ANALYSIS OF TECHNICAL-TACTICAL AND PSYCHOMOTOR PERFORMANCE IN BADMINTON PRACTICE

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Abstract

Badminton, through its specific characteristics, requires both technical and tactical skills as well as the development of motor and psychomotor abilities, having a positive impact on overall physical fitness. It is assumed that the inclusion of an educational program based on badminton-specific exercises significantly contributes to improving the technical-tactical and psychomotor performance of middle school students by developing coordination, balance, spatial orientation, and other complex motor skills, compared to the standard physical education curriculum. The aim of this study is to evaluate the impact of an educational program based on badminton-specific exercises on the development of technical-tactical and psychomotor performance in middle school students, focusing on coordination, balance, spatial orientation, and complex motor structures to optimize the educational process during physical education classes. The results obtained highlight notable progress in the development of coordination, balance, spatial orientation, and other complex motor skills compared to the standard physical education curriculum.

Keywords: analysis, performance, technical, tactical, motor, badminton, students, middle school.

INTRODUCTION

Research conducted in the field of sports has highlighted various solutions for optimising the training process and promoting the use of innovative methods and techniques. These advancements have led to the development of equipment, facilities, and computerised technologies that have played an important role in improving the efficiency of sports preparation. In this context, studies by [6,11] emphasise the impact of computerised technologies on the evaluation of athletes' performances.Moreover, children's environment and lifestyle have negatively influenced their physical activity, as they often live in confined spaces with limited access to suitable conditions for play. However, this environment can stimulate children's adaptability to new motor

situations, fostering motor learning. The study conducted by [8] reveals differences in the coordination abilities of students from rural and urban areas, highlighting the impact of various environmental conditions on motor development. In terms of school physical education, badminton plays an important role in the physical and psychomotor development of students, particularly at the middle school level. This sport, which involves speed, coordination, and precision, requires technical-tactical skills as well as motor and psychomotor abilities, contributing to the improvement of overall physical fitness and the development of competencies such as coordination, balance, and spatial orientation. Thus, badminton represents an ideal opportunity to stimulate the harmonious development of students, allowing them to learn tactical strategies and fundamental techniques specific to the sport. The educational design of physical education lessons is a complex and challenging activity influenced by factors such as school program regulations, environmental conditions, student diversity, and teacher experience. A study by [7] underscores the importance of adapting learning units to the needs and characteristics of students, considering the specific context of each school.

The analysis of psychomotor and technical-tactical performance in badminton is not limited to assessing physical progress but also aims to identify effective teaching methods for improving physical education lessons. The study [12] highlights the use of computer technology in evaluating sports performance, and the mindset of a physical education teacher plays a crucial role in optimising the instructional-educational process. According to studies by [1,13], a significant openness (91%) of teachers to innovation and adaptability can support the optimization of students' physical fitness.

Furthermore, studies by [10] emphasise the importance of capitalizing on students' motor, technical-tactical, psychological, and attitudinal potential to optimise physical performance. In this context, research conducted by [2] shows that badminton activities, implemented in a school setting, can significantly contribute to the development of children's fundamental motor skills while also stimulating their motivation for movement. Therefore, badminton proves to be an effective activity for the physical and motivational development of primary school students. The attractiveness of this sport, highlighted in the study by [3], supports the active involvement of children in school physical activities and the development of essential

skills for their future performances. The analysis of technical-tactical and psychomotor performance in badminton practice reveals the importance of this sport in the physical and psychomotor development of students. Badminton, by its nature, simultaneously demands complex motor skills and tactical strategies, contributing to improved coordination, balance, spatial orientation, and the development of essential competencies for physical performance. Studies show that including this sport in school curricula supports not only physical progress but also increased motivation for movement, encouraging students to actively participate in physical education lessons.

At the same time, implementing effective teaching methods tailored to the individual needs of students is essential for optimising the educational process. Thus, badminton proves to be an excellent choice for developing fundamental motor skills and promoting an active, healthy lifestyle, significantly contributing to improving students' technical-tactical and psychomotor performance.

