Table Tennis Physical Activity Program and Its Effect on the Skills Performances of Selected Athletes in a University in Shenyang City, Liaoning Province, China

Wang Yu

Faculty Of the Graduate School Emilio Aguinaldo College Manila, Philippines Doctor of Philosophy in Educational Management Major in Physical Education

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ABSTRACT

This study investigated the performance of selected student-respondents in table tennis prior to and after the implementation of a structured training program, focusing on five key skill constructs: Grip, Serve, Block, Spin, and Footwork. A descriptive-experimental design was employed, involving 50 student respondents classified by sex, grade level, and course. Standardized performance tests were administered before and after the intervention, and the data were analyzed using weighted means and standard deviations, t-tests, and ANOVA to determine performance levels and significant differences. The pre-test results revealed that the respondents generally had low performance levels in the basic skills of table tennis, namely: spin, block, serve, grip, and footwork. No significant differences in pre-test performance were found when grouped by sex, grade level, and course, confirming that deficiencies were uniformly distributed across these variables.

Post-test results showed marked improvement, verbally interpreted as high. Spin being the highest in rank as to mean result, followed by serve and block, footwork, and grip. The results also revealed that grip, block, spin, and footwork showed significant improvements, while serve was relatively low. When grouped by demographics, differences were generally not significant, except that males outperformed females on overall post-test scores, and Grade 4 students obtained significantly higher Grip scores than lower grades.

The findings confirmed that the training program was largely effective in enhancing the technical and tactical competencies of the student-respondents, particularly in Spin, Block, Grip, and Footwork, while serving skills required further reinforcement. It was concluded that structured, progressive, and game-based training interventions can significantly elevate table tennis performance, although individualized approaches may be necessary to address persistent weaknesses in Serve and ensure overall consistency across learners.

Keywords: table tennis, grip, serve, block, spin, footwork, pre-test, post-test, training program, performance improvem

INTRODUCTION

Table tennis, known for its fast-paced and dynamic nature, demands exceptional agility from its players. The ability to move quickly and change directions on the court can significantly impact game performance. According to Sekulić et al. (2019), agility in sports is crucial for improving reaction time and overall performance, making it a key focus in training programs. The demands of table tennis require players to develop both speed and precise control, which are closely related to agility performance.

Training programs designed to enhance agility often include a variety of physical activities aimed at improving speed, coordination, and balance. Zouhal et al. (2019) explored the effects of neuromuscular training on agility and found that structured programs significantly enhance athletes' ability to perform rapid directional changes. Similarly, Latorre-Román et al. (2018) demonstrated that contrast training, which combines different types of exercises, can effectively improve agility performance in young athletes. These findings underscore the importance of targeted training interventions in developing agility.

For sports athletes, engaging in a structured physical activity program can offer numerous benefits beyond enhanced athletic performance. Regular participation in physical activities, such as a table tennis program, contributes to overall health, fitness, and well-being. Research by Wang et al. (2016) indicates that physical training programs can lead to improvements in strength, speed, and agility, which are beneficial for students' physical health and academic performance. As students balance academic responsibilities with physical activities, effective training programs can help them maintain a high level of fitness and agility.

This study aims to evaluate the impact of a table tennis physical activity program on the agility performance of college students at a selected university in Liaoning Province, China. By examining the effectiveness of this specific training program, the research will provide insights into how targeted physical activity interventions can enhance agility and overall athletic performance among college students. The findings will contribute to the development of more effective training programs and to promoting the importance of physical activity in maintaining a balanced, healthy lifestyle.

BACKGROUND OF THE STUDY

China, a nation with a rich sporting tradition and a strong focus on physical education, highly values the development of athletic skills among its youth. Table tennis, in particular, holds a special place in Chinese sports culture, being a national sport with a profound historical and competitive legacy. The country's dedication to sports excellence is shown through investments in training programs and sports facilities to develop talented athletes from a young age. This context provides a solid foundation for exploring the effects of physical activity programs, like table tennis, on college students' agility performance.

The researcher, who is both a table tennis coach and a physical education (PE) teacher, brings a unique perspective to this study. With extensive experience in coaching and teaching, the researcher has witnessed firsthand the benefits and challenges of physical training in educational settings. This dual role has instilled a deep understanding of the importance of integrating effective training programs to enhance students' physical performance and overall well-being. The motivation to explore the effects of a table tennis physical activity program on agility performance stems from a desire to optimize training methods and contribute to the development of comprehensive physical education strategies that can be implemented in academic institutions.

This study holds significant importance for the selected university in Liaoning Province, China. By evaluating the effectiveness of a table tennis physical activity program, the research aims to provide valuable insights that can enhance the university's physical education curriculum. The findings could lead to the development of more targeted and effective training programs, fostering improved athletic performance and overall health among students. Additionally, this study aligns with the university's mission to promote physical fitness and sports excellence, thus supporting its commitment to providing a holistic educational experience.

Despite the recognized benefits of physical activity in enhancing athletic performance, there remains a notable gap in research specifically focusing on the impact of table tennis training programs on agility among college students. While existing studies have explored various aspects of agility and training in different sports contexts, there is limited research addressing the specific effects of table tennis programs on agility performance in the collegiate setting. This study aims to fill this gap by providing empirical evidence on how structured table tennis training can influence agility, offering new insights that can inform future research and practice in physical education and sports training.

REVIEW OF RELATED LITERATURE AND STUDIES

This section presents a comprehensive review of literature and previous studies related to table tennis skill development, particularly focusing on grip, serve, block, spin, and footwork. It aims to provide a theoretical and empirical foundation for the present study by highlighting relevant concepts, findings, and training approaches that have been proven effective in improving performance in racket sports. The review draws upon both local and international sources to contextualize the significance of structured training programs and to support the assessment of pre-test and post-test results among teenage participants.

Table Tennis Physical Activity Program

The development and implementation of table tennis physical activity programs have been explored through various studies, highlighting their importance in enhancing physical fitness, motor skills, and overall well-being among different populations. These programs are not only crucial for athletes but also for general physical education, especially in inclusive and school settings.

A key study by Al Ilham et al. (2022) focused on the evaluation of physical training programs in table tennis clubs in Bengkulu City. The research revealed that while the selection processes for coaches and athletes are adequate, the implementation of physical training programs is lacking, and the facilities and infrastructure need significant improvement. This evaluation underscores the need for improved program execution and facilities to enhance athlete performance, particularly at national events, where fatigue from poor physical conditioning has been a recurring issue.

In a broader educational context, Hook (2023) developed an innovative technology for organizing physical education in inclusive middle school classes through table tennis. This approach not only promotes motor skill development and physical fitness but also fosters social skills, teamwork, and self-confidence among students. The program is designed to motivate students to lead active and healthy lifestyles, highlighting the role of table tennis in comprehensive physical and psychological development.

Wang and Zhou (2023) examined the effects of lower-limb flexibility exercises on table tennis players' physical fitness, demonstrating significant improvements in both static and dynamic flexibility. These findings suggest that incorporating flexibility training into table tennis programs can optimize player performance, emphasizing the importance of targeted physical exercises in athletic training.

Similarly, Abdelkhalek (2022) investigated the effects of core stability exercises on dynamic balance and other physical and skill variables in table tennis players. The study found that these exercises significantly enhanced the players' dynamic balance and skill levels, recommending the integration of such training into regular preparation periods for athletes.

Zeng (2023) analyzed the physical demands of table tennis, particularly in the context of energy metabolism. The study highlighted the need for a balanced approach to aerobic and anaerobic exercises in training, given the sport's intermittent nature and reliance on both energy systems. This research emphasizes the importance of a well-rounded physical training program that addresses the specific metabolic needs of table tennis players.

In the realm of rehabilitation, Bo and Mingjun (2023) examined the recovery process following muscle injuries resulting from high-intensity training in table tennis. The study concluded that effective rehabilitation protocols not only alleviate muscle pain but also enhance both the physiological and psychological aspects of athlete recovery, facilitating quicker return to optimal performance levels.

The influence of cultural differences on table tennis training and coach-athlete relationships was explored by Lenartowicz (2022), who compared the sports organizational cultures of China and Poland. The study revealed significant challenges faced by Chinese athletes in adapting to the Polish training environment, highlighting the need for intercultural competency in coaching to address the growing globalization of sports.

In addition to professional and competitive contexts, table tennis has also been shown to be effective in school-based physical activity programs. Lee et al. (2021) demonstrated that such programs can significantly improve health-related physical fitness among Korean adolescents, reinforcing the importance of integrating sports like table tennis into school curricula to promote physical health.

Furthermore, Bechar and Grosu (2015) explored the development of specialized training programs for intellectually disabled athletes in Special Olympics (SO) table tennis. The study found that tailored programs significantly enhanced skills such as balance, hand-eye coordination, and power regulation, illustrating the effectiveness of structured physical activity programs in improving the motor abilities of athletes with intellectual disabilities.

Chang Hu (2023) investigated the effectiveness of integrating digital technology with traditional table tennis training methods in Jing Zhou City. This study involved 92 students and focused on the impact of compound training on lower limb mobility, strength, agility, and quickness. The results indicated that compound training, which combines digital technology with conventional methods, was superior in monitoring sports loads and enhancing mobility. This method significantly improved performance in tests such as the half-meter word test, side slip plus linear sprint test, and squat jump test, suggesting that the combination of traditional and digital approaches offers a more effective training regimen for table tennis players.

Similarly, Meng et al. (2023) explored the role of muscle warm-up routines in enhancing the physical conditioning of high school table tennis players. This study demonstrated that a well-structured warm-up phase could significantly improve functional movement levels, leading to a 22% improvement in total test scores over 12 weeks of training. The findings underscore the critical role of warm-up exercises in not only improving athletic performance but also in preventing injuries, which is essential for maintaining long-term participation in sports.

In addition to warm-up exercises, weight training has also been highlighted as a crucial component of physical conditioning for table tennis players. Zhan and Cui (2023) examined the impacts of weight training on the physical fitness of professional table tennis players. Their study showed that incorporating weight training into the existing regimen improved training efficiency and optimized competitive levels. Notably, the Illinois sensitivity test and hexagonal ball sensitivity test scores showed marked improvements in the experimental group compared to the control group, suggesting that weight training enhances the physical attributes necessary for high-level table tennis performance.

Beyond the traditional physical training approaches, the influence of table tennis on gross motor development has been studied in younger populations. Gu et al. (2021) conducted a study on the impact of a table tennis physical activity program on the gross motor skills (GMS) of Chinese preschoolers. The program, conducted three times per week over 12 weeks, resulted in significant improvements in GMS, particularly in object control skills like striking a stationary ball and overarm throw. These findings highlight the potential of table tennis as an effective tool for promoting motor development in early childhood, providing a strong foundation for more complex motor skills later in life.

The educational aspect of table tennis has also been explored, with Siregar et al. (2023) focusing on the effectiveness of digital table tennis teaching materials in improving students' cognitive abilities. Their research demonstrated that students exposed to digital teaching materials showed higher post-test scores compared to those who used traditional methods, indicating that digital resources can enhance the learning outcomes in table tennis education.

The role of table tennis in the physical education system of female students at technical institutions was explored by Zavadskaya and Grishko (2020). Their research emphasized the importance of table tennis in improving the emotional and physical well-being of students, highlighting its potential to motivate female students to engage more actively in physical education. This study suggests that incorporating table tennis into the physical education curriculum can address the issue of low physical activity among students and promote a healthier lifestyle.

Table Tennis Physical Activity Program

The Table Tennis Physical Activity Program focuses on several key themes related to physical activity, each contributing to the overall fitness and well-being of participants. One of the primary components is physical fitness development. Table tennis requires continuous movement and quick, sustained exertion, which significantly enhances cardiovascular endurance. As players engage in fast-paced rallies and footwork, their cardiovascular systems are constantly challenged, leading to improved heart rate variability and better autonomic regulation, as noted in studies like Ulizko et al. (2024).

The importance of physical fitness in table tennis is emphasized through various studies and training programs. Liu (2023) demonstrated that incorporating upper limb strength training into table tennis practice significantly

enhances physical fitness, including explosive muscle strength. This finding aligns with the broader recognition that strength training is crucial for overall athletic performance. Similarly, Liang, Siriphan, Hongsaenyatham, and Khachornumpaisook (2024) found that a SAQ (Speed, Agility, and Quickness) training program effectively improved both table tennis skills and agility among high school students, highlighting the role of specialized physical conditioning in optimizing sport-specific abilities.

Agility and coordination are also central to the program. The sport demands rapid changes in direction, speed, and position, which help develop quick reflexes and precise hand-eye coordination. These skills are essential not only for performance in table tennis but also for overall physical agility and motor skills, which can translate to better performance in other physical activities (Jones & Smith, 2019). Also, research by Liang et al. (2024) indicates that targeted SAQ training enhances these attributes, thereby improving game performance. This is supported by Zhang et al. (2018), who noted that systematic match analyses in table tennis help coaches and players better understand tactical features and improve their coordination on the court. The integration of agility training into regular practice routines can thus contribute to more effective and dynamic gameplay.

Flexibility and injury prevention are further emphasized within the program. Regular participation in table tennis encourages dynamic stretching and joint flexibility, particularly in the wrists, shoulders, and hips. This aspect of the sport helps reduce the risk of injuries commonly associated with repetitive motions and sudden movements (Thompson et al., 2022). Incorporating proper warm-up and cool-down routines within the program also plays a vital role in maintaining muscle elasticity and joint health. Although specific studies on flexibility in table tennis are less prevalent, the general importance of flexibility in athletic training is well-documented. For instance, Sharma and Prasad (2023) highlighted the impact of VMBR (Visual Motor Behavior Rehearsal) training on mental toughness and anxiety, which indirectly suggests that a well-rounded training regimen that includes flexibility exercises might also benefit mental and physical adaptability.

