kick, Side kick, Push kick, and Downward kick ($p > .05$), except for the Hook kick where the control group performed better (7.06 ± 1.22 vs. 6.00 ± 0.84 , $p = .01$). However, post-test results revealed that the experimental group achieved significantly higher mean scores than the control group across all five kicking skills, including Front kick (17.46 ± 1.50 vs. 13.06 ± 1.48 , $t = 8.055$, $p < .01$), Side kick (16.93 ± 0.79 vs. 10.26 ± 0.59 , $t = 25.944$, $p < .01$), Push kick (13.00 ± 0.89 vs. 9.46 ± 0.51 , $t = 13.817$, $p < .01$), Hook kick (13.66 ± 0.89 vs. 8.20 ± 1.26 , $t = 13.640$, $p < .01$), and Downward kick (24.33 ± 1.17 vs. 15.46 ± 1.24 , $t = 20.051$, $p < .01$). Repeated measures ANOVA further confirmed significant improvements over time in all skills (Front kick: $p < .01$; Side kick: $p < .01$; Push kick: $p < .01$; Hook kick: p

< .01; Downward kick: $p < .01$). These findings indicate that the program effectively enhanced overall kicking performance in novice youth taekwondo players.

Conclusion: The program has a clear structure, practical feasibility, and alignment with sports science principles. Its key strengths lie in its progressive design, the integration of SAQ with kicking skills, emphasis on safety, and motivation for young athletes.

Keywords: Speed Agility and Quickness Training Program; Kicking Skills; Youth Novice Taekwondo; Taekwondo Club

Introduction

Taekwondo, as a combat sport filled with power and speed, has rapidly gained global popularity due to its exciting competitions and exquisite kicking techniques, attracting large numbers of participants and audiences (Chen Jinyu, 2024). In competitions, kicking skills are the decisive factor in determining outcomes. Youth novice taekwondo players demonstrate vitality and enthusiasm, yet their competitive development requires training methods that match the growth and developmental characteristics of adolescents (Deng Y, 2020).

One of the foremost challenges is building leg strength, which forms the foundation for powerful kicking techniques. In addition, speed, agility, and quick reaction abilities are essential to cope with rapidly changing competition scenarios (Chen Jing, 2024; Wang Lu, 2003). Functional movement screening and physical fitness assessments enable coaches to design more targeted and effective training plans, thereby improving athletes' overall performance.

However, traditional training models, though effective in establishing technical and strength foundations, have limitations in cultivating speed, agility, and reaction capabilities. They often emphasize repetitive, rigid technical drills, lack simulation of complex competition environments, and fail to develop rapid decision-making under pressure (Huang Feihong, 2025; Gao, 2017). These shortcomings hinder young athletes' skill breakthroughs and the broader development of Taekwondo.

Therefore, the development of a scientific and targeted training program focusing on speed, agility, and quick response is urgently needed. Such a program not only enhances kicking skills and physical fitness but also bridges the gap between theory and practice. It provides a foundation for systematic and sustainable Taekwondo training, enriching the theoretical framework while promoting long-term advancement in youth Taekwondo training and performance (Chen Jing, 2024; Huang Feihong, 2025).

Objectives

The main objective of this research was to develop a speed, agility, and quickness training program to improve kicking skills for youth novice taekwondo players in a taekwondo club.

Literature Review

1. Taekwondo training activities and develop youth players' theoretical basis for training methods for speed, agility, and quickness training

Youth Taekwondo training is not only about learning technical skills such as kicking and defense, but also about building the fundamental physical qualities that underpin successful performance. Among these qualities, speed, agility, and quickness (SAQ) play a central role in the ability of athletes to attack, defend, and react to their opponents effectively during competition. Developing these components during adolescence is particularly important, as this period is considered a “sensitive window” for motor skill acquisition and long-term physical development.

The design of training methods tailored to the unique demands of Taekwondo is essential for maximizing the benefits of SAQ training. Pan, Y., & Chen, H. (2023) emphasized that striking speed and sensitivity are critical for Taekwondo performance. Athletes with high sensitivity can quickly adapt their movement patterns when opponents change direction or tactics unexpectedly.

In conclusion, the theoretical basis and supporting research demonstrate that SAQ training is fundamental to the development of youth Taekwondo athletes. Speed enhances the execution of offensive and defensive actions, agility enables effective directional changes, and quickness sharpens reaction to unpredictable stimuli. Together, these components form the core of athletic performance in combat sports. By applying SAQ training within the sensitive developmental window of adolescence, coaches can foster not only technical proficiency but also physical robustness and injury prevention, laying the foundation for progression to elite levels in the future.