The aim of this study is to evaluate the impact of an educational program based on badminton-specific exercises on the development of technical-tactical and psychomotor performance in middle school students, focusing on coordination, balance, spatial orientation, and complex motor structures to optimize the educational process in physical education classes. The main objective of this research was to identify the initial level of students' technical-tactical and psychomotor performance using specific badminton tests (e.g., forehand and backhand strokes, general dynamic coordination, spatial orientation). Furthermore, we wanted to develop and implement a program that includes methods and tools specific to badminton in physical education lessons and to evaluate the progress made by students following the implemented program using the same specific tests. Lastly, we compared the technical-tactical and psychomotor performance between the experimental and control groups.

We hypothesized that the inclusion of an educational program based on badminton-specific exercises significantly contributes to improving the technical-tactical and psychomotor performance of middle school students by developing coordination, balance, spatial orientation, and other complex motor skills, compared to the standard physical education curriculum.

METHODOLOGY

The main research methods we the analysis of specialized literature, observation method, pedagogical experiment method, testing method, mathematical-statistical method, and tabular-graphical method.

The study included a sample of 50 middle school students from "Alexandru Ioan Cuza" School in Fălticeni, divided equally into two groups: experimental group: 25 students (15 boys and 10 girls) who participated in a specific training program based on badminton and control group: 25 students who followed the standard physical education curriculum.

The experiment was conducted during Module III, lasting 7 weeks. Each week included two physical education lessons, each lasting 50 minutes. Inclusion criteria: Age and study level: Middle school students (grades VI-VII), aged 11 to 13 years. Regular participation in physical education classes. No medical contraindications for participating in physical education lessons. Students without significant prior experience in badminton to ensure similar starting conditions among participants. Ethical considerations: Parental consent was obtained after detailed information was provided about the study's purpose, methods, duration, benefits, and potential risks. Participation was voluntary, and students were informed that they could withdraw from the study at any time without consequences. To protect participants' identities, collected data was anonymized and used exclusively for research purposes.

Table 1. Programs Badminton Exercises for Module III

Week	Lection 1 - Technical-tactical exercises	Lesson 2 - Psychomotor and Tactical Exercises
1	Objective: Mobility and basic techniques	Objective: Agility and efficient service
	- Drill Field Trip: Sideways, forward and backward steps (10x in each direction) - Forehand și backhand: Basic shots with partner (10x on each side) - Drop-shot: Short shots with precise placement (10x on each side)	- Short and long service exercise: Short and long serves on each side (10x each) - Field running intervals: 30 seconds speed, 30 seconds recovery (6-8 repetitions) - 1 on 1 game: Focus on fast movement and precise placement
2	Objective: Shot control and movement strategy	Objective: Reflexes and direction control
	- Forehand/Backhand Drill: Correctly placed shots in the corners (10x on each side) - Drill with serve: Practicing short or long serves and returns (10x each)	- Quick reaction exercise: Partner throws the random flyer and the student must hit quickly (15 throws) - 1-on-1 match: Focus on quick reaction and placing the butterfly at unpredictable angles