Mental and emotional well-being of participants is an integral part of the program. Engaging in table tennis not only fosters physical health but also enhances mental sharpness and emotional resilience. The strategic and fast-paced nature of the game requires intense focus and quick decision-making, which can reduce stress and improve overall cognitive function. Regular participation can lead to better mood regulation and stress management, contributing to a holistic sense of well-being (Bahamondes-Rosado et al., 2023).

Injury prevention, particularly concerning knee injuries, is crucial for maintaining long-term athletic performance. Wang (2023) discussed the causes and preventive measures for knee injuries in table tennis players, emphasizing the need for proper training techniques and injury prevention strategies. This research underscores the importance of including injury prevention practices within physical activity programs to sustain athlete health and performance.

Mental and emotional well-being is integral to sports performance. Li and Buang (2023) propose integrating mental health education with table tennis training to address students' ideological and psychological needs. This approach highlights the role of mental resilience and psychological support in enhancing overall performance and well-being in athletes. Additionally, the study by Seo and Kim (2024) on stroke patients suggests that physical activities like table tennis can positively impact mental health, reinforcing the connection between physical exercise and emotional well-being.

Table tennis offers considerable benefits for enhancing physical fitness across various populations. For elderly individuals, it has been shown to improve balance, agility, and overall functional fitness due to its low-impact nature and the coordination it requires (Deprá et al., 2022). This suggests that incorporating table tennis into physical activity programs tailored for older adults can significantly improve their balance and functional abilities.

In competitive athletics, physical fitness and reaction speed are critical for optimal performance. Research highlights that specialized training, including table tennis, enhances these attributes by improving reaction speed, endurance, strength, coordination, and flexibility (Yao & Chao, 2023). This underscores the importance of integrating specific physical and motor skills training into athletic programs to boost overall performance.

For table tennis players, circuit weight training programs have demonstrated effectiveness in improving various physical and physiological variables. These programs result in significant gains in fitness and skills, indicating that such training regimens are valuable for enhancing table tennis performance (Abdelkhlaek, 2019). Similarly, table tennis has been associated with better body composition and physical fitness in children compared to other forms of activity, suggesting its effectiveness in promoting health and fitness among younger populations (Pradas de la Fuente et al., 2021).

Gender differences in motivation for learning table tennis have been observed, with female students generally showing less motivation. This implies that physical activity programs might benefit from tailored motivational strategies to engage both male and female participants effectively (Fauzi et al., 2019). Additionally, in higher education, table tennis contributes significantly to the development of agility, speed, and joint mobility, making it a valuable component of physical education programs (Beihul et al., 2024).

Predictive models based on physical and motor abilities can aid in selecting and training table tennis players by identifying key qualities that correlate with performance skills. Such models are useful for optimizing training programs and enhancing performance (Dakhil & Laith, 2024). Moreover, task-oriented table tennis exercise programs have proven beneficial for improving visual perception and motor performance in adolescents with developmental coordination disorder, highlighting the value of task-specific training (Kim et al., 2024).

Regular physical activity, including table tennis, leads to significant cardiovascular adaptations, such as improved heart rate variability and overall cardiovascular health (Uličko et al., 2021). Family-centered physical activity programs that incorporate tennis can also effectively promote physical activity and health, demonstrating the added benefit of involving family members in health promotion efforts (Dombrowski et al., 2021).

Table tennis, despite its lack of physical contact, demands high levels of physical conditioning due to its intense and rapid movements. The knee joint, often held in a flexed position, is particularly vulnerable to injury if its stability is compromised. Recent studies have explored the use of Functional Motion Scanning (FMS) in rehabilitating knee injuries among table tennis athletes. Xun Li (2022) investigated the application of FMS for assessing and guiding therapeutic protocols, finding that physical training combined with FMS screening significantly reduced the incidence of knee injuries and improved overall physical metrics like BMI and limb circumference. This underscores the importance of integrating specific screening techniques into injury rehabilitation programs to enhance recovery and prevent future injuries.

Technological advancements have significantly influenced the field of sports, particularly through the application of wearable sensors. Hao Zhang (2022) examined how intelligent sensors and machine learning technologies, including support vector machines (SVM), can enhance the assessment of table tennis training. These sensors record and analyze training intensity, movement patterns, and stroke counts, providing valuable data for evaluating athletic performance and physical fitness. The integration of these technologies into training routines allows for more precise monitoring and adjustment of training regimens, ultimately improving both evaluation efficiency and training outcomes.

The inclusion of proper warm-up routines is critical for reducing sports-related risks. Kangrong Luo and Wang Zhang (2023) studied the impact of warm-ups on sports risk reduction in table tennis teaching. Their findings indicated that incorporating comprehensive warm-up activities significantly improved stability scores and reduced sports risks compared to a control group that did not perform warm-ups. This highlights the effectiveness of preventive measures in enhancing safety and performance in table tennis training and teaching environments.

Fei Meng and Fanwei Meng (2017) explored the evolution of table tennis teaching in universities, emphasizing the shift from recreational play to a competitive sport with educational significance. Their analysis suggested that adopting "lifelong learning" principles and integrating various theoretical frameworks, such as action theory and implicit theory, can guide effective teaching reforms. The proposed reforms focus on developing students' technical and tactical skills, fostering a cooperative learning environment, and enhancing overall engagement with the sport.

The role of table tennis in promoting national fitness is significant, as highlighted by Julian He and Jun He (2018). The development of table tennis, aligned with the National Fitness Program, has contributed to improved public health and physical fitness. This program encourages widespread participation in table tennis, fostering healthier lifestyles and supporting the broader goals of social modernization and public well-being in China.

In 2021, Yi Zhang and John Breedlove conducted a review of the influence of digital technology on table tennis, with a particular emphasis on the manner in which technological advancements have impacted the sport's growth in China. The study examines the historical background and contemporary opportunities for incorporating digital technologies into table tennis, with the goal of improving market competitiveness and facilitating continued progress in the sport. Their research revealed that digital technology has revolutionized training methods, data analysis, and fan engagement in table tennis, leading to a surge in popularity both domestically and internationally. By leveraging digital tools such as smart sensors, virtual reality training programs, and live streaming platforms, players and coaches in China have gained a competitive edge and attracted a wider audience to the sport. The findings suggest that embracing digital innovation is crucial for the future development and success of table tennis, paving the way for exciting advancements and growth opportunities in the years to come.

A SWOT-AHP model was implemented by Qing Yi et al. (2024) to evaluate the development strategies of amateur table tennis in Shanghai. Their research presents a range of strategic methods to promote amateur competition and participation, offering a comprehensive framework for improving the structure and effectiveness of amateur table tennis events. These strategies include enhancing marketing efforts through social media platforms, implementing technology-driven solutions for event organization, and establishing partnerships with local businesses to increase funding and support. By incorporating these recommendations, amateur table tennis in Shanghai can continue to grow and attract a larger and more diverse audience, ultimately contributing to the overall success and sustainability of the sport. The research by Qing Yi et al. (2024) provides valuable insights for stakeholders in the table tennis community looking to expand and enhance their amateur programs.

The most effective strategies employed by university table tennis teams in China were examined by Ying Wang (2024) through qualitative interviews. The study identified many team development models and emphasized the significance of efficient management structures, training methodologies, and sources of finance. The purpose of the findings is to provide institutions with guidance on how to optimize their table tennis programs and enhance the overall performance of their teams. By implementing the strategies outlined in Wang's study, stakeholders in the table tennis community can improve the quality and competitiveness of their amateur programs. By focusing on efficient management structures, training methodologies, and sources of finance, institutions can create a strong foundation for success in table tennis. Ultimately, these findings aim to help teams reach their full potential and achieve greater success in the sport.

Especially for the 2024 Paris Olympics, Anke Xiao and Phattaraphon Mahakhan (2024) concentrated on creating a table tennis program for mixed doubles contests. Their study entailed the examination of technical and tactical statistics through a four-stage evaluation methodology. The objective of the study is to improve the approaches and strategies used in mixed doubles, with the goal of boosting performance and competitiveness in international competitions. This research will provide a theoretical foundation for achieving these improvements. By analyzing the data collected, Xiao and Mahakhan were able to identify key areas for improvement in their mixed doubles game. With a focus on refining their techniques and tactics, they hope to gain a competitive edge over their opponents in the upcoming Paris Olympics. By implementing the findings of their study, Xiao and Mahakhan are confident that they will be able to elevate their performance to new heights and potentially secure a medal in the mixed doubles competition.

Chinfang Kuo and Hsienwei Kuo (2021) examined the role of table tennis coaches from the Republic of China in Latin America during the Cold War. Their study highlights the use of sport diplomacy as a strategy for international exchange and public diplomacy, illustrating the historical significance of sport in fostering global relationships and promoting cultural exchange.

Chenchen Xu et al. (2019) assessed the impact of the sport education model (SEM) on high school students' table tennis skills and attitudes compared to a traditional sport model. The study found that SEM led to greater

improvements in skills and more positive attitudes towards table tennis, emphasizing the benefits of extended, collaborative learning experiences in sports education.

Hui Zhang et al. (2019) analyzed the success of Chinese table tennis from historical, training, and scientific research perspectives. Their study identified key factors such as focused development, effective training systems, and scientific support as crucial to the sport's global dominance. This comprehensive approach underscores the importance of integrating societal, training, and research elements to achieve sustained success in competitive table tennis.

An intervention program utilizing elastic bands has been shown to enhance the accuracy and effectiveness of the forehand topspin stroke in young table tennis players. This training method improved muscular coordination and physical control, leading to better stroke success rates (Shao et al., 2020). Additionally, integrating table tennis training programs that focus on sustained attention and cognitive flexibility can address motor skills and executive function challenges in children with developmental coordination disorder, highlighting the importance of cognitive and physical training in skill development (Jalilvand, 2020).

Technological advancements also play a crucial role. For instance, image processing-based ball tracking programs offer valuable insights into game strategies and performance, though accuracy improvements are needed for international competition contexts (Moon et al., 2020). Psychological aspects are equally important, with deep learning technologies enabling precise monitoring of psychological fluctuations through heart rate measurement, thereby enhancing mental training and reducing stress (Peng & Kim, 2023).

The historical and ongoing strategic adjustments in table tennis, such as adapting to rule reforms and incorporating new technologies, underscore the need for continuous innovation in training methods (Hung et al., 2019). Furthermore, abdominal core training has been demonstrated to improve physical fitness and sports efficiency in table tennis players, suggesting that targeted physical conditioning can enhance overall athletic performance (Ma et al., 2023).

Finally, table tennis has a profound impact on public health by promoting physical activity and mental well-being, making it a valuable sport for improving overall health and quality of life (Cong, 2023). It has been shown to improve cardiovascular fitness, hand-eye coordination, and reflexes. Additionally, the social aspect of table tennis can help reduce feelings of isolation and loneliness, contributing to better mental health. Overall, the combination of physical and mental benefits makes table tennis a fantastic choice for individuals looking to improve their overall well-being.

Agility Performance

Agility performance is a complex, multifaceted attribute crucial for athletes across various sports. It integrates both physical and cognitive components, reflecting an individual's ability to rapidly and effectively change direction and respond to environmental stimuli.

Agility involves the swift, precise, and coordinated movement in response to changing conditions, necessitating both physical capabilities and cognitive processes. For instance, Büchel et al. (2024) demonstrated that agility performance is influenced by the cognitive demands associated with movement tasks. They found that agility tasks with high cognitive complexity, such as those involving working memory and inhibition, led to slower performance compared to simpler tasks that only required processing speed. This indicates that the cognitive load can affect the efficiency of agility, suggesting that training should incorporate complex cognitive elements to better prepare athletes for real-world scenarios.

Several studies have demonstrated the efficacy of different training programs in enhancing agility performance. Zouhal et al. (2019) investigated the impact of a 6-week neuromuscular training program on elite soccer players. This intervention, which included change-of-direction (CoD) drills, plyometric exercises, and dynamic stability work, significantly improved agility in both slower and faster turning directions. The results suggest that incorporating neuromuscular training into regular routines can enhance overall agility performance (Zouhal et al., 2019).

Similarly, contrast training, combining isometric and plyometric exercises, has been shown to benefit prepubertal basketball players. Latorre-Román et al. (2018) reported that a 10-week contrast training program led to notable improvements in jumping, sprinting, and agility performance. This form of training, which included exercises such as isometric holds followed by explosive plyometric moves, was superior to traditional training methods (Latorre-Román et al., 2018).

Competitive elements in training can also enhance agility. Kováčiková and Zemková (2020) found that agility training with a competitive component led to significant improvements in agility performance in competitive conditions. Athletes who engaged in head-to-head competition during their agility drills showed greater improvements compared to those who trained individually. This suggests that simulating competitive scenarios can further boost agility performance (Kováčiková & Zemková, 2020).

Effective evaluation methods are crucial for assessing agility. Spasić et al. (2015) developed and validated sport-specific tests for reactive agility and change-of-direction speed (CODS) in handball players. Their findings underscore the importance of using sport-specific tests to accurately measure agility, as well as the need for high reliability and validity in these assessments (Spasić et al., 2015).

In futsal, Sekulić et al. (2019) introduced new testing protocols for CODS and reactive agility, which showed good inter- and intra-testing reliability. These tests effectively distinguished between different performance levels among players, highlighting their applicability in both training and performance evaluation (Sekulić et al., 2019).