Nie Weiwei (2025) further explores the importance of improving speed and agility in athletes' physical training during special technical training. He pointed out the importance of speed and agility in athletes' training and competition and focused on the corresponding training strategies. In the speed boost training, you can choose from acceleration training, sprinting explosive training, and reaction speed training. In agility and speed improvement training, agility ladder training, quick steering and change of direction training, as well as explosive power and coordination training can be performed. Shu Jie (2024) conducted an in-depth study on the effect of strength training based on speed loss on the maximum strength and explosiveness of adolescent female taekwondo athletes. The results of the

study confirmed that the training regimen in the experimental group had a positive effect on improving the speed and agility of the athletes, as well as other relevant body composition parameters, while the control group did not have the same improvement effect.

2. Theoretical basis for the training of taekwondo kicking skills

2.1 Importance of Kicking Skills in Taekwondo

Kicking techniques are the core component of Taekwondo, contributing to both offensive and defensive strategies. They require the integration of lower limb strength, explosive power, coordination, and reaction speed. Developing these abilities from a theoretical perspective involves the principles of specificity, overload, progression, and periodization, which ensure that training is targeted, effective, and aligned with the physiological characteristics of Taekwondo athletes.

2.2 Motor Learning and Skill Acquisition

According to motor learning theory, repeated practice of specific skills under varied conditions promotes automaticity and adaptability. Kicking skills such as front, side, push, hook, and downward kicks require repetition, feedback, and progressive complexity to achieve mastery.

2.3 Neuromuscular and Biomechanical Principles

Biomechanically, Taekwondo kicking involves a coordinated sequence of movements, starting from the core and hip muscles, transferring force through the thigh, knee, and ankle joints, and finally delivering precise impact through the foot. Neuromuscular adaptations such as motor unit recruitment, synchronization, and firing frequency underpin the ability to generate explosive and controlled kicks.

2.4 Sensitive Period of Youth Development

Adolescence is regarded as a sensitive period for the development of explosive strength, coordination, and speed, which are critical for effective kicking. Training should adhere to the principles of age-appropriateness and progressive overload, ensuring long-term athletic development (LTAD).

2.5 Footwork and Agility as the Foundation of Kicking Skills

Effective kicking not only depends on leg strength but also on agility, balance, and footwork control, which allow athletes to position themselves correctly, generate power, and recover quickly after execution.

Su Meng (2025) discussed the research on taekwondo lower limb strength training and footwork agility training methods. She emphasized that in the fierce competition, athletes must have the ability to react quickly and burst out with maximum strength in a very short period to defeat their opponents. Therefore, for taekwondo athletes, footwork agility training and lower limb strength training are of great significance. This study analyzes the importance of taekwondo lower limb strength training and footwork agility training and

introduces the methods of taekwondo lower limb strength training and footwork agility training.

Zhu Dinghuang (2021) investigated the effect of compression training on anaerobic capacity and lower limb strength of taekwondo athletes, providing an objective reference for the application of compression training to taekwondo athletes' ability metabolism training. Studies have shown that compression training is equivalent to traditional heavy weight resistance training in the training of athletes' vertical jumping ability, and the former is used as an auxiliary training method for lower limb explosiveness in taekwondo. Li Yuqing (2020) examined the test and training methods of lower limb explosiveness of taekwondo athletes and proposed their applicability to develop lower limb explosiveness in taekwondo training. He stressed that the development of lower limb strength by taekwondo athletes is a prerequisite for designing a taekwondo training program. With the increase in training time, the explosive power of the lower limbs of taekwondo athletes showed an increasing trend.

Wei Wei (2019) conducted a study on the effect of soft ladder training on the footwork mobility of taekwondo athletes. After 12 weeks of soft ladder training, the study proved that the soft ladder training influenced the improvement of footwork movement ability through statistical analysis. In addition, the soft ladder training allowed the athletes to better use the footwork to move, and the athletes in the experimental group performed better than the control group in the combined footwork. Soft ladder training significantly improves the movement, acceleration, and braking ability of athletes' lower limbs. Xiao Ying (2017) studied the reaction speed training of high-level taekwondo athletes and its effect test, and found that there are differences in the way signals are executed in the cerebral cortex of different taekwondo athletes. Studies have shown that reaction speed training is a must-have training program for every taekwondo athlete, and through scientific training, taekwondo athletes' reaction speed can be continuously improved and improved. Zeng Liling (2016) conducted a study on the training method of special fast strength for taekwondo athletes. She found that for taekwondo athletes, specialized fast strength has a direct impact on athletic performance. Therefore, in the actual competition, if the athlete wants to effectively hit the opponent, he needs to have fast and flexible footwork, and in the usual training, he should pay attention to the training of the footwork speed, and only with fast strength can he ensure the completion of the action.