Week	Lection 1 - Technical-tactical exercises	Lesson 2 - Psychomotor and Tactical Exercises
	- Agility and change of direction: 3 sets of 30 seconds of fast travel (crooked and diagonal)	- Jumps and speed intervals: Jumps on the spot and 30-second running intervals (10 reps)
3	Objective: Improve services and smash	Objective: Mobility and game tactics
	- Long and short serve: Practicing serves with exact placement (10x on each side) - Smash with partner: Hitting the butterfly from a high position (10x) - Power Jumps: Jumps to simulate a smash (3x 10 jumps)	- Fast Field Movement: Quick Change Drill Between Corners (10x) - Tactile play: Short exchanges with a partner to train the placement of the flyer - Running intervals: 30-second speed interval and 30-second break (10 reps)
4	Objective: Control of shots under pressure	Objective: Reflexes and quick reaction
	- Serve & Return Under Pressure: Practicing Fast Return Serves (10x each) - Controlled Smash: Precise Placement Butterfly Kicking Exercise (10x) - Field Travel: Quick Turn Drill and Place Flyer (10x)	- Quick reaction with the steering wheel: Partner throws the flyer in random directions (15 throws) - Quick Recovery Game: Quick Changes of Direction and Butterfly Placement (15 Exchanges) - Sprint intervals: 10-meter sprint, 30-second sprint/30-second break (10 rounds)
5	Objective: Mobility and physical endurance	Objective: Doubles technique and tactical reaction
	- Fast Move Drill: 4-Corner Fast Move (10x) - Jumps on the spot: Jumps for agility and strength (10x) - Running intervals: 30-second sprints followed by a 30-second break (10 rounds)	- 2v2 Game: Focus on Communication and Team Coordination - Double Tactile Drill: Using Space to Place Flyer (15 Shifts) - Double Game: Team Exercise to Practice Collaborative Moves
6	Objective: To improve doubles tactics	Objective: Reaction speed and steering wheel placement
	- Doubles Game: Practicing Court Covering Tactics (10 Exchanges) - Synchronized double-handed travel: Team movement exercises (10x) - Steering wheel placement in corners: Practice placing the flyer (10x on each side)	- Quick reaction and placement: Partner throws The flyer and the receiver must hit quickly and accurately (15 throws) - Anticipation Exercise: Opponent's Shot Anticipation Exercise (10x) - Jumping on the spot: 10 quick jumps for agility
7	Objective: Final testing and evaluation of progress	Objective: Evaluation matches and final feedback
	- Performance Testing: 1-on-1 games to evaluate progress on serve, smash and placement (3 games) - Feedback & Progress Analysis: Shot & Move Analysis - Resistance jumps: 3 sets of 10 physical endurance jumps	- Full matches: 1 lab1 or double matches to apply everything learned - Psychological assessment and feedback: Analysis of execution from matches - Match Completion: Feedback and Discussion of Strengths and Weaknesses

Each week has been designed to improve students' fundamental skills, including basic techniques, mobility, agility, quick reactions and correct butterfly placement.

RESULTS

The purpose of data analysis is to assess the current level of physical condition of athletes and their potential to achieve future performance [9]. We will analyze and interpret the results obtained from the tests applied at the beginning and end of the program, as well as the differences in the performance of the students in the participating groups. This data will be used to evaluate the effectiveness of the educational program implemented, providing an insight into the progress made following the exercises specific to the game of badminton.