A comparison of plyometric training modalities revealed that assisted and resisted plyometric exercises were more effective than common plyometric exercises for improving sprint and agility performance. Khodaei et al. (2017) found that assisted and resisted plyometric training modes, utilizing elastic bands, led to greater reductions in sprint times and agility test scores compared to traditional plyometric exercises. This indicates that varying the resistance during plyometric training can optimize agility development (Khodaei et al., 2017).

Irandoust and Jami (2022) introduced the Jami Agility Table (JAT), a tool designed to enhance agility by combining physical and mental challenges. The JAT increases contextual interference and incorporates varied movement algorithms, which improves both cognitive and neuromuscular coordination. This approach aligns with the finding that agility training should engage athletes in diverse and unpredictable scenarios to develop better agility performance.

The influence of physical attributes on agility is also notable. For instance, Spiteri et al. (2014) highlighted that eccentric strength plays a significant role in change of direction (COD) and agility performance. Their study indicated that while overall strength contributes to agility, eccentric strength is a critical factor for effective COD. This finding underscores the need for targeted strength training to improve agility, particularly emphasizing eccentric strength.

Forster et al. (2022) reviewed various training methods to improve pro-agility performance and found that specific training types such as sprint, plyometric, and resistance training significantly enhance agility. Their analysis suggests that combining different training methods can simultaneously develop multiple aspects of agility, including acceleration, deceleration, and COD.

Moreover, Zouhal et al. (2018) examined the impact of laterality—such as handedness and footedness—on agility in soccer players. They found that laterality influences reaction times and movement speed, highlighting the importance of considering individual differences in agility training and assessment.

Maćkała et al. (2020) explored differences in agility performance between individual and team sports, noting that individual athletes often excel in reactive agility and COD compared to their team sport counterparts. This difference suggests that sport-specific training approaches should be tailored to the unique demands of individual versus team sports.

In addition, Romdhani et al. (2018) investigated how sleep deprivation affects agility, revealing that both total sleep deprivation and recovery sleep can alter agility performance. This emphasizes the importance of adequate rest for optimal agility.

Lastly, Richman et al. (2019) assessed the effects of self-myofascial release (SMR) combined with dynamic stretching on agility performance. They found that while SMR improved flexibility, it did not negatively affect agility, suggesting that incorporating SMR into warm-up routines may be beneficial without detracting from agility performance.

THEORETICAL FRAMEWORK

For this study, the theoretical framework is centered on the Motor Learning and Skill Acquisition Theory, as articulated by Schmidt and Lee (2011). This theory is particularly appropriate for understanding and enhancing physical skills required for table tennis due to its focus on the progressive refinement of motor skills through practice and feedback.

Motor Learning and Skill Acquisition Theory posits that skill acquisition is a dynamic process characterized by the improvement of motor performance over time through systematic practice and iterative feedback. This theory is grounded in the principle that learning complex motor skills, such as those involved in table tennis, requires more than just repetitive action; it necessitates the incorporation of variability and adaptation in practice sessions to effectively develop and refine skills (Schmidt & Lee, 2011). According to the theory, effective practice should include various conditions and challenges that mimic real-game scenarios, thus promoting skill transfer and adaptability.

In the context of table tennis, agility and overall performance are critical components that benefit significantly from structured and diverse training regimens. The Motor Learning and Skill Acquisition Theory emphasizes the importance of practice variability—engaging in different types of drills and scenarios to enhance skill transfer—and the role of feedback in guiding performance improvements. By integrating these principles into the physical activity program designed for college students, the study aligns with the theory's recommendations to improve agility and overall game performance.

The table tennis physical activity program incorporates a range of drills and exercises specifically designed to enhance agility, coordination, and tactical skills. These exercises are structured to provide diverse practice conditions, facilitating the development of motor skills and adaptability as advocated by the theory. Additionally, the program includes regular feedback to guide participants' progress and refine their techniques, thereby reinforcing the theoretical framework's emphasis on the iterative nature of skill acquisition.

By applying the Motor Learning and Skill Acquisition Theory, the study aims to validate the hypothesis that a well-structured and varied training program, combined with consistent feedback, will lead to significant improvements in agility performance among college students. This theoretical foundation ensures that the training program is grounded in established principles of motor learning, making it a robust framework for achieving the study's objectives.

Statement of the Problem

This study investigates the influence of a Table Tennis Physical Activity Program on the table tennis skills of selected teenagers in a sports club in Shenyang City, China. The independent variable in this study is the Table Tennis Physical Activity Program, which comprises several critical components. The dependent variables represent various aspects of the skills performance that are expected to be influenced by the physical activity program. The expected output was the contextualized and structured table tennis training program.

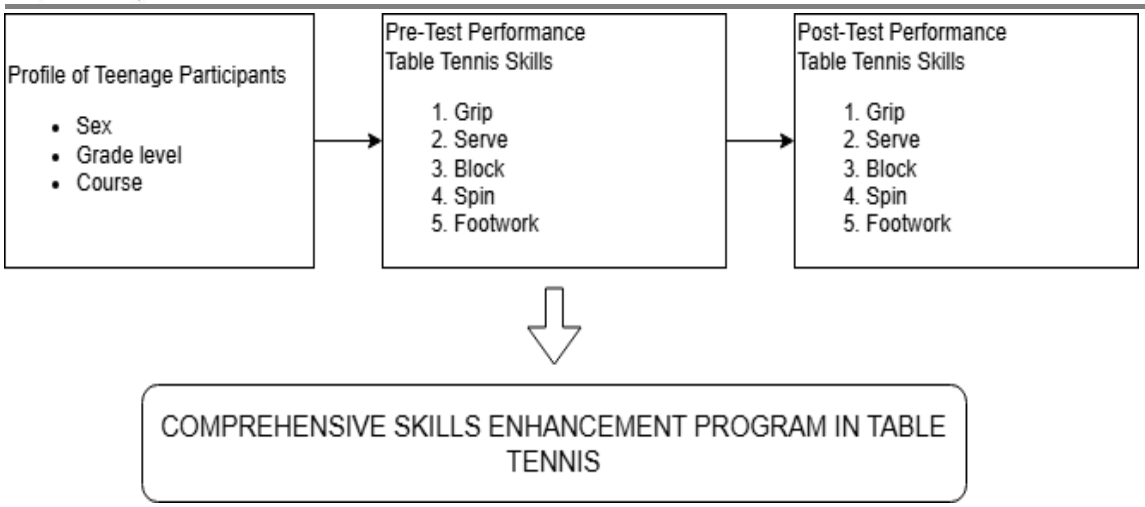

Figure 1. Research Paradigm

Specifically, this study aims to answer the following questions:

What is the profile of the respondents in terms of:

1.1. Sex;
1.2. Grade level;
1.3. Course?

What are the pre-test results on the performance of the selected student-respondents prior the training program in terms of the following skills?

1.4. Grip;
1.5. Serve;
1.6. Block;
1.7. Spin;
1.8. Footwork

Is there a significant difference in the pre-test performance of the selected student-respondents when grouped according to profile?

What are the post-test results on the performance of the selected student-respondents after the training program in terms of the following skills?

1.9. Grip;
1.10. Serve;
1.11. Block;
1.12. Spin;
1.13. Footwork

Is there a significant difference in the post-test performance of the selected student-respondents after the training program when grouped according to profile?
Is there a significant difference in the pre-test and post-test performance of the selected student-respondents prior and after the table tennis program?
Based on the finding of the study, what comprehensive table tennis training enhancement program can be proposed?

Hypothesis

H_{01}: There was no significant difference in the pre-test performance of the selected student-respondents when grouped according to sex, grade level, and course.

H_{02}: There was no significant difference in the post-test performance of the selected student-respondents when grouped according to sex, grade level, and course.

H_{03}: There was no significant difference between the pre-test and post-test performance of the selected student-respondents before and after the implementation of the table tennis training program.

Significance of the Study

This study holds significant value for various stakeholders in the field of sports education and athletics.

Student Athletes: The primary beneficiaries of this study are the teenage athletes participating in the table tennis physical activity program. By identifying the program's impact on agility performance, this study provides insights into how structured physical activity can enhance physical abilities, particularly in a sport as demanding as table tennis. The findings will empower students with evidence-based knowledge on the benefits of participating in such programs, potentially motivating them to engage more actively in physical education and sports.

Physical Education Teachers and Coaches: This study offers valuable insights for physical education teachers and table tennis coaches responsible for designing and implementing training programs. By demonstrating the effectiveness of specific training interventions in improving agility, the study equips educators with practical strategies to enhance their students' athletic performance. The results can inform curriculum development, leading to more effective training sessions and better student outcomes.

Sports Science Researchers: The study contributes to the growing body of knowledge in sports science, particularly in the area of agility performance in table tennis. Researchers interested in motor learning, skill acquisition, and sports training methodologies will find this study relevant for further exploration. The insights gained can stimulate future research aimed at refining training techniques and developing new approaches to improving athletic performance.

Policy Makers in Sports Education: The results of this study could inform policymakers at the regional or national level involved in sports education. By providing evidence of the benefits of structured physical activity programs, the study can support the development of policies that promote physical education and sports as essential components of the educational system. This could lead to increased funding, better facilities, and more comprehensive sports programs in educational institutions.

General Public: The general public, particularly parents and community members, may also benefit from understanding the importance of physical activity in developing agility and overall physical fitness. The study highlights the role of sports in fostering not just physical health but also mental and emotional well-being, encouraging broader support for sports programs in educational settings.

Scope and Delimitation

This study was conducted to assess the effectiveness of a table tennis training program on the skill performance of selected teenage participants in a sports university in Shenyang City, Liaoning Province, China. Using a single-group experimental design, the study will measure participants' performance before and after the training intervention using pre-test and post-test evaluations. The primary focus will be on five core table tennis skills: grip, serve, block, spin, and footwork.

The participants in this study will be limited to teenagers currently enrolled in the university program. Only those participants who complete both the pre-test and post-test within the specified training cycle will be included in the analysis.

The study will not employ a randomized control group, consistent with its single-group experimental nature. However, it will rely on a single-group pre-test–post-test design to assess improvements. External factors such as nutrition, motivation, previous training outside the program, and psychological influences will not be controlled and are therefore beyond the scope of this study.

Furthermore, the results will be context-specific and may not be generalized to all table tennis athletes or training programs. However, the findings will be used to propose a refined table tennis training program based on the observed improvements, with potential application to similar athletic populations or training contexts.

Definition of Terms

Table Tennis Training Program – A structured set of physical and skill-based activities specifically designed to enhance the table tennis performance of teenage participants. It consists of the following components:

- **Grip** – The correct way of holding the racket, affecting control and shot execution. Assessed based on form and consistency during drills.
- **Serve** – The skill of initiating play with accuracy, speed, and spin. Evaluated through successful execution and legal compliance.
- **Block** – The ability to respond to fast incoming shots with stability and control. Measured by timing, racket angle, and return accuracy.
- **Spin** – The capability to apply rotational force to the ball, influencing its trajectory and bounce. Assessed through observable ball behavior.
- **Footwork** – The effectiveness of movement and positioning on the court. Evaluated through agility tests and in-game movement efficiency.

Dependent Variable

Skill Performance – The measurable level of proficiency in performing table tennis techniques before and after the training program. It is evaluated using pre-test and post-test results across the five sub-skills.

RESEARCH METHODOLOGY

Research Design

This study employed a quasi-experimental research design, specifically a single-group pretest-posttest design, to determine the effectiveness of a table tennis training program on the skill performance of selected teenage participants. This design was appropriate for measuring participants' improvement over time without a randomized control group. It allowed for the assessment of changes in specific table tennis skills—namely, Grip, Serve, Block, Spin, and Footwork—before and after the intervention. By administering pre- and post-tests, this design facilitated comparisons of participants' skill levels before and after their exposure to the structured training program. The single-experimental design supported the study's objective of evaluating the program's direct impact on skill development, making it a practical and relevant choice for research conducted in real-world educational and athletic settings.

Locale of the Study

The study was conducted at Shenyang Sport University, one of the leading higher education institutions in Liaoning Province, China, specializing in sports science, physical education, and athletic training. The university was strategically chosen as the research site for its reputation for producing highly skilled athletes and for providing advanced facilities for sports development. It had modern training centers, gymnasiums, and specialized laboratories that supported both academic and athletic programs.

The institution was also known for its diverse student population, many of whom pursued specialized programs in physical education, coaching, and sports management. These characteristics made Shenyang Sport University an ideal setting for assessing the performance of teenage participants in relation to grip, serve, block, spin, and footwork prior to the training program. The environment provided authentic exposure to structured athletic training, ensuring that the data gathered reflected actual sports practices.

By situating the study in Shenyang Sport University, the research was able to draw upon a setting where the integration of academic learning and practical training was highly emphasized. The institution's strong commitment to sports excellence ensured that the respondents were accustomed to systematic training and performance evaluations, thereby supporting the objectives of the investigation.

Population, Samples, & Sampling Technique

The study utilized purposive sampling to select participants from student-athletes at Shenyang Sport University. Purposive sampling was deemed appropriate because it enabled the researcher to focus on a specific group of students who met the criteria essential to the study's objectives. This approach ensured that the participants possessed the necessary background and engagement to provide meaningful insights into the effectiveness of the table tennis training program.

The participants were purposefully selected table tennis student-athletes who met the following criteria: (1) they were currently engaged in table tennis activities within the university, (2) they had at least three years of playing experience, ensuring a foundational skill level and familiarity with the sport, (3) they provided informed consent and voluntarily agreed to participate, and (4) they committed to the full six-month duration of the program to ensure consistent participation and reliable data collection.