3. Speed, agility, and quickness training

Zou Junliang (2023) conducted a study on physical strength training for teenage taekwondo athletes and proposed specialized training programs to enhance speed and agility. He pointed out that adolescence is a crucial stage for the physical quality development of athletes, and scientifically reasonable physical training can lay a solid foundation for their improvement in taekwondo-specific abilities. The study designed various training methods,

including agility training, speed drills, and strength training. Through a systematic training plan, it effectively enhanced the physical qualities of teenage athletes, improved their reaction speed and movement execution ability in taekwondo competitions, and consequently elevated their overall competitive performance.

Chen Jian (2023) discussed methods to enhance the sprinting strength and speed of high school students, some of which are also applicable to speed training for teenage taekwondo athletes. The article points out that speed is one of the key factors for taekwondo athletes to gain an advantage in competitions, and strength is the foundation of speed. The study emphasizes the importance of scientific training and proposes various effective training methods, such as using weight training to improve lower body strength and explosive exercises to enhance movement speed.

To sum up, a youth novice taekwondo player's speed, agility, and reflexes are an important part of their competitive abilities. Through scientific and reasonable training methods, the abilities of youth novice taekwondo players can be effectively improved to achieve better results in competitions.

Conceptual Framework

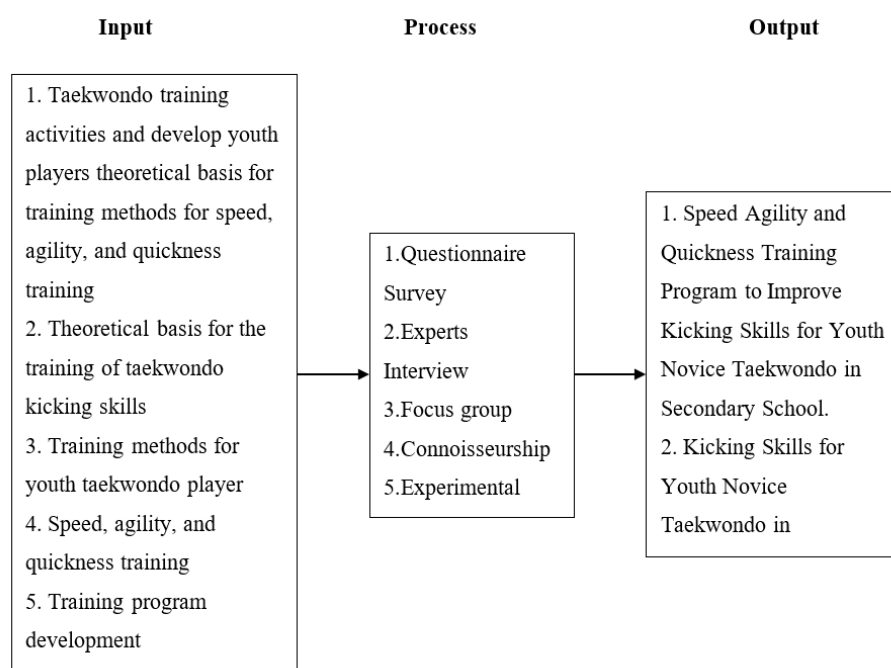


Figure 1 Conceptual Framework

Methodology

Population

The participants of this study were selected from the Jiaozuo City Daoyi Youth Taekwondo Club. Among the many students in the club, there are 150 students aged between 14 and 16 years old.

Sample

From 150 eligible youth novice taekwondo players, the researchers will make an announcement to find people interested in participating in the experiment, and then test their kicking skills. Finally, 30 youth novice taekwondo players who had the lowest score of kicking skill. These 30 athletes were randomly divided into two groups, with 15 in each group. The experimental group of 15 youth novice taekwondo players will train according to a speed, agility, and quickness training program, while the control group of 15 youth novice taekwondo players will train according to a traditional training program.

After recruitment and independent registration for the test, the ranking was based on the kicking skill test results of 30 youth novice taekwondo players who participated in this experiment. And ranked the test scores from highest to lowest, then used a systematic method to divide athletes into two groups with 15 athletes each, and then random lottery method to determine the experimental group and control groups.

Inclusion criteria:

1. An experimental training course in which all novice taekwondo players can participate in a six-week experiment.
2. Youth novice taekwondo players have experienced health problems or injuries during the experiment but can continue training.
3. Youth novice taekwondo players who can complete the test within the time specified by the investigator.