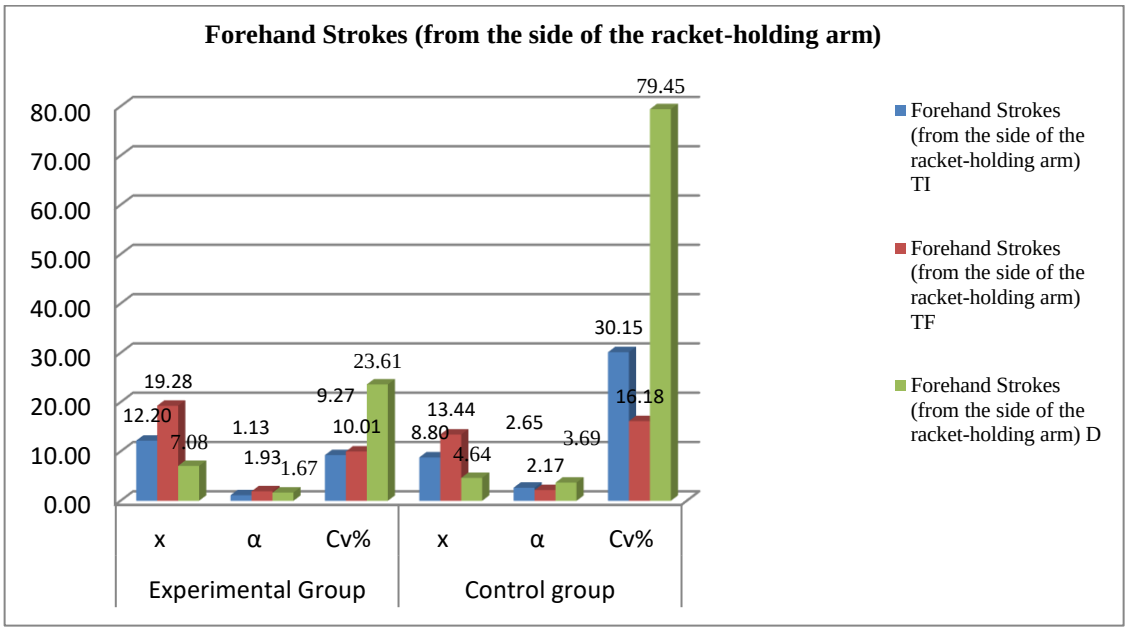

Figure 1. Forehand Strokes (from the side of the racket-holding arm)

It can be seen in Fig.1 that the experimental group recorded a significant increase in the average performance of forehand shots (D = 7.08) compared to the control group (D = 4.64), which highlights the effectiveness of the specific training program. The high consistency of the results in the experimental group (low Cv%) and the large variation in progress in the control group (Cv% = 79.45% for D) confirm the superiority of the applied intervention.

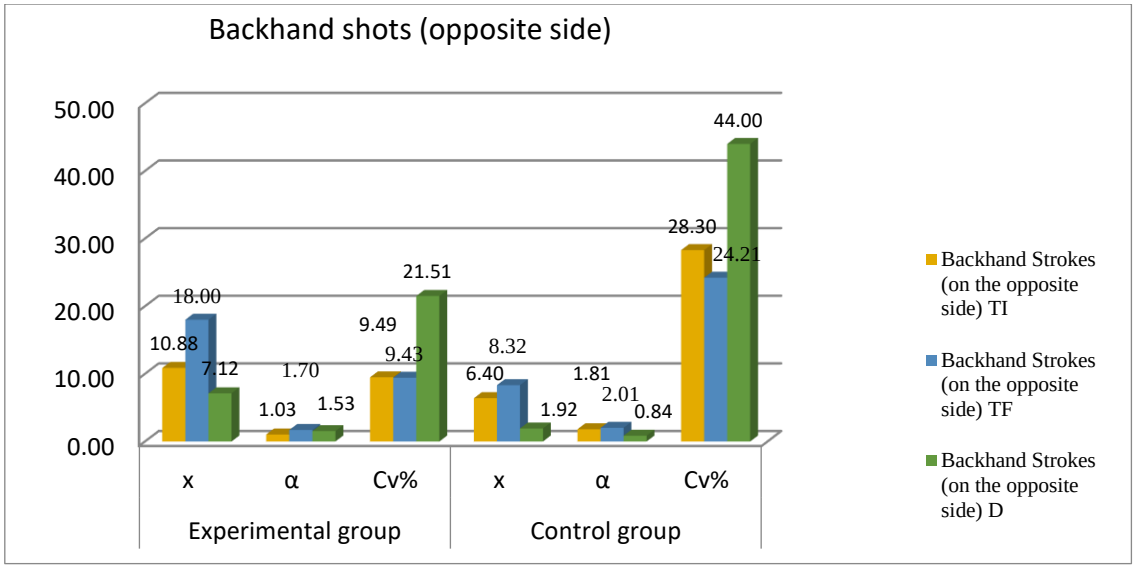

Figure 2. Backhand shots (opposite side)

The experimental group recorded a significantly higher progress in backhand shots (D = 7.12) compared to the control group (D = 1.92), highlighting the effectiveness of the means applied. The high consistency of the results in the experimental group (low Cv%) and the large variation in progress in the control group (Cv% = 44.00% for D) confirm the superiority of the specific means.