A total of 50 student-athletes were selected from Shenyang Sport University. This number was considered adequate to provide statistical reliability while remaining manageable for data collection and analysis. By selecting participants who met the stated criteria, the study ensured a relevant and informed sample capable of yielding valid and reliable findings on the impact of the training program on table tennis skill performance

Instrumentation

To assess participants' skill performance, the study employed a researcher-developed Table Tennis Skill Evaluation Rubric. This instrument evaluated the five skill constructs—Grip, Serve, Block, Spin, and Footwork—through both pre-test and post-test observations. Trained evaluators used a 4-point rating scale to rate each skill based on accuracy, control, consistency, and proper execution.

1. Grip was assessed in terms of the correctness of the shakehand or penhold grip, consistency during play, and freedom of wrist and arm movement.

2. Serve was rated based on legality, consistency, spin application, and placement.

3. Block was evaluated by the respondent's ability to return fast incoming shots with timing and control effectively.

4. Spin was assessed in terms of application, variation (topspin, backspin, sidespin), and tactical effectiveness.

5. Footwork was rated on quickness, anticipation, and efficiency in maintaining positioning during rallies.

Each skill was rated using a 4-point scale: 4 – Very High, 3 – High, 2 – Low, 1 – Very Low. This rubric ensured standardized, objective, and comprehensive assessment of skill development throughout the program.

Data Gathering Procedure

The data-gathering process followed a structured sequence: a pre-test, the implementation of the Table Tennis Physical Activity Program (TT-PAP), and a post-test.

- During the pre-test in the first week, participants' baseline skills were assessed using the evaluation rubric in a controlled environment.

- This was followed by a three-month training program consisting of progressive 90-minute sessions held three times a week. The program included physical conditioning, technical drills, tactical exercises, footwork training, and game-based simulations. Each week, targeted one or two core skills, with gradual integration of all five constructs by the second month.

- Coaches also incorporated circuit training, plyometric drills, and flexibility exercises to improve strength, endurance, and coordination.

- Attendance, engagement, and skill progress were monitored weekly, with feedback provided to correct errors.

- After the program, a post-test was conducted under the same conditions as the pre-test, enabling direct comparison of performance before and after training.

This procedure ensured reliability, consistency, and accuracy in evaluating the effectiveness of the TT-PAP.

Statistical Analysis of Data

The statistical analysis of this study's data was comprehensive, encompassing both descriptive and inferential statistics to thoroughly examine the research questions.

Mean and Standard Deviation (SD): These were calculated to summarize the central tendency and variability of continuous variables, such as the extent of implementation of the Table Tennis Physical Activity Program and respondents' agility performance. The mean indicated the average score for each construct, while the standard deviation measured the dispersion of scores around the mean.

Rank: Ranking was applied to assess the relative importance or effectiveness of the different components of the Table Tennis Physical Activity Program, based on respondents' assessments. This helped in identifying which components were perceived as most and least effective.

T-Test: This test was used to compare the means of two independent groups to determine if there were significant differences in the assessments of the Table Tennis Physical Activity Program and agility performance. For instance, it compared assessments by gender or by different course groups.

ANOVA (Analysis of Variance): ANOVA was employed to analyze differences among three or more groups. This was useful for comparing the mean assessments of the Table Tennis Physical Activity Program and agility performance across different grade levels or other categorical variables.

To determine whether there was a significant difference in the pre-test and post-test performance of the selected teenage participants, a paired-samples t-test was employed. This test was appropriate for comparing two related means and was used to evaluate the effectiveness of the intervention by analyzing the differences in performance within the same group of individuals over time.

Ethical Consideration

In conducting this research, adherence to ethical standards was crucial to ensure the rights and well-being of all participants were protected. To begin with, obtaining informed consent was a primary ethical requirement. All participants were provided with detailed information about the study's purpose, procedures, potential risks, and benefits. They were required to sign an informed consent form before their participation. This form affirmed that they understood the nature of the study and agreed to participate voluntarily.

Confidentiality was strictly maintained throughout the research process. Personal information was anonymized, and all data were securely stored. Identifiable data were not included in any reports or publications to protect

participants' privacy. Only authorized personnel had access to the data, ensuring that it remained confidential and was used solely for research purposes.

Voluntary participation was another cornerstone of ethical research. Participants were clearly informed that their involvement was voluntary and that they had the right to withdraw from the study at any time without facing any adverse consequences. This policy guaranteed that participation was voluntary and eliminated any external pressures or coercion.

The study was designed to minimize any potential harm to participants. The physical activity program was monitored to ensure it was safe and appropriate for participants' fitness levels. Any discomfort or adverse effects experienced during the study were addressed promptly and effectively to ensure participants' safety and well-being.

Ethical approval was sought from the institutional review board (IRB) or ethics committee at Shenyang Sport University before the study began. This review process ensured that the study complied with ethical guidelines and standards, providing an additional layer of oversight and accountability.

Maintaining data integrity was essential for credible research. The study ensured accurate and honest reporting of findings, avoiding any manipulation or misrepresentation of data. Transparency in the research process and in the reporting of results was maintained to ensure the reliability and validity of the study.

Finally, respect for participants was a guiding principle throughout the research. Researchers approached participants with sensitivity and respect, valuing their time and contributions. Participants had the opportunity to ask questions and seek clarifications at any stage of the study, ensuring open communication and respect for their involvement.

RESULTS AND DISCUSSION

This section presents the analysis and interpretation of the data obtained from the study. It entails a systematic examination of the results to identify relevant patterns, trends, and insights in relation to the stated research objectives and questions. The analysis was carried out in an organized manner, with appropriate statistical methods applied to ensure accuracy and reliability. By comparing pre-test and post-test results and examining differences across demographic variables such as sex, grade level, and course, the section aims to provide a comprehensive understanding of respondents' performance in table tennis. The interpretation further contextualizes these results by linking the statistical findings to their practical implications for skill development and training interventions.

Part I: Demographic profile of the respondents in terms of: Sex, Grade level and Course

Table 1. Respondents' Demographic Profile

Indicators	Classification	Frequency	Percentage (%)
Sex	Male	31	62.0%
	Female	19	38.0%
	TOTAL	50	100%
Grade level	1	12	24.0%
	2	10	20.0%
	3	9	18.0%

	4	19	38.0%
	TOTAL	50	100%
Course	Teaching	14	28.0%
	Management	7	14.0%
	Culture	14	28.0%
	Science	6	12.0%
	Arts	9	18.0%
	TOTAL	50	100%

Table 1 presents the demographic profile of the 50 respondents and provides a clear overview of the sample's composition across sex, grade level, and course. Overall, the distribution sums matched the total sample size, with percentages totaling 100% in each subsection, indicating internal consistency in reporting. The data showed a modest skew by sex and grade level, whereas course affiliations were more evenly distributed across five academic disciplines.

Regarding sex, Table 1 indicated that males accounted for 62.0% (n = 31) and females for 38.0% (n = 19). The male share was therefore the highest in this subsection, exceeding the female share by 24 percentage points. This imbalance suggested that any performance or perception analyses using this cohort should consider sex as a potential covariate, given the overrepresentation of male respondents that may influence aggregate means and variances.

For grade level, Table 1 showed that Grade 4 had the highest proportion at 38.0% (n = 19), followed by Grade 1 at 24.0% (n = 12), Grade 2 at 20.0% (n = 10), and Grade 3 at 18.0% (n = 9), the lowest. The distribution thus concentrated at the terminal grade, with Grade 4 alone composing more than one-third of the cohort. This concentration implied greater representation of more advanced students and, consequently, analyses should be attentive to potential maturity or experience effects associated with grade standing.

Regarding the course, Table 1 reported two equal peaks: Teaching at 28.0% (n = 14) and Culture also at 28.0% (n = 14). Arts ranked next at 18.0% (n = 9), while Management at 14.0% (n = 7) and Science at 12.0% (n = 6) represented the lowest proportions. The twin highs in Teaching and Culture suggested stronger enrollment or sampling within these domains. In contrast, Science and Management together accounted for only 26.0% of the sample, indicating comparatively lighter representation from these tracks.

A notable pattern in Table 1 was the coexistence of a male-majority sample with a course distribution that was otherwise reasonably diversified across five disciplines, with two disciplines tied for the top share. Another interesting observation was the asymmetry in grade levels, with Grade 4 respondents more than twice the count of Grade 3 respondents, suggesting a cohort weighted toward later academic stages. Though cross-tabulations were not provided, these margins alone pointed to plausible interactions between grade level and course that future analyses could examine through stratified summaries or multivariate controls.

In summary, Table 1 documented a 50-responder sample characterized by a male majority (62.0%), a grade-level skew toward Grade 4 (38.0%), and a course distribution topped jointly by Teaching and Culture (both 28.0%), with Science registering the lowest share (12.0%). These features were analytically consequential: sex and grade level should be treated as control variables in subsequent comparisons, and course effects should be interpreted with attention to the twin peaks and the thinner tails in Science and Management. Overall, the table established a coherent baseline description that would guide fair comparisons and the selection of appropriate statistical adjustments in later sections.

Part II: The pre-test result on the performance of the selected student-respondents prior to the training program in terms of: Grip, Serve, Block, Spin, and Footwork

Table 2. Pre-Test Result on the Performance of the Selected Student-Respondents Prior to the Training Program in terms of Grip

Indicator	Weighted Mean	Standard Deviation	Verbal Interpretation	Rank
Holds racket correctly (shakehand/penhold)	2.02	0.82	Low	1
Maintains grip consistency during rallies	1.78	0.82	Low	3.5
Wrist and arm movement supported by the grip	1.88	0.8	Low	2
Adjusts grip effectively in forehand/backhand	1.74	0.78	Low	5
Avoids excessive tension or frequent repositioning	1.78	0.76	Low	3.5
Overall Mean	1.84	0.35	Low	

Legend: 3.51 – 4.00 (Very High); 2.51 – 3.50 (High); 1.51 – 2.50 (Low); 1.0-1.50 (Very Low)

Table 2 presents the pre-test results of the student-respondents on grip, with an overall mean of 1.84 (SD = 0.35), interpreted as Low. Among the specific indicators, the ability to hold the racket correctly (shakehand/penhold) obtained the highest mean of 2.02 (SD = 0.82), which, though still low, suggested that most respondents had a basic familiarity with racket handling. In contrast, the lowest rating was recorded for adjusting grip effectively in forehand and backhand strokes at 1.74 (SD = 0.78), indicating difficulties with grip flexibility and adaptability during rallies.

The ranking also showed interesting ties. Both “maintains grip consistency during rallies” and “avoids excessive tension or frequent repositioning” received identical means of 1.78 (SD = 0.82 and 0.76, respectively), ranking third. This indicates that inconsistent grip execution and a tendency to lose control under pressure were equally problematic for respondents. Furthermore, “wrist and arm movement supported by grip” was rated 1.88 (SD = 0.80), ranking second, revealing a slight improvement compared to other indicators but still within the low interpretation.

These values illustrated that although respondents could initially hold the racket correctly, their execution faltered when faced with the dynamic adjustments required in active play. This gap between static grip knowledge and dynamic execution was a recurring weakness that training interventions could target by reinforcing muscle memory and consistency under game conditions.

The relatively narrow range of means, from 1.74 to 2.02, reflected a generally uniform deficiency across grip-related skills. The presence of multiple low ratings underscored that grip mastery was not yet a strength among the participants. However, the slightly higher score for “holding the racket correctly” could be considered a foundation upon which subsequent training might build.

Overall, Table 2 suggests that while the fundamentals of grip were minimally present, the respondents were unable to maintain consistency, adaptability, and relaxation in handling the racket, all of which are crucial to more advanced execution. This made grip one of the moderately weak areas prior to training, though not the weakest among the skill domains.

Table 3. Pre-Test Result on the Performance of the Selected Student-Respondents Prior to the Training Program in terms of **Service**

Indicator	Weighted Mean	Standard Deviation	Verbal Interpretation	Rank
Adheres to service rules (ball toss, legality)	2.00	0.83	Low	1
Controls ball speed, spin, and placement	1.74	0.78	Low	2
Consistency and accuracy of serve	1.50	0.74	Low	3.5
Varies serve type (short/long, spin/no spin)	1.5	0.81	Low	3.5
Demonstrates confidence and fluidity	1.44	0.64	Low	5
Overall Mean	1.41	0.46	Low	

Legend: 3.51 – 4.00 (Very High); 2.51 – 3.50 (High); 1.51 – 2.50 (Low); 1.0-1.50 (Very Low)

Table 3 reported the pre-test performance on serve, with an overall mean of 1.41 (SD = 0.46), interpreted as Low and notably the lowest among the five skill domains. Within this table, the highest indicator was "adheres to service rules (ball toss, legality)" at 2.00 (SD = 0.83), implying that most respondents could comply with the formalities of service without committing faults. However, performance declined substantially for more technical aspects of serving.

Both "consistency and accuracy of serve" and "varies serve type" tied at 1.50 (SDs of 0.74 and 0.81), placing them in the Low interpretation and highlighting the difficulty respondents had in introducing variability and accuracy into their serves. Even more concerning was the lowest-rated indicator, "demonstrates confidence and fluidity," which received a score of 1.44 (SD = 0.64), suggesting a very low level of ease and composure when executing serves.

The results indicated that respondents were able to perform the serve at a basic procedural level but struggled significantly with the technical and tactical demands. The narrow margin between the lowest and highest items (ranging from 1.44 to 2.00) underscored a uniform weakness across all serve-related skills, reflecting an underdeveloped capacity in both mechanics and psychological readiness.

It was particularly striking that serving, which is considered the foundational offensive skill in table tennis, was the weakest domain overall. This deficiency suggested that the respondents entered the program without the ability to establish an advantage at the start of rallies, a limitation that training interventions must prioritize.

In summary, Table 3 highlighted that serving was the weakest skill set, with minimal proficiency in variation, accuracy, and confidence. Although adherence to rules was somewhat evident, the technical execution of serves required significant attention to raise the respondents' competency to competitive levels.