Eliminate criteria:

1. During the 8-week experiment, less than 90% of the training sessions were attended.
2. The sample couldn't complete the test within the time specified by the investigator.
3. The sample who have experienced health problems or injuries during the experiment and can continue the experiment.
4. The sample that withdrew from the study.

Research instrument

1. Interview Outline: The open-ended questions are designed to explore the experiences, challenges, and perspectives of young taekwondo enthusiasts and coaches on agile and fast ability training. These qualitative insights complement the quantitative survey data. Before using the questionnaire, it will be tested for validity by 3 experts.

4. Focus Group Outline: A structured set of questions was developed for focus group discussions to gather collective insights from experts on agile and rapid competency training practices.

5. Connoisseurship Outline: A validation outline was designed to cross-check the results of the experimental data to ensure the reliability and accuracy of the study results.

6. Specific training program: An experimental plan was developed outlining specific training interventions, their implementation, and methods used to assess performance.

7. Taekwondo kicking skills test: A performance test program for agility and fast ability, including tests of reaction speed, movement speed, and explosiveness.

7.1 Speed test: 20-meter sprint

7.2 Agility test: T-Test

7.3 Quickness test: Choice-Reaction Kick

7.4 Kicking skill test: 1) Front kick: Number of kicks that successfully hit the target correctly within the specified time (20 seconds). 2) Side kick: Number of kicks that successfully hit the target correctly within the specified time (20 seconds). 3) Downward kick: Number of kicks that successfully hit the target correctly within the specified time (30 seconds). 4) Push Kick: Number of kicks that successfully hit the target correctly within the specified time (20 seconds). 5) Hook kick: Number of kicks that successfully hit the target correctly within the specified time (30 seconds).

Data collection

1. Interviews 5 experts were invited to consult and determine elements and training methods to improve kicking skills for youth novice taekwondo players in the taekwondo club. The group includes 1 sports physiologist, 1 youth novice taekwondo players training specialist, 1 provincial taekwondo coach, 1 university taekwondo coach, and 1 popular taekwondo club coach.

2. Focus group with 9 experts participated in a focus group and made recommendations for improving the training program. Focus groups include experts in sports medicine, biomechanics, performance analysis, sports nutrition, and taekwondo.

3. Connoisseurship with 7 experts evaluated the experimental samples using the connoisseurship method. This group includes sports scientists, biomechanics specialists, sports performance analysts, and professional youth novice taekwondo players.

4. Experimental: A speed, agility, and quickness training program is implemented for 8 weeks. The experimental group consists of 15 youth novice taekwondo players who train in the university indoor gym every Monday, Wednesday, and Friday from 4:00 PM to 5:30 PM. The control group also consists of 15 youth novice taekwondo players following a traditional training program during the same time. Attendance and compliance are monitored during the training.

By comparing the implementation process of two training programs, the study focuses on the practical effects of a specialized experimental training program on enhancing the kicking speed, agility, and quickness of youth beginners.

6.1 Pre-Test Data Collection: Baseline demographic data (e.g., height, weight, age) and taekwondo competitive youth novice taekwondo players' response tests were performed to determine the level of performance at the beginning.

6.2 Mid-Test Data Collection: Experimental data were collected before the start of the experiment and at the end of week 4.

6.3 Post-test Data Collection: collected at the end of 8 weeks to evaluate the progress and effectiveness of the training.

7. Data Analysis: All collected data were systematically processed and verified to ensure reliability and accuracy.

Data Analysis

Experimental data analysis: An independent sample t-test was used for data comparison between groups. Repeated measures ANOVA for within-group comparisons and post hoc (Bonferroni).

Results

1. The speed, agility, and quickness training program to improve kicking skills for youth novice taekwondo players in the taekwondo club.

Table 1 Draft of speed, agility, and quickness training program to improve kicking skills for youth novice taekwondo players in a taekwondo club.

Week	Focus	SAQ Drills	Kicking Integration	Progression & Notes
1	Foundation & Safety	Ladder drills (basic steps), cone zigzag	Front kick (accuracy on target zone)	Warm-up & ankle/knee mobility emphasized; RPE 5–6
2	Basic Speed & Core Strength	20 m sprint (start from fighting stance), line hops, core exercises	Push kick (timed reps, zone-target)	Introduce simple plyometric (squat jump 2x6)
3	Intro to Change of Direction	Short 505 test (10–12 m), side shuffle	Side kick to fixed pad (accuracy focus)	Start random target cues; adjust difficulty by player level
4	Agility + Mid-Test	Modified T-test, ladder in–out, bounding drills	Downward/Axe kick (20s × 2, accuracy check)	Mid-test: 10 m sprint + reaction kick