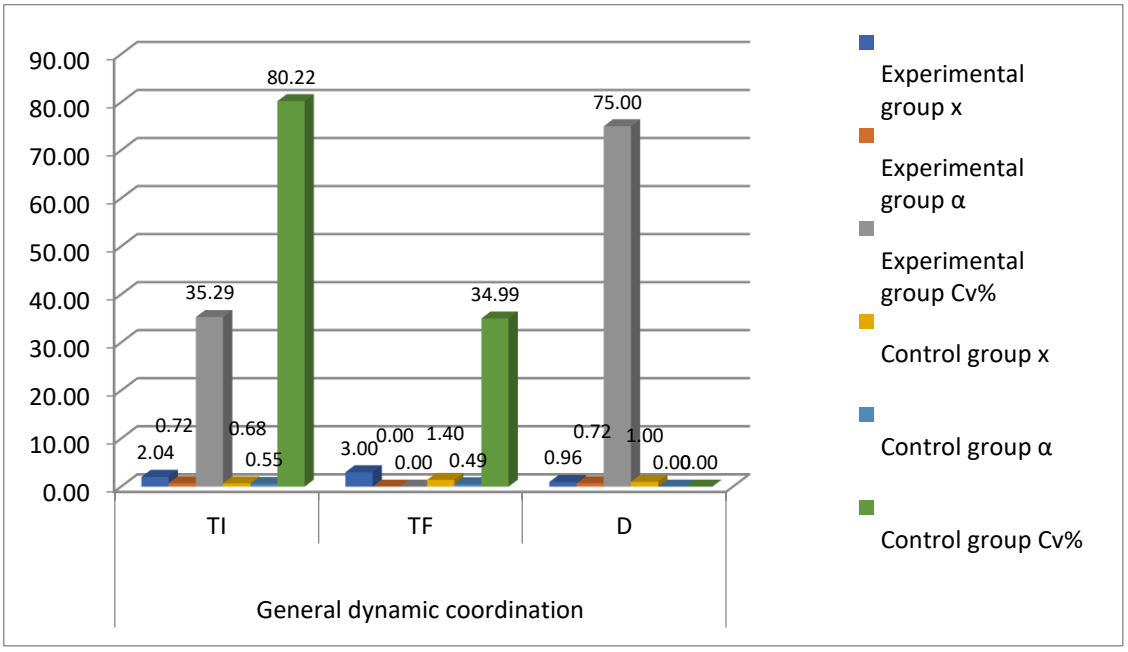

Figure 3. General dynamic coordination

The experiment group made remarkable progress in overall dynamic coordination (D = 0.96), similar to the control group (D = 1.00), but with a higher consistency in results (Cv% for TI and TF in the experiment group being more

balanced). The high variability of progress in the experiment group (Cv% for D = 75.00) suggests greater individual differences in learning compared to the control group.