Table 4. Pre-Test Result on the Performance of the Selected Student-Respondents Prior to the Training Program in terms of **Block**

Indicator	Weighted Mean	Standard Deviation	Verbal Interpretation	Rank
Redirects fastballs accurately	1.94	0.84	Low	1
Controls racket angle and positioning	1.66	0.8	Low	3

Reacts quickly to the opponent's attack	1.64	0.8	Low	4
Consistently neutralizes offensive strokes	1.62	0.83	Low	5
Places blocked returns strategically	1.92	0.83	Low	2
Overall Mean	1.76	0.44	Low	

Legend: 3.51 – 4.00 (Very High); 2.51 – 3.50 (High); 1.51 – 2.50 (Low); 1.0-1.50 (Very Low)

Table 4 presented the pre-test performance in terms of blocking, with an overall mean of 1.76 (SD = 0.44), which fell under the Low category. Among the indicators, "redirects fast balls accurately" ranked first with a mean of 1.94 (SD = 0.84), suggesting that participants had a basic ability to handle fast-paced shots. This was followed closely by "places blocked returns strategically" at 1.92 (SD = 0.83).

However, the lowest indicator was "consistently neutralizes offensive strokes," with a mean of 1.62 (SD = 0.83), pointing to difficulties in sustaining defensive control against aggressive plays. Similarly, "reacts quickly to opponent's attack" recorded a mean of 1.64 (SD = 0.80), further indicating deficiencies in reaction time and readiness. "Controls racket angle and positioning" was only slightly higher at 1.66 (SD = 0.80), underscoring limited technical execution.

The results revealed that while respondents could occasionally redirect and place blocks, their defensive consistency and tactical response were weak. The slight variance between the highest and lowest means (1.62-1.94) indicated that block-related skills were consistently low across respondents, with no subskill standing out.

An interesting finding was that blocking—although requiring defensive anticipation—still scored higher than serving. This suggested that respondents had slightly better instincts in reactive defense than in initiating offensive plays. However, these scores were still low and insufficient for competitive standards.

In summary, Table 4 illustrated that while some ability to redirect fast balls and place returns existed, blocking overall was characterized by slow reactions and inconsistent neutralization. Training is needed to sharpen defensive reflexes, improve anticipation, and strengthen racket-angle control to raise this competency.

Table 5. Pre-Test Result on the Performance of the Selected Student-Respondents Prior to the Training Program in terms of **Spin**

Indicator	**Weighted Mean**	**Standard Deviation**	**Verbal Interpretation**	**Rank**
Applies spin in serves effectively	1.98	0.87	Low	3
Uses spin in rallies (topspin/backspin/sidespin)	1.96	0.73	Low	4
Produces consistent spin effect	1.9	0.74	Low	5
Controls direction and depth with spin	2.02	0.71	Low	2
Varies spin to disrupt the opponent rhythm	2.04	0.78	Low	1
Overall Mean	1.98	0.36	Low	

Legend: 3.51 – 4.00 (Very High); 2.51 – 3.50 (High); 1.51 – 2.50 (Low); 1.0-1.50 (Very Low)

Table 5 showed the pre-test results for spin, which received an overall mean of 1.98 (SD = 0.36), the highest among the five skill domains. The top-rated indicator was "varies spin to disrupt opponent rhythm" with 2.04

(SD = 0.78), followed by "controls direction and depth with spin" at 2.02 (SD = 0.71). These values, while still low, suggested that respondents had a slightly stronger inclination to use spin as a tactical tool than for other skill areas.

Lower ratings included "produces consistent spin effect" at 1.90 (SD = 0.74) and "uses spin in rallies" at 1.96 (SD = 0.73). The lowest indicator was "applies spin in serves effectively," with a mean of 1.98 (SD = 0.87), indicating that while respondents could occasionally generate spin, consistency was not present.

The distribution of results demonstrated that respondents were at least somewhat exposed to spin application, possibly reflecting basic prior instruction or imitation of advanced players. The relatively tighter clustering of scores around 2.0, compared to other tables, highlighted that spin was uniformly low but slightly better than in other domains.

An interesting observation was that, although serving was the weakest area overall, the application of spin in general play was the highest-rated subskill, creating a paradox in which respondents lacked control in initiating serves but showed slightly better tactical capacity during rallies.

In summary, Table 5 indicates that spin application was the relatively strongest domain among the pre-test results, yet it remained low across all indicators. Spin training could thus capitalize on this initial strength to bring about noticeable improvements in respondents' overall game strategies.

Table 6. Pre-Test Result on the Performance of the Selected Student-Respondents Prior to the Training Program in terms of **Footwork**

Indicator	**Weighted Mean**	**Standard Deviation**	**Verbal Interpretation**	**Rank**
Demonstrates quickness and agility	1.98	0.85	Low	3
Position correctly before strokes	1.84	0.79	Low	4.5
Maintains balance and coordination	1.84	0.68	Low	4.5
Anticipates and prepares for returns	2.08	0.67	Low	1
Moves efficiently across court zones	2.04	0.76	Low	2
Overall Mean	1.96	0.32	Low	

Legend: 3.51 – 4.00 (Very High); 2.51 – 3.50 (High); 1.51 – 2.50 (Low); 1.0-1.50 (Very Low)

Table 6 presented the results on footwork, with an overall mean of 1.96 (SD = 0.32), ranking second overall among the domains. The highest-rated indicator was "anticipates and prepares for returns" at 2.08 (SD = 0.67), followed closely by "moves efficiently across court zones" with 2.04 (SD = 0.76). These results suggested that respondents had some capacity to position themselves in response to the opponent's shots.

Meanwhile, "demonstrates quickness and agility" had a score of 1.98 (SD = 0.85), reflecting moderate deficiencies in speed and mobility. The lowest indicators, both at 1.84 (SD = 0.79 and 0.68), were "positions correctly before strokes" and "maintains balance and coordination," which highlighted weaknesses in stability and preparatory positioning.

The findings showed that footwork, though better than grip, serve, and block, remained underdeveloped. The narrow variance among items (ranging from 1.84 to 2.08) suggested that all aspects of footwork were equally challenging for respondents, with no clear strength dominating.

Interestingly, footwork ranked second overall, behind spin, which implied that the respondents were more accustomed to basic movement and positioning than to serving and blocking skills. Nevertheless, deficiencies in balance and preparation indicated an incomplete foundation that required systematic drills.

In summary, Table 6 shows that footwork was among the stronger but still low-rated areas, requiring training interventions targeting agility, anticipation, and court coverage. Strengthening this skill would directly enhance respondents' ability to execute strokes more effectively.

Table 7. Summary of the Pre-Test Result on the Performance of the Selected Student-Respondents Prior to the Training Program

Indicator	**Weighted Mean**	**Standard Deviation**	**Verbal Interpretation**	**Rank**
Grip	1.84	0.35	Low	3
Serve	1.41	0.46	Low	5
Block	1.76	0.44	Low	4
Spin	1.98	0.36	Low	1
Footwork	1.96	0.32	Low	2
Overall Mean	1.79	0.17	Low	

Legend: 3.51 – 4.00 (Very High); 2.51 – 3.50 (High); 1.51 – 2.50 (Low); 1.0-1.50 (Very Low)

Table 7 summarized the pre-test performance across all domains, showing an overall mean of 1.79 (SD = 0.17), interpreted as Low. Among the five domains, Spin ranked first with 1.98, followed by Footwork at 1.96, while Grip (1.84) and Block (1.76) occupied the middle, and Serve was the weakest at 1.41. This ordering confirmed that the respondents entered the training program with universally low skill levels, but with notable variation between domains.

The highest skill area, spin, indicated that respondents had at least some basic knowledge of tactical play, while footwork showed a modest ability to anticipate and move on the court. In contrast, the weakest area, serving, revealed severe deficiencies in initiating plays effectively, particularly in variation, accuracy, and confidence. The large gap of 0.57 points between spin (1.98) and serve (1.41) highlighted the stark disparity across skill domains.

The relatively uniform low interpretations across the board also suggested that none of the skill areas were developed to a satisfactory level prior to training. However, the closeness of grip, block, and footwork to the mid-range of the Low interpretation implied that these could improve more quickly with focused interventions. Serving, however, would require more intensive remedial training.

An interesting finding was that the respondents appeared to be relatively stronger in reactive skills (spin and footwork) than in proactive or initiating skills (serving and blocking). This imbalance hinted at possible exposure to informal or recreational play, where reactive instincts are more frequently developed than technical mastery.

In conclusion, Table 7 established that the respondents entered the training program with an overall low level of proficiency across all five domains, with spin and footwork as relative strengths and serve as the weakest skill. This baseline profile underscored the necessity of structured training interventions to build technical consistency, enhance tactical versatility, and balance both offensive and defensive components of play.

Table 8. Test of Difference in the Pre-Test Result on the Performance of the Selected Student-Respondents Prior the Training Program in terms of SEX

Indicator	**SEX**	**Mean**	**t**	**Sig.**	**Decision on Ho**	**Interpretation**
Grip	Male Female	1.83 1.86	.160	.691	Accepted	Not Significant
Serve	Male Female	1.41 1.42	.011	.915	Accepted	Not Significant
Block	Male Female	1.74 1.78	.310	.580	Accepted	Not Significant
Spin	Male Female	2.03 1.91	.052	.821	Accepted	Not Significant
Footwork	Male Female	2.00 1.88	.137	.713	Accepted	Not Significant
Overall	Male Female	1.80 1.77	.020	.889	Accepted	Not Significant

Legend: *Sig.* < 0.05 – Significant (Reject Ho); *Sig.* ≥ 0.05 – Not Significant (Accept Ho)

Table 8 presented the test of difference in the pre-test performance of respondents according to sex. The results revealed that across all indicators—Grip, Serve, Block, Spin, and Footwork—the differences between male and female respondents were not statistically significant, as all p-values exceeded the .05 threshold. For example, Grip showed means of 1.83 for males and 1.86 for females with a t-value of .160 and a significance of .691, leading to the acceptance of the null hypothesis. Similarly, the overall mean difference was negligible at 1.80 for males versus 1.77 for females, t = .020, p = .889.

The highest male mean was recorded in Footwork (2.00) compared to females (1.88), whereas females slightly outperformed males in Grip (1.86 vs. 1.83) and Block (1.78 vs. 1.74). However, these differences remained minimal and non-significant, suggesting that both sexes displayed consistently low skill levels across all performance domains.

An interesting observation was that males scored higher in Spin (2.03) than females (1.91), indicating a slight advantage in tactical play, whereas females had a small edge in Grip and Block. Yet, these advantages did not reach statistical significance, highlighting that gender differences were not a determinant of skill variation in the pre-test stage.

The low standard deviations across both sexes also reinforced that the respondents' skills were uniformly weak regardless of sex, suggesting that both groups shared similar baseline limitations prior to the training program. This uniformity pointed to the need for program-wide skill interventions rather than sex-specific training approaches.

In summary, Table 8 established that sex did not significantly affect pre-test performance in any skill domain. Both male and female respondents demonstrated generally low proficiency, with only marginal variations across specific indicators. The results implied that skill deficiencies were universal across the cohort and not influenced by gender.

Table 9. Test of Difference in the Pre-Test Result on the Performance of the Selected Student-Respondents Prior the Training Program in terms of Grade Level

Indicator	**Grade Level**	**Mean**	**F**	**Sig.**	**Decision on Ho**	**Interpretation**
Grip	1 2 3 4	1.95 1.72 1.87 1.82	.814	.493	Accepted	Not Significant
Serve	1 2 3 4	1.33 1.46 1.71 1.30	1.925	.139	Accepted	Not Significant
Block	1 2 3 4	1.85 1.70 1.82 1.70	.417	.742	Accepted	Not Significant
Spin	1 2 3 4	1.93 2.1 2.02 1.93	.614	.610	Accepted	Not Significant
Footwork	1 2 3 4	1.9 2.08 1.91 1.95	.656	.583	Accepted	Not Significant
Overall	1 2 3 4	1.79 1.81 1.87 1.74	1.281	.292	Accepted	Not Significant

Legend: *Sig.* < 0.05 – Significant (Reject Ho); *Sig.* ≥ 0.05 – Not Significant (Accept Ho)

Table 9 summarized the comparison of pre-test results across four grade levels. The results showed that differences across Grade 1 to Grade 4 were not statistically significant, as all p-values exceeded the .05 threshold, and the null hypothesis was consistently accepted. For example, the overall means ranged narrowly from 1.74 (Grade 4) to 1.87 (Grade 3), with F = 1.281 and p = .292, indicating no significant difference among grade levels.

The highest mean was recorded in Spin for Grade 2 students (2.10), suggesting that students in this level demonstrated slightly more proficiency in generating spin compared to other grades. Conversely, the lowest mean was observed in Serve for Grade 4 students (1.30), further emphasizing that serving was the weakest skill area across the board, with Grade 4 students showing particular difficulty.

Interestingly, Grade 3 posted relatively higher averages across multiple skills, such as Serve (1.71) and Block (1.82), while Grade 4 respondents consistently fell in the lower ranges despite being the most senior group. This counterintuitive finding suggested that higher grade level did not automatically translate into better pre-test performance, possibly due to differences in training exposure, focus on academics over athletics, or sampling variations.

The spread of means across indicators remained within the Low interpretation, reflecting uniform deficiencies regardless of grade. While some levels showed slight advantages in specific domains, such as Spin for Grade 2 and Serve for Grade 3, these did not translate into significant differences overall.

In summary, Table 9 demonstrated that grade level had no significant effect on pre-test performance. Although minor variations were noted—such as Grade 2 performing better in Spin and Grade 4 struggling in Serve—the respondents' skill levels were consistently low across grade levels, indicating that training interventions should be applied uniformly across all groups.