Week	Focus	SAQ Drills	Kicking Integration	Progression & Notes
5	Quickness & Reaction	First-step quickness (signal → sprint 3 m), cone-to-pad reaction	Hook kick (10 reps/side, judged for speed & accuracy)	Increase signal speed, shorten rest; add feedback immediately
6	Integrated SAQ + Kicks	Reactive shuttle run (5–10 m), plyometric bounding, core rotation	Kick combinations (Front + Push / Side + Hook)	Use station format for large groups; small competitive drills
7	Match Simulation & Motivation	COD drills with random cues, chase-tag game	Choice-reaction kicks (left/right pad)	Mini match simulation (1v1, 12s/round, real scoring)
8	Evaluation & Feedback	Retest: 10 m sprint, 505, Modified T, reaction drills	All 5 kicks (20–30s each, count correct hits in target zones)	Compare pre–post; include qualitative feedback from players

Table 1 found that the revised SAQ training program for youth novice taekwondo players is structured over eight weeks, with training conducted 2–3 times per week and each session lasting 60–75 minutes. The program sets clear weekly objectives, progressing systematically from fundamental movement patterns and basic speed development to change of direction, quickness, and match-simulation training.

In weeks 1–2, the focus is on building foundations, ensuring safety, and developing short sprint speed alongside basic kicks such as the front kick and push kick. Core training and injury-prevention exercises are also emphasized. Weeks 3–4 introduce change-of-direction and agility drills, integrated with sidekicks and downward kicks, while also incorporating a mid-test to monitor progress. Weeks 5–6 emphasize reaction and quickness, combining hook kicks and kick combinations, with increased intensity and reduced rest intervals. Week 7 focuses on match-simulation drills in 1v1 settings to develop decision-making skills and prepare athletes for competitive pressure. Finally, week 8 is dedicated to comprehensive evaluation, including SAQ performance tests and all five kicking skills, measured for speed, volume, and accuracy.

2. The experimental result by using a speed, agility, and quickness training program to improve kicking skills for youth novice taekwondo players in a taekwondo club



In this step, the researcher would summarize the experimental results analysis, and the independent sample t-test was used for comparison of data between groups. Comparison analysis within groups between pre-test, mid-test, and post-test on kicking skills using Repeated measures ANOVA. The two-group comparison within the group was used dependent sample t-test. ($p < 0.05$, which means it has a significant difference; $p > 0.05$ means no significant difference). After data analysis, the research results could be summarizing as table below.

Table 2 The comparison of kicking skill on pre-test between the control group and experimental group by using an independent sample t-test ($n=30$)

Variables	Control Group	Experimental group	t	p
	(n=15)	(n=15)		
	$\bar{x} \pm SD$	$\bar{x} \pm SD$		
1. Front kick (frequency)	9.80 $\pm$ 1.14	10.13 $\pm$ 1.18	0.782	0.44
2. Side kick (frequency)	8.33 $\pm$ 0.48	8.40 $\pm$ 0.50	0.367	0.71
3. Push Kick (frequency)	8.00 $\pm$ 0.65	7.86 $\pm$ 0.91	-0.459	0.65
4. Hook kick (frequency)	7.06 $\pm$ 1.22	6.00 $\pm$ 0.84	-2.779	0.01*
5. Downward kick (frequency)	13.66 $\pm$ 1.11	14.00 $\pm$ 1.55	0.674	0.50

* $p < 0.05$

Table 2 found that the comparison of kicking skills between the control and experimental groups using the independent samples t-test revealed no statistically significant differences in Front kick, Side kick, Push kick, and Downward kick ($p > 0.05$). This indicates that the training programs applied in both groups produced similar outcomes in these skills.

However, for the Hook kick, the mean score of the control group (7.06 $\pm$ 1.22 times) was significantly higher than that of the experimental group (6.00 $\pm$ 0.84 times), with a statistically significant difference at the .05 level. This finding suggests that the control group performed better in the Hook kick skill compared to the experimental group.