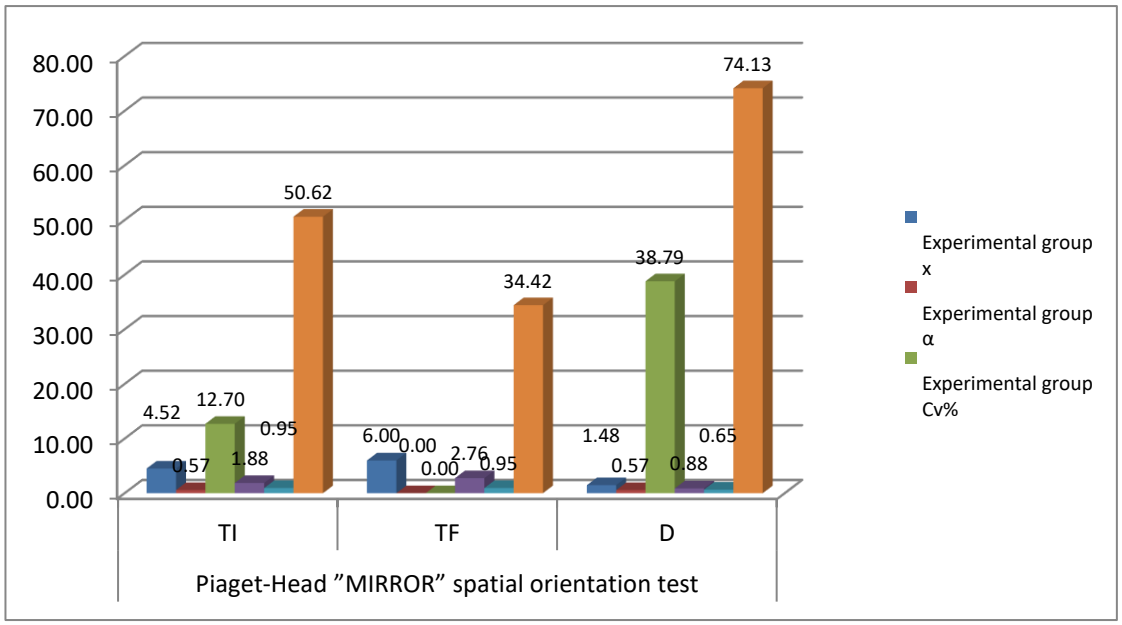

Figure 4. Piaget-Head "MIRROR" spatial orientation test

The experimental group achieved significantly higher progress in the spatial orientation test (D = 1.48) compared to the control group (D = 0.88), highlighting the effectiveness of the applied intervention. Also, the consistency of the results in the experimental group (Cv% for D = 38.79) is superior to that in the control group (Cv% for D = 74.13), demonstrating a more uniform improvement in performance.

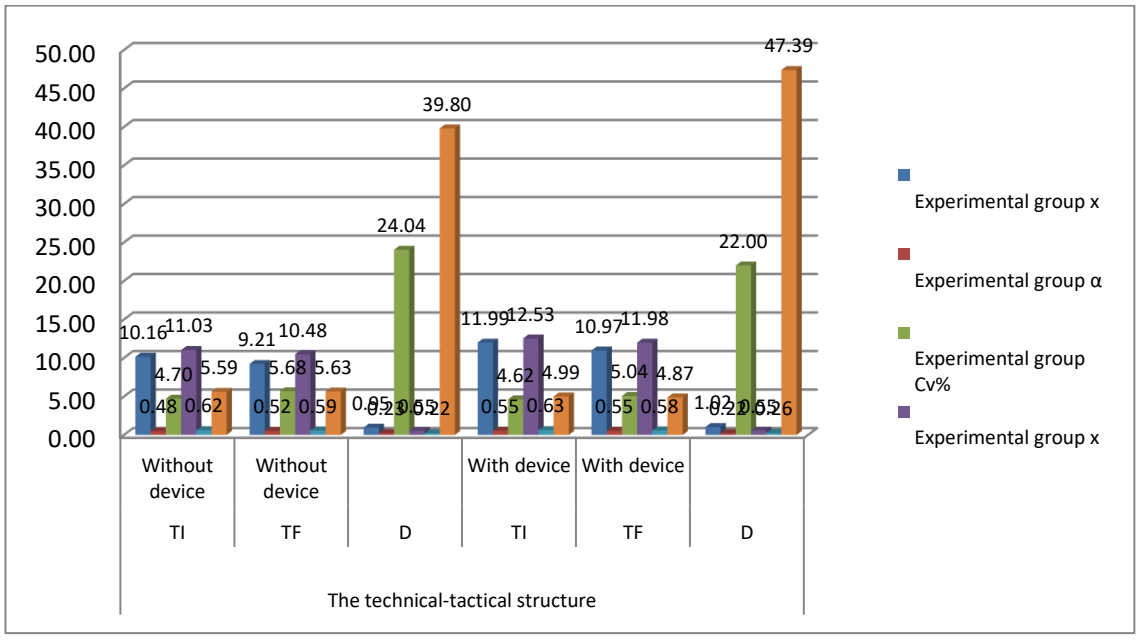

Figure 5. The technical-tactical structure

The experiment group made greater progress in both non-brace (D = 0.95) and apparatus (D = 1.02) executions compared to the control group (D = 0.55 for both conditions), which reflects the effectiveness of the specific intervention. The consistency of the results is higher in the experimental group (Cv% for D = 24.04 and 22.00) than in the control group (Cv% for D = 39.80 and 47.39), demonstrating a superior uniformity of progress.