Table 10. Test of Difference in the Pre-Test Result on the Performance of the Selected Student-Respondents Prior to the Training Program in terms of the Course

Indicator	Course	Mean	F	Sig.	Decision on Ho	Interpretation
Grip	Teaching	1.73	1.205	.322	Accepted	Not Significant
	Management	1.83				
	Culture	1.84				
	Science	2.10				
	Arts	1.84				
Serve	Teaching	1.37	.471	.757	Accepted	Not Significant
	Management	1.34				
	Culture	1.56				
	Science	1.37				
	Arts	1.33				
Block	Teaching	1.54	2.067	.101	Accepted	Not Significant
	Management	1.66				
	Culture	1.90				

	Science Arts	1.70 1.98				
Spin	Teaching Management Culture Science Arts	2.03 2.06 1.96 1.97 1.89	.291	.882	Accepted	Not Significant
Footwork	Teaching Management Culture Science Arts	2.00 2.11 1.87 1.87 1.96	.823	.518	Accepted	Not Significant
Overall	Teaching Management Culture Science Arts	1.73 1.80 1.83 1.80 1.80	.516	.724	Accepted	Not Significant

Legend: *Sig.* < 0.05 – Significant (Reject Ho); *Sig.* ≥ 0.05 – Not Significant (Accept Ho)

Table 10 examined differences in pre-test performance across the five courses of Teaching, Management, Culture, Science, and Arts. The results consistently showed no statistically significant differences, as indicated by p-values greater than .05 across all skill domains. The overall means ranged narrowly from 1.73 (Teaching) to 1.83 (Culture), with F = .516 and p = .724, confirming uniformity across courses.

Notably, Science students recorded the highest mean in Grip (2.10) compared to other groups, while Arts students posted the highest mean in Block (1.98). These findings suggested that students from different courses had slight advantages in certain skills. However, Serve remained universally weak, with means ranging from 1.33 (Arts) to 1.56 (Culture), highlighting its persistent status as the lowest-performing domain.

Management students appeared to perform slightly better in Footwork (2.11) compared to the other groups, while Culture students consistently maintained mid-level averages, such as Grip (1.84) and Serve (1.56). Interestingly, Teaching students consistently recorded some of the lowest means, with Serve at 1.37 and Block at 1.54, suggesting weaker initial proficiency despite being associated with pedagogical training.

The lack of significant differences suggested that course affiliation did not play a role in shaping the pre-test skill levels of the respondents. This reinforced the interpretation that deficiencies in Grip, Serve, Block, Spin, and Footwork were universal and cut across disciplinary boundaries.

In conclusion, Table 10 confirmed that the pre-test skill deficiencies were consistent across all courses. Although Science students showed a slight advantage in Grip and Management students in Footwork, the differences were not statistically significant. Serving was again highlighted as the weakest domain across all courses, underscoring the need for focused training regardless of academic specialization.

Part III: The post-test results on the performance of the selected student-respondents after the training program in terms of the following skills Grip; Serve; Block; Spin; Footwork.

Table 11. Post-Test Result on the Performance of the Selected Student-Respondents After the Training Program in terms of **Grip**

Indicator	Weighted Mean	Standard Deviation	Verbal Interpretation	Rank
Holds racket correctly (shakehand/penhold)	2.62	0.92	High	**1**
Maintains grip consistency during rallies	2.34	0.94	Low	**5**
Wrist and arm movement supported by grip	2.46	0.97	Low	**3**
Adjusts grip effectively in forehand/backhand	2.58	1.03	High	**2**
Avoids excessive tension or frequent repositioning	2.36	0.9	Low	**4**
Overall Mean	2.47	0.41	Low	

Legend: 3.51 – 4.00 (Very High); 2.51 – 3.50 (High); 1.51 – 2.50 (Low); 1.0-1.50 (Very Low)

Table 11 showed the post-test results of the respondents' performance in grip, where the overall mean was 2.47 (SD = 0.41), interpreted as Low. This was an improvement compared to the pre-test mean of 1.84, although it did not reach the High level overall. The highest indicator was "holds racket correctly (shakehand/penhold)," which obtained a mean of 2.62 (SD = 0.92), interpreted as High. This result indicated that the training program helped participants become more familiar with correct grip techniques. Another relatively strong indicator was "adjusts grip effectively in forehand/backhand," rated at 2.58 (SD = 1.03), also at the High level.

On the other hand, the lowest indicator was "maintains grip consistency during rallies," which had a mean of 2.34 (SD = 0.94), still within the Low range. Similarly, "avoids excessive tension or frequent repositioning" received 2.36 (SD = 0.90), showing that participants continued to struggle with maintaining relaxed yet controlled grip during extended play. "Wrist and arm movement supported by grip" scored 2.46 (SD = 0.97), which also fell in the Low range, ranking third.

These results suggested that while the training program enhanced foundational aspects of grip, such as holding the racket properly and adapting grips for forehand and backhand strokes, more advanced aspects requiring consistency and composure under pressure were still problematic. The small gap between the highest and lowest means, ranging from 2.34 to 2.62, reflected moderate but incomplete development.

It was interesting to note that the items rated High were mostly static or fundamental skills, while the items rated Low were more dynamic and situational, requiring sustained control during rallies. This suggested that participants mastered basic forms more quickly than performance under game conditions.

In summary, Table 11 highlighted a significant improvement in grip performance after training, but the overall classification remained Low. Respondents showed mastery of correct grip forms but still needed reinforcement in consistency, fluidity, and relaxation during competitive rallies.

Table 12. Post -Test Result on the Performance of the Selected Student-Respondents After the Training Program in terms of **Serve**

Indicator	Weighted Mean	Standard Deviation	Verbal Interpretation	Rank
Adheres to service rules (ball toss, legality)	2.48	0.86	Low	**3**
Controls ball speed, spin, and placement	2.38	0.86	Low	**5**
Consistency and accuracy of serve	2.42	0.93	Low	**4**
Varies serve type (short/long, spin/no spin)	2.52	0.97	High	**2**
Demonstrates confidence and fluidity	2.72	0.81	High	**1**
Overall Mean	2.5	0.4	Low	

Legend: 3.51 – 4.00 (Very High); 2.51 – 3.50 (High); 1.51 – 2.50 (Low); 1.0-1.50 (Very Low)

Table 12 presented the post-test performance in serving, where the overall mean was 2.50 (SD = 0.40), still interpreted as Low, though very close to the High threshold. The results indicated notable gains compared to the pre-test overall mean of 1.41, which was previously the weakest skill domain. The highest indicator was "demonstrates confidence and fluidity," with a mean of 2.72 (SD = 0.81), interpreted as High. This suggested that participants developed improved composure and rhythm in executing serves after training.

The second strongest aspect was "varies serve type," which scored 2.52 (SD = 0.97), also in the High range. This showed that respondents learned to diversify their serves, a crucial factor in competitive play. By contrast, the lowest indicator was "controls ball speed, spin, and placement" at 2.38 (SD = 0.86), which remained Low. Similarly, "consistency and accuracy of serve" had 2.42 (SD = 0.93), reflecting continued weaknesses in precision.

Interestingly, while technical control of serves remained problematic, psychological aspects such as confidence and tactical variation improved significantly. This contrast showed that the training effectively enhanced respondents' willingness to experiment and perform under pressure but required further focus on technical refinement for accuracy and spin control.

The improvement from a pre-test mean of 1.41 to 2.50 demonstrated that serving benefitted substantially from the training program, transforming it from the weakest skill area to one nearing the High range overall. This was a remarkable outcome, as it suggested that targeted instruction directly impacted respondents' confidence and adaptability in serving.

In conclusion, Table 12 confirmed that although serving remained at the Low interpretation overall, the progress from very low baseline scores to almost High was one of the most substantial improvements observed. Confidence and variety increased, while accuracy and technical precision required more sustained practice.

Table 13. Post -Test Result on the Performance of the Selected Student-Respondents After the Training Program in terms of **Block**

Indicator	Weighted Mean	Standard Deviation	Verbal Interpretation	Rank
Redirects fast balls accurately	2.54	1.01	High	2.5
Controls racket angle and positioning	2.24	0.98	Low	5
Reacts quickly to opponent's attack	2.54	1.07	High	2.4
Consistently neutralizes offensive strokes	2.5	0.97	Low	4
Places blocked returns strategically	2.66	1	High	1
Overall Mean	2.5	0.43	Low	

Legend: 3.51 – 4.00 (Very High); 2.51 – 3.50 (High); 1.51 – 2.50 (Low); 1.0-1.50 (Very Low)

Table 13 reported the post-test performance in blocking, where the overall mean was 2.50 (SD = 0.43), interpreted as Low. Despite this, the results showed improvement compared to the pre-test mean of 1.76. The strongest indicator was "places blocked returns strategically," with a mean of 2.66 (SD = 1.00), which reached the High interpretation. Respondents also performed better in "reacts quickly to opponent's attack" (2.54, SD = 1.07) and "redirects fast balls accurately" (2.54, SD = 1.01), both at the High level.

Meanwhile, the lowest-rated indicator was "controls racket angle and positioning," which scored 2.24 (SD = 0.98), indicating ongoing challenges in managing the technical aspects of defensive play. Another low-rated indicator was "consistently neutralizes offensive strokes," with a mean of 2.50 (SD = 0.97), which was borderline between Low and High.

The results showed that while players improved their reaction time and ability to redirect or strategically place blocks, they still lacked the technical mastery to manage racket positioning consistently. This imbalance suggested that respondents relied more on instinct and reaction than on controlled technical precision.

It was notable that the variability of scores (SD values close to 1.0) was higher in this table compared to others, suggesting that respondents developed blocking skills at uneven rates, with some performing much better than others.

In summary, Table 13 highlighted that blocking improved considerably, with strengths in reaction and tactical placement. However, technical deficiencies in racket control limited overall consistency, preventing the domain from achieving a fully High interpretation.

Table 14. Post -Test Result on the Performance of the Selected Student-Respondents After the Training Program in terms of **Spin**

Indicator	Weighted Mean	Standard Deviation	Verbal Interpretation	Rank
Applies spin in serves effectively	2.52	0.95	High	4
Uses spin in rallies (topspin/backspin/sidespin)	2.68	1.02	High	1
Produces consistent spin effect	2.66	0.92	High	2
Controls direction and depth with spin	2.48	0.91	Low	5

Varies spin to disrupt opponent rhythm	2.56	0.93	High	3
Overall Mean	2.58	0.4	High	

Legend: 3.51 – 4.00 (Very High); 2.51 – 3.50 (High); 1.51 – 2.50 (Low); 1.0-1.50 (Very Low)

Table 14 displayed the post-test results in spin, where the overall mean was 2.58 (SD = 0.40), interpreted as High. This marked a significant advancement from the pre-test mean of 1.98, which was already the strongest area at baseline. The top indicator was "uses spin in rallies" at 2.68 (SD = 1.02), closely followed by "produces consistent spin effect" (2.66, SD = 0.92). These both reflected strong improvements in tactical and technical application of spin during rallies.

The lowest indicator was "controls direction and depth with spin," rated 2.48 (SD = 0.91), which still fell in the Low category, showing that while spin was applied effectively, its precision in terms of placement required further development. Meanwhile, "varies spin to disrupt opponent rhythm" (2.56) and "applies spin in serves effectively" (2.52) were rated High, suggesting that variety and serve integration benefitted from training.

These results showed that respondents became increasingly adept at using spin as a tactical advantage, moving from rudimentary exposure to active utilization in rallies. The gap between the highest (2.68) and lowest (2.48) scores was relatively small, reflecting a consistent development across spin-related skills.

It was interesting that spin, which was already the highest-rated pre-test skill, became the only domain to cross into the High interpretation post-test. This demonstrated that the training successfully enhanced an existing relative strength, amplifying its importance in the respondents' skill set.

In summary, Table 14 confirmed that spin was the strongest skill domain after training, with clear improvements in rally application, consistency, and tactical variation. Only placement control lagged slightly, but overall, spin represented the most notable success of the training program.

Table 15. Post -Test Result on the Performance of the Selected Student-Respondents After the Training Program in terms of **Footwork**

Indicator	**Weighted Mean**	**Standard Deviation**	**Verbal Interpretation**	**Rank**
Demonstrates quickness and agility	2.5	1.06	Low	2
Positions correctly before strokes	2.44	1.03	Low	4
Maintains balance and coordination	2.46	0.97	Low	3
Anticipates and prepares for returns	2.62	1.01	High	1
Moves efficiently across court zones	2.4	0.97	Low	5
Overall Mean	2.48	0.49	Low	

Legend: 3.51 – 4.00 (Very High); 2.51 – 3.50 (High); 1.51 – 2.50 (Low); 1.0-1.50 (Very Low)

Table 15 presented the post-test performance in footwork, where the overall mean was 2.48 (SD = 0.49), interpreted as Low. Although this showed an improvement from the pre-test mean of 1.96, the results indicated that footwork remained one of the weaker domains. The highest indicator was "anticipates and prepares for returns," with a mean of 2.62 (SD = 1.01), interpreted as High. This implied that the training helped respondents improve anticipation skills, a critical aspect of positioning.

However, most other indicators remained in the Low category. “Moves efficiently across court zones” scored the lowest at 2.40 (SD = 0.97), highlighting continued difficulties in lateral and forward-backward mobility. Similarly, “positions correctly before strokes” (2.44) and “maintains balance and coordination” (2.46) both showed modest improvements but remained Low. “Demonstrates quickness and agility” was rated 2.50, right at the threshold between Low and High.