Table 3 The comparison of kicking skill on post-test between the control group and the experimental group by using an independent sample t-test ($n=30$)

Variables	Control Group	Experimental group	t	p
	(n=15)	(n=15)		
	$\bar{x} \pm SD$	$\bar{x} \pm SD$		
1. Front kick (frequency)	13.06 $\pm$ 1.48	17.46 $\pm$ 1.50	8.055	0.01*
2. Side kick (frequency)	10.26 $\pm$ 0.59	16.93 $\pm$ 0.79	25.944	0.01*
3. Push Kick (frequency)	9.46 $\pm$ 0.51	13.00 $\pm$ 0.89	13.817	0.01*
4. Hook kick (frequency)	8.20 $\pm$ 1.26	13.66 $\pm$ 0.89	13.640	0.01*
5. Downward kick (frequency)	15.46 $\pm$ 1.24	24.33 $\pm$ 1.17	20.051	0.01*

* $p < 0.05$

Table 3 found that the comparison of kicking skills between the control group and the experimental group using the independent samples t-test revealed statistically significant differences across all five measured skills. Specifically, the experimental group demonstrated significantly higher mean scores than the control group in Front kick (17.46 ± 1.50 vs. 13.06 ± 1.48 , $t = 8.055$, $p = 0.01$), Side kick (16.93 ± 0.79 vs. 10.26 ± 0.59 , $t = 25.944$, $p = 0.01$), Push kick (13.00 ± 0.89 vs. 9.46 ± 0.51 , $t = 13.817$, $p = 0.01$), Hook kick (13.66 ± 0.89 vs. 8.20 ± 1.26 , $t = 13.640$, $p = 0.01$), and Downward kick (24.33 ± 1.17 vs. 15.46 ± 1.24 , $t = 20.051$, $p = 0.01$). These results indicate that the experimental training program was more effective than the control training program in enhancing performance across all types of kicking skills measured. The consistently significant differences suggest that the experimental intervention provided a substantial improvement in both the frequency and quality of kicking execution.

Table 4 The comparison of front kick skill on pre-test, mid-test, and post-test within the experimental group by using Repeated measures ANOVA (n=15)

Variables	Source of variant	Sum of squares	df	MS	F	p
Front kick	Time	406.178	2	203.089	190.680	0.01*
	Error	29.822	28	1.065		
	Total	436.00	44			

* $p < 0.05$

Table 4 found that the repeated measures ANOVA for the Front kick skill revealed that the factor of time had a statistically significant effect at the .05 level ($F = 190.680$, $p = 0.01$). The analysis showed a Sum of Squares of 406.178 with degrees of freedom (df) = 2 and a Mean Square (MS) = 203.089 for the time factor. The error term indicated a Sum of Squares of 29.822, $df = 28$, and $MS = 1.065$. These results demonstrate that the performance level of the Front kick skill significantly changed across the measurement periods, indicating that the training program was effective in progressively improving this skill over time.

Table 5 The comparison of front kick skill on pre-test, mid-test, and post-test within the experimental group, comparing two groups by using the Bonferroni test (n=15)

Variables	Test	Pre-test	Mid-test	Post-test
Front kick	Pre-test	-	3.133*	7.333*
	Mid-test	-	-	4.200*
	Post-test	-	-	-

Table 5 found that the pairwise comparison analysis revealed statistically significant differences in the mean scores of the Front kick skill across all measurement periods.

Table 6 The comparison of side kick skill on pre-test, mid-test, and post-test within the experimental group by using Repeated measures ANOVA (n=15)

Variables	Source of variant	Sum of squares	df	MS	F	p
Side kick	Time	548.978	2	274.489	434.492	0.01*
	Error	17.689	28	0.6632		
	Total	566.667	44			

*p < 0.05

Table 6 found that the repeated measures ANOVA for the Side kick skill indicated that the factor of time had a statistically significant effect at the .05 level (F = 434.492, p = 0.01). The analysis revealed a Sum of Squares of 548.978 with degrees of freedom (df) = 2 and a Mean Square (MS) = 274.489 for the time factor. The error term showed a Sum of Squares of 17.689, df = 28, and MS = 0.663. These results demonstrate that the performance of the Side kick skill significantly improved across the different measurement periods, confirming the effectiveness of the training program in enhancing this specific kicking ability over time.

Table 7 The comparison of side kick skill on pre-test, mid-test, and post-test within the experimental group, comparing two groups by using the Bonferroni test (n=15)

Variables	Test	Pre-test	Mid-test	Post-test
Side kick	Pre-test	-	4.800*	8.533*
	Mid-test	-	-	3.733*
	Post-test	-	-	-

Table 7 found that the pairwise comparison analysis revealed statistically significant differences in the mean scores of the Side kick skill across all measurement periods.

Table 8 The comparison of push skill on pre-test, mid-test, and post-test within the experimental group by using Repeated measures ANOVA (n=15)

Variables	Source of variant	Sum of squares	df	MS	F	p
Push kick	Time	218.178	2	109.089	165.207	0.01*
	Error	18.489	28	0.660		
	Total	236.667	44			

*p < 0.05

Table 8 found that the repeated measures ANOVA for the Push kick skill indicated that the factor of time had a statistically significant effect at the .05 level ($F = 165.207$, $p = 0.01$). The analysis revealed a Sum of Squares of 218.178 with degrees of freedom (df) = 2 and a Mean Square (MS) = 109.089 for the time factor. The error term showed a Sum of Squares of 18.489, $df = 28$, and $MS = 0.660$. These results demonstrate that the performance of the Push kick skill significantly improved across the measurement periods, confirming the effectiveness of the training program in enhancing this particular kicking ability over time.