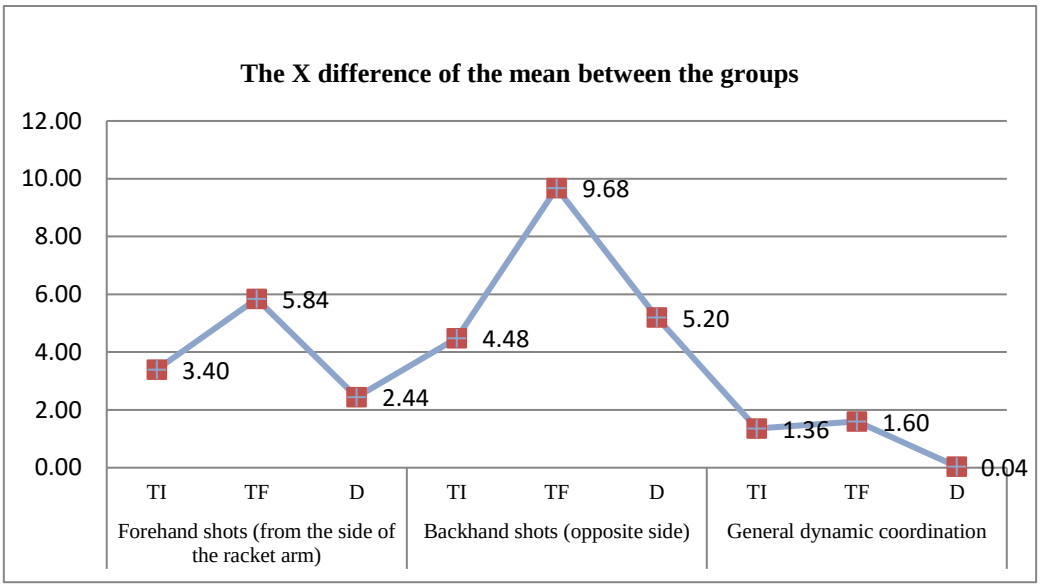

Figure 6. The X difference of the mean between the groups

The experimental group recorded significantly superior progress in forehand shots, with the average difference between the groups increasing from 3.40 (TI) to 5.84 (TF), with a progress advantage (D) of 2.44 in its favor. At the backhand shots, the impact of the program was even more obvious, the mean difference between the groups increasing from 4.48 (TI) to 9.68 (TF), with a clearly higher progress of the experimental group (D=5.20,D = 5.20,D=5.20). In general dynamic coordination, progress was almost similar between the two groups (D=0.04, D = 0.04, D=0.04), suggesting a comparable influence of means. The results confirm the effectiveness of specific lessons for improving technical-tactical performances, especially in shots, but less on general coordination.