These findings revealed that while respondents became better at anticipating plays, they still struggled with actual execution of footwork, particularly efficiency of movement and stability during rallies. This discrepancy suggested that cognitive anticipation improved faster than physical agility and balance.

The wider spread of means (ranging from 2.40 to 2.62) highlighted uneven development across sub-skills, with anticipation as the strongest and movement efficiency as the weakest.

In summary, Table 15 showed that footwork improved after training but remained below the High threshold overall. While anticipation showed gains, agility, efficiency, and balance required more targeted training drills.

Table 16. Post -Test Result on the Performance of the Selected Student-Respondents After the **Training Program**

Indicator	**Weighted Mean**	**Standard Deviation**	**Verbal Interpretation**	**Rank**
Grip	2.47	0.41	Low	5
Serve	2.5	0.4	Low	2.5
Block	2.5	0.43	Low	2.5
Spin	2.58	0.4	High	1
Footwork	2.48	0.49	Low	4
Overall Mean	2.51	0.17	High	

Legend: 3.51 – 4.00 (Very High); 2.51 – 3.50 (High); 1.51 – 2.50 (Low); 1.0-1.50 (Very Low)

Table 16 summarized the post-test results across all domains, with an overall mean of 2.51 (SD = 0.17), now interpreted as High. This was a substantial improvement compared to the pre-test overall mean of 1.79. Among the five skill domains, Spin ranked first with 2.58, followed by Serve (2.50) and Block (2.50) tied at second, then Footwork at 2.48, and Grip at the lowest with 2.47.

Spin emerged as the strongest skill area, moving from 1.98 (Low) in the pre-test to 2.58 (High) in the post-test. Serve, which was previously the weakest skill with 1.41, improved significantly to 2.50, showing one of the most remarkable progressions. Grip, despite improvement from 1.84 to 2.47, remained the weakest relative domain, indicating that consistency and technical relaxation were still underdeveloped.

The differences across domains were relatively small, with means ranging from 2.47 to 2.58, suggesting that the training program elevated skill levels more uniformly. However, the domain rankings revealed that certain skills, such as Spin and Serve, responded better to training compared to Grip and Footwork.

An interesting finding was the dramatic improvement of Serve, which transformed from the weakest to a mid-level ranking, nearly equal to Block. This reflected that targeted drills and training focus had a strong impact on service performance.

In conclusion, Table 16 confirmed that the training program was effective, raising overall performance from Low to High. Spin was the strongest skill domain, while Grip remained the weakest, and Serve showed the most

dramatic improvement. These results provided strong evidence that structured training enhanced both technical and tactical competencies of the respondents.

Part IV: Significant difference in the post-test results on the performance of the selected student-respondents after the training program based on profile

Table 17. Test of Difference in the Post-Test Result on the Performance of the Selected Student-Respondents After the Training Program in terms of **Sex**

Indicator	SEX	Mean	t	Sig.	Decision on Ho	Interpretation
Grip	Male Female	2.47 2.47	1.000	.322	Accepted	Not Significant
Serve	Male Female	2.52 2.48	.009	.924	Accepted	Not Significant
Block	Male Female	2.50 2.50	2.433	.125	Accepted	Not Significant
Spin	Male Female	2.66 2.45	.321	.574	Accepted	Not Significant
Footwork	Male Female	2.53 2.41	.178	.675	Accepted	Not Significant
Overall	Male Female	2.53 2.46	8.097	.007	Rejected	Significant

Legend: *Sig.* < 0.05 – Significant (Reject Ho); *Sig.* ≥ 0.05 – Not Significant (Accept Ho)

Table 17 presented the test of difference in post-test results by sex. The findings revealed that in all individual skill domains—Grip, Serve, Block, Spin, and Footwork—the mean scores between male and female respondents were not statistically significant, as p-values exceeded .05. For instance, Grip showed equal means of 2.47 for both males and females, with t = 1.000 and p = .322. Serve also showed near equality, with males at 2.52 and females at 2.48, t = .009, p = .924. These results indicated that skill improvements after training were distributed fairly evenly across sexes.

Interestingly, Spin and Footwork showed slightly higher means for males (2.66 and 2.53) compared to females (2.45 and 2.41), but the differences were not statistically significant. Similarly, in Block, both groups had an identical mean of 2.50, underscoring the balanced improvement across sexes in defensive skills. These patterns suggested that the training program provided equitable opportunities for skill development without favoring one sex over the other.

However, the overall post-test result showed a significant difference, with males recording 2.53 and females 2.46, yielding t = 8.097 and p = .007. This indicated that although domain-specific differences were not significant, the aggregated post-test scores reflected a statistically meaningful advantage for males.

This outcome implied that male respondents might have benefited slightly more holistically from the training program, even though individual skill domains did not show significant variation. This could be attributed to physical conditioning, stamina, or confidence levels that collectively influenced overall performance gains.

In summary, Table 17 revealed that while no sex differences were observed in specific skill domains, the overall post-test performance showed a significant advantage for males. The training program was effective across both sexes, but the overall improvement favored male respondents.

Table 18. Test of Difference in the Post -Test Result on the Performance of the Selected Student-Respondents After the Training Program in terms of **grade level**

Indicator	**Grade Level**	**Mean**	**F**	**Sig.**	**Decision on Ho**	**Interpretation**
Grip	1 2 3 4	2.58 2.18 2.27 2.65	4.808	.005	Rejected	Significant
Serve	1 2 3 4	2.58 2.48 2.51 2.46	.229	.876	Accepted	Not Significant
Block	1 2 3 4	2.48 2.36 2.38 2.63	1.197	.321	Accepted	Not Significant
Spin	1 2 3 4	2.42 2.66 2.56 2.65	1.019	.393	Accepted	Not Significant
Footwork	1 2 3 4	2.43 2.60 2.40 2.50	.314	.815	Accepted	Not Significant
Overall	1 2	2.50 2.46	2.254	.095	Accepted	Not Significant

	3 4	2.42 2.58				

Legend: *Sig.* < 0.05 – Significant (Reject Ho); *Sig.* ≥ 0.05 – Not Significant (Accept Ho)

Table 18 presented the test of difference across grade levels, revealing that Grip showed a significant difference, with an F-value of 4.808 and p = .005, leading to rejection of the null hypothesis. The means indicated that Grade 4 respondents performed best in Grip with 2.65, while Grade 2 students performed lowest with 2.18. This suggested that senior students were more adept at adapting grip techniques compared to their younger counterparts.

For the other domains, the differences were not significant, as p-values exceeded .05. Serve ranged narrowly from 2.46 (Grade 4) to 2.58 (Grade 1), Block ranged from 2.36 (Grade 2) to 2.63 (Grade 4), Spin ranged from 2.42 (Grade 1) to 2.66 (Grade 2), and Footwork ranged from 2.40 (Grade 3) to 2.60 (Grade 2). Although variations were present, these did not translate into significant differences.

The overall mean across grade levels ranged from 2.42 (Grade 3) to 2.58 (Grade 4), with F = 2.254 and p = .095, which was not statistically significant. This implied that overall improvements in skills after training were uniform across grade levels, even though Grip showed a clear advantage for Grade 4 students.

The finding that only Grip yielded significant differences highlighted that mastery of racket handling might be more strongly influenced by academic maturity or cumulative training experience. Older students may have had greater exposure or better fine motor control, contributing to their stronger grip performance.

In summary, Table 18 demonstrated that grade level did not significantly influence post-test performance in most skill domains, except Grip, where Grade 4 students clearly outperformed lower grade levels. The results suggested that while improvements were consistent across grades, maturity and experience provided an advantage in technical aspects of racket control.

Table 19. Test of Difference in the Post -Test Result on the Performance of the Selected Student-Respondents After the Training Program in terms of **Course**

Indicator	**Course**	**Mean**	**F**	**Sig.**	**Decision on Ho**	**Interpretation**
Grip	Teaching Management Culture Science Arts	2.40 2.51 2.44 2.53 2.56	.250	.908	Accepted	Not Significant
Serve	Teaching Management Culture Science Arts	2.57 2.54 2.44 2.57 2.42	.316	.866	Accepted	Not Significant

Block	Teaching Management Culture Science Arts	2.40 2.37 2.56 2.50 2.64	.635	.640	Accepted	Not Significant
Spin	Teaching Management Culture Science Arts	2.69 2.57 2.47 2.60 2.58	.484	.747	Accepted	Not Significant
Footwork	Teaching Management Culture Science Arts	2.46 2.54 2.40 2.20 2.80	1.703	.166	Accepted	Not Significant
Overall	Teaching Management Culture Science Arts	2.50 2.51 2.46 2.48 2.60	.901	.471	Accepted	Not Significant

Legend: *Sig.* < 0.05 – Significant (Reject Ho); *Sig.* ≥ 0.05 – Not Significant (Accept Ho)

Table 19 showed the post-test differences according to course. The results revealed that none of the domains showed significant differences, as all p-values exceeded .05. For example, Grip ranged from 2.40 (Teaching) to 2.56 (Arts) with F = .250, p = .908. Similarly, Serve ranged from 2.42 (Arts) to 2.57 (Teaching and Science), but F = .316, p = .866 indicated non-significance.

Block performance varied slightly, with Arts students achieving the highest mean (2.64) and Management students the lowest (2.37). Spin showed a peak in Teaching (2.69) and the lowest in Culture (2.47), but differences were statistically insignificant (F = .484, p = .747). Footwork showed the widest spread, from 2.20 (Science) to 2.80 (Arts), but again, the difference was not significant (F = 1.703, p = .166).

The overall means across courses ranged from 2.46 (Culture) to 2.60 (Arts), with F = .901 and p = .471, confirming that course affiliation did not significantly affect skill development. Despite differences in academic focus, respondents achieved comparable gains in technical and tactical table tennis skills after the training program.

An interesting pattern emerged with Arts students consistently posting some of the highest means across domains, particularly in Grip (2.56) and Footwork (2.80). This may indicate a natural alignment between creative, physically expressive disciplines and better adaptability in sports training, although the results were not statistically significant.

In summary, Table 19 demonstrated that course affiliation had no significant effect on post-test skill performance. While some groups, particularly Arts students, posted slightly higher means, the improvements were consistent across all courses, reflecting the universal effectiveness of the training program regardless of academic background.

Part V:Significant difference in the pre-test and post-test performance of the selected student-respondents prior and after the table tennis program

Table 20. Test of Difference in the Pre-test and Post-Test Result on the Performance of the Selected Student-Respondents Prior and After the Table Tennis Program

Indicator	Test	Mean	t	Sig.	Decision on Ho	Interpretation
Grip	Pre-Test Post-Test	1.84 2.47	.476	.000	Rejected	Significant
Serve	Pre-Test Post-Test	1.41 2.50	.136	.347	Accepted	Not Significant
Block	Pre-Test Post-Test	1.76 2.5	.533	.000	Rejected	Significant
Spin	Pre-Test Post-Test	1.98 2.58	.761	.000	Rejected	Significant
Footwork	Pre-Test Post-Test	1.96 2.48	.746	.000	Rejected	Significant
Overall	Pre-Test Post-Test	1.79 2.51	.246	.086	Accepted	Not Significant

Legend: $p < 0.05$ – Significant (Reject Ho); $p \geq 0.05$ – Not Significant (Accept Ho)

Table 20 presents the test of the difference between the pre-test and post-test results of the respondents' performance in the five skill domains of table tennis: Grip, Serve, Block, Spin, and Footwork. The results showed that four of the five domains (Grip, Block, Spin, and Footwork) yielded statistically significant differences, as their p-values were less than 0.05, leading to the rejection of the null hypothesis. By contrast, Serve did not show a significant improvement despite an increase in the mean score, while the overall performance also did not reach statistical significance.

In terms of Grip, the mean score improved from 1.84 (Pre-Test) to 2.47 (Post-Test), with a t-value of .476 and p = .000, indicating a significant difference. This suggested that the training program substantially enhanced respondents' ability to hold the racket correctly and adapt their grips during play. Similarly, Block improved from 1.76 to 2.50, with p = .000, indicating significant progress in defensive capabilities, such as redirecting fastballs and placing strategic returns.

Spin registered the largest gain, improving from 1.98 to 2.58, and the difference was significant at p = .000. This confirmed that the respondents not only developed greater familiarity with spin but also enhanced their ability to vary and apply it during rallies. Footwork also improved significantly, with mean scores rising from 1.96 to 2.48 (p = .000), demonstrating that the program strengthened anticipation, agility, and court movement.

Interestingly, Serve, despite showing a notable mean increase from 1.41 to 2.50, did not achieve statistical significance (p = .347). This outcome suggested variability in performance among respondents, possibly due to differences in confidence, control, or ability to master service mechanics. The same was true for the overall mean, which improved from 1.79 to 2.51 but did not yield a significant difference (p = .086). This implied that while individual skills showed strong improvement, the aggregation across all domains may have diluted the statistical significance.

A key observation was that the highest post-test mean was recorded in Spin (2.58), while the lowest pre-test mean was found in Serve (1.41). The improvements across domains demonstrated that the training program had a marked positive effect, though serving remained the most inconsistent skill. The overall pattern suggested that the program was effective in enhancing specific technical and tactical aspects. However, more structured interventions might be needed to strengthen serving and to ensure uniform gains across all respondents.

In summary, Table 20 highlighted that the table tennis training program significantly improved Grip, Block, Spin, and Footwork, while Serve and overall performance did not yield statistically significant differences. The findings suggested that the intervention was essentially practical, especially in technical execution and tactical application. However, additional emphasis should be placed on serving skills and balancing improvements across the cohort to achieve stronger overall outcomes.