Table 9 The comparison of push kick skill on pre-test, mid-test, and post-test within the experimental group, comparing two groups by using the Bonferroni test ($n=15$)

Variables	Test	Pre-test	Mid-test	Post-test
Push kick	Pre-test	-	1.133*	5.133*
	Mid-test	-	-	4.000
	Post-test	-	-	-

Table 9 found that the pairwise comparison analysis revealed that the mean scores of the Push kick skill showed statistically significant differences across some measurement periods. Specifically, a significant difference was found between the Mid-test and Post-test (Mean difference = 4.000), it was not statistically significant ($p > .05$). These findings confirm that the Push kick skill improved significantly from the pre-test to the post-test. However, the progression between the mid-test and post-test stages was not statistically significant, suggesting a plateau in improvement during the latter phase of training.

Table 10 The comparison of hook kick skill on pre-test, mid-test, and post-test within the experimental group by using Repeated measures ANOVA ($n=15$)

Variables	Source of variant	Sum of squares	df	MS	F	p
Hook kick	Time	454.444	2	227.222	622.391	0.01*
	Error	10.222	28	0.365		
	Total	464.666	44			

* $p < 0.05$

Table 10 found that the repeated measures ANOVA for the Hook kick skill indicated that the factor of time had a statistically significant effect at the .05 level ($F = 622.391$, $p = 0.01$). The analysis revealed a Sum of Squares of 454.444 with degrees of freedom (df) = 2 and a Mean Square (MS) = 227.222 for the time factor. The error term showed a Sum of Squares of 10.222, $df = 28$, and $MS = 0.365$. These results demonstrate that the performance of the Hook

kick skill significantly improved across the measurement periods, confirming the effectiveness of the training program in progressively enhancing this particular skill.

Table 11 The comparison of hook kick skill on pre-test, mid-test, and post-test within the experimental group, comparing two groups by using the Bonferroni test (n=15)

Variables	Test	Pre-test	Mid-test	Post-test
Hook kick	Pre-test	-	5.000	7.667*
	Mid-test	-	-	2.667*
	Post-test	-	-	-

Table 11 found that the pairwise comparison analysis indicated that the mean scores of the Hook kick skill showed statistically significant differences across certain measurement periods. Specifically: Between Pre-test and Mid-test, the mean difference was 5.000 but did not reach statistical significance ($p > .05$).

Table 12 The comparison of downward kick skill on pre-test, mid-test, and post-test within the experimental group by using Repeated measures ANOVA (n=15)

Variables	Source of variant	Sum of squares	df	MS	F	p
Downward kick	Time	802.711	2	401.356	344.488	0.01*
	Error	32.622	28	1.165		
	Total	835.333	44			

* $p < 0.05$

Table 12 found that the repeated measures ANOVA for the Downward kick skill revealed that the factor of time had a statistically significant effect at the .05 level ($F = 344.488$, $p = 0.01$). The analysis showed a Sum of Squares of 802.711 with degrees of freedom ($df = 2$) and a Mean Square ($MS = 401.356$) for the time factor. The error term reported a Sum of Squares of 32.622, $df = 28$, and $MS = 1.165$. These results demonstrate that the performance of the Downward kick skill significantly changed across the measurement periods, confirming that the training program was highly effective in progressively improving this particular kicking skill.

Table 13 The comparison of downward kick skill on pre-test, mid-test, and post-test within the experimental group, comparing two groups using the Bonferroni test (n=15)

Variables	Test	Pre-test	Mid-test	Post-test
Downward kick	Pre-test	-	4.733*	10.333*
	Mid-test	-	-	5.600*
	Post-test	-	-	-

Table 13 found that the pairwise comparison analysis showed statistically significant differences in the mean scores of the Downward kick skill across all measurement periods.

Summary: After 8 weeks of using the speed, agility, and quickness training program to improve kicking skills for youth novice taekwondo players in a taekwondo club, the comparison of kicking skills between the control and experimental groups on pre-test using the independent samples t-test revealed no statistically significant differences in Front kick, Side kick, Push kick, and Downward kick ($p > 0.05$). However, for the Hook kick, the mean score of the control group was significantly higher than that of the experimental group, with a statistically significant difference at the .05 level.