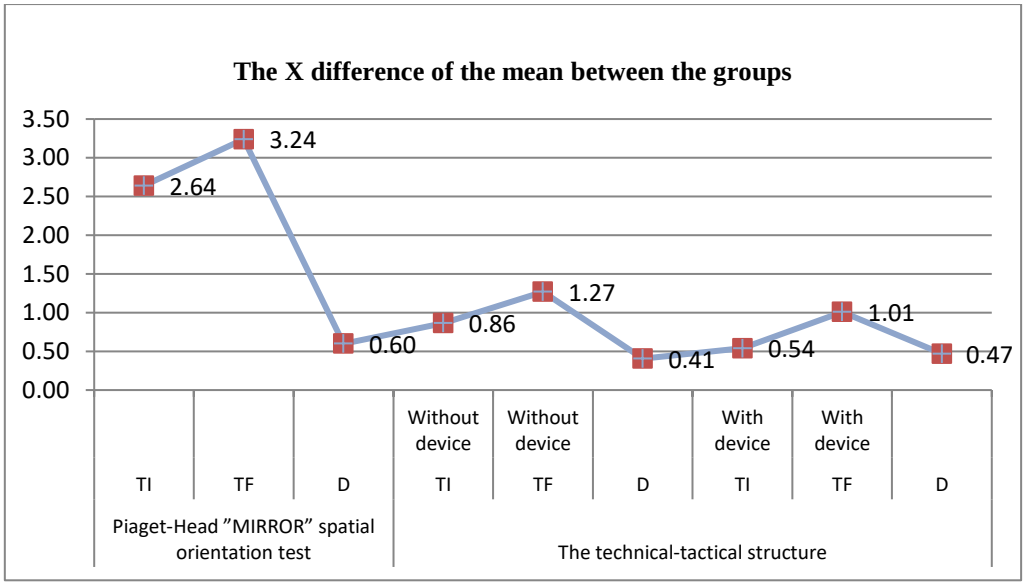

Figure 7. The X difference of the mean between the groups

In the Piaget-Head spatial orientation test "MIRROR", the X difference in the mean between the groups was 2.64 for TI and 3.24 for TF, with a progress (D) of 0.60, indicating a slight improvement in performance in the TF group. In the technical-tactical structure, the differences between the groups without apparatus are 0.86 for the TI and 1.27 for the TF, with a progress (D) of 0.41 in favor of the TF group. In the case of the apparatus groups, the difference between TI and TF is 0.54 and 1.01, and the progress (D) is 0.47, indicating a slightly larger advance in the TF group.

DISCUSSIONS

In the study [4] programs based on psychological strategies of self-speech and mental image had a significant impact on the improvement of badminton motor skills and self-confidence, with variable effects depending on the specific combinations of trained and motivational functions. The purpose of another article is to provide physical education teachers with guidance for creating meaningful instructional tasks and to introduce them to effective ways of teaching badminton, based on three fundamental principles of the approach to the game [5], and another study investigated the evolution of playing skills and tactics in badminton at different levels of development of high school students, highlighting significant progress as the skill level increased, but also the use of immature strokes and the decrease in the frequency of standard techniques at all levels[14].

CONCLUSIONS

The study shows that the implementation of a didactic program based on badminton-specific exercises had a significant impact on the improvement of the technical-tactical and psychomotor performances of secondary school students. Advances in coordination, balance, spatial orientation and other complex motor skills demonstrate the effectiveness of this type of approach compared to the standard physical education program.

The comparison of performance between the study groups showed that the students who followed the badminton-based program made greater progress than those who participated in the traditional program, thus confirming the hypothesis of the study and emphasizing the importance of integrating sports-specific exercises into the physical education curriculum for the development of students' motor and psychomotor skills.

The didactic program made with badminton means emphasizes the importance of combining technical-tactical and psychomotor exercises for the development of students' physical and tactical skills. The structure of the lessons allowed the students to improve both their individual technique (shots, serves, smashes) and their ability to react quickly, mobility on the court and teamwork skills, in the case of doubles games.

The final test showed significant progress in all technical-tactical and psychomotor aspects, and the feedback provided to the students was essential for strengthening learning and correctly applying skills in a real game context.

The experiment group made significant progress in all test categories. For example, in forehand shots, the average increased from 12.20 (TI) to 19.28 (TF), with a difference of 7.08, and in backhand shots, the progress was even more obvious, with the average increasing from 10.88 (TI) to 18.00 (TF), with a difference of 7.12. As for the general dynamic coordination, the experimental group registered an increase from 2.04 (TI) to 3.00 (TF), with a difference of 0.96, and in the Piaget-Head spatial orientation test "MIRROR", the progress was 1.02 (from 10.16 to 9.21). These substantial advances suggest that the program has had a significant impact on students' technical-tactical and psychomotor skills.

Variability of results and differences in performance: The control group experienced lower performance and greater variability of results. For example, in forehand shots, the average increased from 8.80 (TI) to 13.44 (TF), with a difference of 4.64, and in backhand, the progress was only 1.92 (from 6.40 to 8.32). In terms of general dynamic coordination, the difference was only 0.68, and in the "MIRROR" Piaget-Head spatial orientation, the difference was 0.55. These results emphasise a more modest performance compared to the experimental group, and the higher variability (Cv% of 30.15% in forehand shots and 44.00% in backhand) indicates greater inequality in the progress of students in the control group.

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