SUMMARY OF FINDINGS, CONCLUSION, AND RECOMMENDATION

Summary of Findings

The study was conducted to determine the performance of the selected student-respondents in table tennis prior to and after the training program, focusing on five constructs: Grip, Serve, Block, Spin, and Footwork. The analysis covered their demographic profile, pre-test results, differences in pre-test performance across variables, post-test results, differences in post-test performance, and the overall test of difference between pre-test and post-test scores. The following summarizes the key findings:

1. Profile of the Respondents. The study involved 50 student respondents with diverse demographic backgrounds, including sex, grade level, and course enrollment. The majority were male (62%), while females represented 38%, indicating that the sample was slightly male-dominated. Grade level distribution showed that most respondents were in Grade 4 (38%), followed by Grade 1 (24%), Grade 2 (20%), and Grade 3 (18%). This revealed that the cohort was composed mainly of senior-level students, which could suggest prior exposure to more structured sports activities. In terms of course classification, the highest proportions were from Teaching and Culture (28% each), while Science had the least representation (12%). Management and Arts also contributed smaller shares at 14% and 18%, respectively. The profile thus reflected a diverse set of participants, though skewed toward male and senior students, which was important to consider in analyzing performance differences.

2. Assessment of Respondents' Performance in the Pre-Test. The pre-test evaluation revealed that the respondents' performance across all five skill constructs was generally low, with an overall mean of 1.79, verbally interpreted as Low. Among the constructs, Spin posted the highest mean at 1.98, followed by Footwork (1.96), Grip (1.84), and Block (1.76). Serve, however, registered the lowest mean of 1.41, making it the weakest skill among the respondents. The results showed that although the participants demonstrated slight strengths in Spin and Footwork, they lacked consistency, technical precision, and tactical effectiveness across most domains. In particular, the poor rating in Serve highlighted that students struggled with initiating plays, controlling ball placement, and demonstrating confidence during service execution. Overall, the pre-test findings pointed to a uniform deficiency in fundamental table tennis skills prior to training.

3. Differences in Pre-Test Results. When analyzed across sex, grade level, and course, the pre-test results revealed no statistically significant differences in any of the constructs. Male and female respondents performed at similar levels, with none showing a clear advantage in Grip, Serve, Block, Spin, or Footwork. Similarly, differences across grade levels did not yield significance, even though Grade 4 students tended to have slightly higher means in some skills. Course-based comparisons also indicated uniformity in low performance, regardless of academic orientation. This uniformity confirmed that all respondents, irrespective of sex, academic level, or course, entered the training program with equally low performance levels. These findings underscored the appropriateness of implementing a uniform training program applicable to the entire cohort, since no subgroup demonstrated a clear advantage at the outset.

4. Assessment of Respondents' Performance in the Post-Test. The post-test assessment showed substantial improvement in respondents' performance, with the overall mean rising to 2.51, which was verbally interpreted as High. Spin emerged as the strongest construct with a mean of 2.58, demonstrating significant enhancement in the tactical use of spin in rallies. Serve and Block tied at 2.50, reflecting considerable progress compared to their pre-test values, particularly for Serve, which had been the weakest skill at baseline. Footwork obtained 2.48, while Grip remained the lowest at 2.47, though it still showed a notable improvement from its pre-test value of 1.84. These results highlighted the effectiveness of the training program, as respondents not only enhanced their technical execution but also developed greater confidence in competitive play. The post-test findings clearly demonstrated that targeted training interventions significantly contributed to skill development across all domains, even if certain areas like Grip required further reinforcement.

5. Differences in Post-Test Results. Post-test analysis showed that most comparisons across sex, grade level, and course did not yield statistically significant differences, with only two exceptions. In terms of sex, males recorded a significantly higher overall mean (2.53) than females (2.46, $p = .007$), although skill-specific differences remained statistically insignificant. This suggested that male respondents, as a group, benefited slightly more holistically from the training program. Grade-level comparisons showed a significant difference in Grip ($p = .005$), with Grade 4 students performing better (2.65) than their lower-grade counterparts, suggesting a potential advantage of maturity and prior experience. However, for the remaining constructs, no significant differences were found across grade levels or course affiliations. This reinforced the finding that the training program was broadly effective across demographic groups, providing equitable opportunities for skill enhancement.

6. Test of Difference between Pre-Test and Post-Test Results. The overall comparison between pre-test and post-test results revealed that four constructs—Grip, Block, Spin, and Footwork—demonstrated statistically significant improvements ($p < 0.05$). Grip improved from 1.84 to 2.47, Block from 1.76 to 2.50, Spin from 1.98 to 2.58, and Footwork from 1.96 to 2.48, all indicating meaningful gains after the intervention. Serve also improved substantially in mean score (1.41 to 2.50), but this difference was not statistically significant ($p = .347$), likely due to variability in performance across respondents. The overall mean increased from 1.79 to 2.51, but the difference was not statistically significant ($p = .086$). These results underscored that the training program was largely successful in enhancing the technical and tactical competencies of the respondents, particularly in Spin, Block, and Footwork. At the same time, further reinforcement was needed in serving skills and overall performance consistency.

Conclusion

Based on the study examining the performance of selected student-respondents in table tennis before and after a structured training program, several key conclusions emerged.

1. First, despite differences in sex, grade level, and course affiliation, all respondents exhibited comparable deficiencies in their table tennis skills at the outset. The pre-test results revealed uniformly low means across skills such as Grip, Serve, Block, Spin, and Footwork, indicating that demographic factors did not confer any advantage and that a standardized intervention was necessary for all students. Specifically, the pre-test data showed low proficiency across all domains, with Serve as the weakest area. This suggests that students not only struggled with technical execution but also with initiating and controlling play, a critical aspect of table tennis.

While Spin and Footwork had slightly higher initial scores, the overall low performance highlighted a fundamental lack of technical mastery and tactical awareness.

2. Statistical analysis further confirmed the absence of significant pre-test differences across sex, grade level, and course affiliation, reinforcing the idea that all groups started from a similar baseline. This justified the use of a uniform training approach. Following the training program, students demonstrated substantial improvements across all skill categories, with post-test means indicating a shift from low to high proficiency. Spin emerged as the strongest skill after the intervention, and although Grip remained the lowest among the improved skills, all domains saw marked gains. This overall improvement highlights the effectiveness of structured, guided practice in enhancing table tennis performance within a short timeframe.

3. Notably, while most demographic groups improved similarly, two significant post-test differences were observed: males outperformed females in overall scores, and Grade 4 students surpassed Grade 2 students in Grip, possibly due to greater maturity or experience. Course affiliation did not result in significant differences, suggesting the program benefited students regardless of academic background. Statistical tests confirmed significant gains in Grip, Block, Spin, and Footwork, though not in Serve, where improvement was evident but not statistically significant. Similarly, the overall mean improvement, though large, did not reach statistical significance, indicating some variability in student progression. These findings suggest a continued need to focus on Serve and to develop strategies that promote more uniform advancement across all skill areas.

Recommendations

Based on the findings and conclusions of this study, the following recommendations are advanced:

1. Strengthen training interventions targeting Grip and Serve. Since Grip remained the weakest skill after the program and Serve did not achieve significant improvement despite increases in mean scores, specialized training modules focusing on these two constructs should be implemented. Grip exercises must emphasize consistency during rallies and relaxation techniques to avoid excessive tension, while serving drills should enhance accuracy, variation, and confidence under competitive conditions.

2. Introduce individualized or small-group training to address variability. The results showed that while most respondents improved significantly, serving performance varied widely. This implies that some students progressed faster than others. To bridge this gap, coaches should adopt individualized or small-group sessions that provide targeted feedback and corrective exercises, ensuring that no student is left behind in skill acquisition.

3. Incorporate progressive and game-based training approaches. To sustain motivation and enhance mastery, training should integrate progressive skill-building exercises that gradually increase in difficulty. Game-based drills that replicate real match situations should also be used to strengthen application under pressure. This will help translate technical improvements into tactical effectiveness, particularly in Serve, Block, and Footwork.

4. Provide equal opportunities and gender-sensitive coaching strategies. Although both males and females improved, males recorded a significantly higher overall post-test mean. Coaches should ensure that training strategies are gender-sensitive, providing adequate encouragement and tailored feedback for female participants. Equal opportunities in leadership roles during drills or matches may also improve confidence and performance across sexes.

5. Enhance support for lower-grade students to balance maturity effects. The findings showed that Grade 4 students outperformed students at other levels in Grip, suggesting that maturity and experience are advantages. To address this disparity, younger grade levels should receive more foundational training sessions that emphasize proper techniques and motor skills. Peer mentoring from senior players could also help first-year students improve more quickly.

6. Continue and expand the training program for holistic development. The overall results confirmed that structured training significantly enhanced four out of five constructs. It is therefore recommended that the table

tennis program be institutionalized and expanded as part of the school's regular physical education curriculum or as an extracurricular activity. Sustained implementation will not only improve technical and tactical skills but also contribute to students' physical fitness, discipline, and sportsmanship.

Output Of the Study

Comprehensive Table Tennis Training Enhancement Program Rationale

China, a nation with a rich sporting tradition and a strong focus on physical education, highly values the development of athletic skills among its youth. Table tennis, in particular, holds a special place in Chinese sports culture, being a national sport with a profound historical and competitive legacy. The country's dedication to sports excellence is shown through investments in training programs and sports facilities to develop talented athletes from a young age. This context provides a solid foundation for exploring the effects of physical activity programs, like table tennis, on college students' agility performance.

The findings of the study compelled the researcher to craft a contextualized and structured training program that consolidates the strengths in Spin, Block, and Footwork while addressing persistent weaknesses in Grip and Serve. Grip remained the lowest-performing construct in the post-test, and serving inconsistency limited respondents' ability to gain tactical advantage during play. By creating a structured, progressive, and game-based training program, the intervention seeks to develop mastery in each construct, improve overall performance, and foster long-term engagement in the sport. Moreover, the program addresses the slight disparities observed by profiles as to sex and grade level, ensuring that all respondents, regardless of demographic profile, receive equitable opportunities to enhance their competencies.

Plan of Implementation

The Table Tennis Training Program will be implemented over 8–12 weeks, designed to build skills across the five key result areas progressively: Grip, Serve, Block, Spin, and Footwork. The training will be conducted in structured sessions led by coaches and PE instructors, with support from fitness trainers and student-athlete leaders.

For Grip Development, daily routines will emphasize proper racket holding techniques, consistency drills during rallies, and relaxation exercises to reduce tension. Corrective feedback will be provided using video analysis to refine grip adjustments between forehand and backhand strokes.

In the area of Blocking Skills, reaction drills, angle-control training, and tactical placement exercises will be administered twice weekly. Partner-based tournaments and multiball training will simulate high-pressure defensive scenarios to enhance reflexes and strategic decision-making.

Spin Application will be reinforced through progressive drills integrating topspin, backspin, and sidespin. Sessions will include serve-plus-spin combinations, rally-based spin variations, and slow-motion video reviews to ensure precision and tactical use of spin during competitive play.

For Footwork and Agility, three sessions per week will be dedicated to ladder and cone drills, shadow footwork practices, and timed court coverage exercises. Balance and coordination routines will be integrated with strength and conditioning activities to support efficient movement across the playing area.

Finally, Serve Precision will be addressed through daily serving drills that target accuracy, variation, and confidence. Students will be required to complete sequences of consecutive legal serves under both relaxed and pressured conditions, with peer and video evaluations used to monitor progress.

Implementation will be staggered to ensure progressive skill development, with assessment checkpoints every two weeks to monitor improvements and adjust training intensity. Success will be measured through performance evaluations using the same indicators from the pre-test and post-test, aiming to raise the means in all constructs to above 3.0 and to ensure more consistent and significant improvements across the group.

Key Result Areas (KRA)	Objectives	Planned Initiatives (Activities)	Stakeholders Responsible	Success Metrics	Implementation Schedule	Project Cost (IN Yuan)
Grip Development	To enhance consistency, relaxation, and adaptability in racket handling	• Daily grip drills (shakehand & penhold) • Rally consistency exercises • Relaxation techniques for reducing tension • Video feedback on grip adjustments	Coaches, PE Teachers, Student-Athletes	Increase in grip mean from **2.47** to ≥ 3.0 in evaluation	Weekly sessions, 12 weeks	8,000
Blocking Skills	To strengthen defensive abilities and consistency in neutralizing attacks	• Reaction-based drills with multiball training • Angle-control exercises • Tactical placement simulations • Partner blocking tournaments	Coaches, Varsity Athletes, Training Assistants	Improvement in block performance from **2.50** to ≥ 3.2	Twice weekly, 10 weeks	10,000
Spin Application	To further refine the tactical use of spin and precision in rallies	• Spin variation drills (topspin, backspin, sidespin) • Serve + spin integration drills	Coaches, Sport Scientists, Advanced Players	Raise spin mean from **2.58** to ≥ 3.3	Twice weekly, 12 weeks	12,000

		• Match simulations with spin emphasis • Use of spin-analyzing tools (rubber markers, slow-motion video)				
Footwork and Agility	To improve quickness, anticipation, and efficiency across the court	• Ladder and cone drills for agility • Shadow footwork exercises with stroke simulation • Court coverage timed drills • Balance & coordination strength training	Coaches, Fitness Trainers, PE Department	Raise footwork mean from **2.48** to ≥ 3.2	3 sessions per week, 8 weeks	15,000
Serve Precision (Reinforcement Area)	To address the inconsistency in serve accuracy and variation	• Target serving drills (zones) • Consistency routines (10 consecutive legal serves) • Serve under pressure simulations • Peer and video evaluation of serving	Coaches, Student Leaders, Training Assistants	Increase serve significance (current p = .347) and raise mean from **2.50** to ≥ 3.0	Daily practice, 6 weeks	9,000

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