The comparison of kicking skills between the control group and the experimental group on post-test using the independent samples t-test revealed statistically significant differences across all five measured skills. Specifically, the experimental group demonstrated significantly higher mean scores than the control group in Front kick, Side kick, Push kick, Hook kick, and Downward kick. These results indicate that the experimental training program was more effective than the control training program in enhancing performance across all types of kicking skills measured.

Discussion

On the front kick skill, the findings revealed that the experimental group showed continuous and significantly greater improvement in the Front kick compared with the control group, indicating that the SAQ training program was highly effective in enhancing the speed and accuracy of this kicking skill. A distinctive feature of this result is the steady progression across all testing periods (Pre–Mid–Post). This result is consistent with Yang, Z., & Wang, J. (2025), who emphasized that agility training is an essential component of physical fitness. They noted that such training helps the cardiovascular and muscular systems adapt to complex movements, enhances athletic performance, and reduces the risk of injuries. This supports the notion that SAQ training can effectively improve fundamental skills such as the Front kick.

On the side kick skill, the results indicated that the Side kick of the experimental group improved steadily and was significantly better than that of the control group. A key characteristic of this outcome is the uninterrupted improvement across all testing periods. This finding is in line with Ma, F., & Wang, L. (2025), who highlighted the importance of speed and agility training, particularly the use of ladder drills and change-of-direction exercises. Such training improves the coordination of the quadriceps, hamstrings, and hip muscles while also strengthening core stability, thereby contributing to more stable and accurate Side kick performance.

On the push kick skill, the results showed that the Push kick improved significantly in the early phase (Pre–Mid) but tended to plateau afterward (Mid–Post showed no significant

difference). The distinctive feature here is the rapid early improvement followed by slowed progress later on. This result corresponds with Shu Jie (2024), who studied speed-loss strength training and found that programs incorporating controlled velocity were more effective than traditional methods in enhancing explosiveness and agility. However, if the same training method is continued without adjustment, a plateau effect may occur. This suggests that for continued improvement in the Push kick, it may be necessary to adopt alternative training methods such as compound training or APRE to overcome stagnation.

On the hook kick skill, the findings indicated that the Hook kick showed significant improvement in the later stage of training (Mid–Post), while no significant differences were observed in the early stage (Pre–Mid). This highlights the nature of the skill, which requires extended and consistent practice before noticeable gains emerge. This result aligns with Yan Yong (2020), who noted that Taekwondo techniques demand high levels of reaction speed and coordination, especially more complex skills such as the Hook kick. These require neuromuscular adaptation and simulated combat training to accelerate responses. This explains why significant improvement in the Hook kick occurred only during the later phase of training.

On the downward kick skill, the results demonstrated that the Downward kick improved consistently across all testing periods (Pre–Mid–Post), with the experimental group significantly outperforming the control group. A distinguishing feature of this result is the clear and continuous progression, which was more pronounced than in any other skill. This finding is consistent with Shang Peng (2018), who underscored the importance of lower limb strength and agility-focused footwork training. Interventions such as soft ladder drills and unilateral training enhance balance, acceleration, and braking ability, key factors in executing a powerful and stable Downward kick.

Recommendations

Application of the research

1. Integration of SAQ in Taekwondo Clubs: Coaches in youth Taekwondo clubs should integrate Speed, Agility, and Quickness (SAQ) training 2–3 times per week into regular practice sessions. The program has been proven to enhance kicking skills across all five techniques (Front, Side, Push, Hook, Downward kick).

2. Skill-Specific Emphasis: For Push kick, coaches should incorporate progressive overload strategies to avoid plateaus in performance. For Hook kick, situational drills, rhythm-based exercises, and core–hip stability training should be emphasized, as these skills show improvement mainly in later phases of training. For Downward kick, unilateral and lower-limb strength training should be prioritized to maximize continuous improvement.

3. Injury Prevention and Physical Literacy: Since SAQ training improves coordination, core stability, and reaction time, it can also help reduce injury risk and promote broader physical literacy, making it useful beyond competition-focused training.

For further research

1. Longitudinal Studies: Extend the training period beyond 8 weeks (e.g., 12–24 weeks) to examine the long-term retention and sustainability of improvements in kicking performance.

2. Comparative Training Models: Compare SAQ training with other methods such as compound training, plyometric training, or speed-loss strength training to determine the most effective interventions for specific kicking techniques.

3. Biomechanical and Physiological Indicators: Incorporate motion capture systems (IMU), EMG, and physiological measures to provide deeper insights into neuromuscular and metabolic adaptations underlying skill improvements.

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