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SPECIAL ISSUE ARTICLE

The Impact of Designing an Instructional Tool on Teaching the Forehand and Backhand Topspin Strokes in Tennis for Players Aged 12–14 Years

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Abstract

The importance of using instructional tools in tennis lies in the fact that proper skill acquisition depends on employing the most effective devices, tools, and modern technologies. These resources facilitate the learning of skills across varying movement paths and types, as they contribute to saving both time and effort for learners and instructors. This allows the instructional focus to remain solely on the skill itself, eliminating unnecessary movements.

Given the complexity of executing tennis skills—particularly for beginners—there is often a noticeable difficulty in performing them correctly. Mastery of these skills requires considerable effort and sustained practice. As one of the researchers is an active tennis player and the other serves as a coach at the Al-Jadriya Academy for the 12–14 age group, it was observed that teaching fundamental skills to younger age categories demands extended periods of time and consistent instructional effort. The aim of this study was to design an instructional tool that supports the learning of the forehand and backhand groundstrokes with topspin for beginners. In addition, the study sought to examine the effect of this instructional tool on learning the forehand and backhand groundstrokes in tennis among individuals aged 12 to 14, and to assess its influence on the acquisition of topspin groundstrokes in the same skills within the research sample. The researchers hypothesized that there would be statistically significant differences in the post-test results between the experimental and control groups in learning to perform the forehand and backhand groundstrokes with topspin. Furthermore, they anticipated statistically significant differences between the post-tests of both groups in favour of the experimental group. The researchers employed the experimental method, using a two-group design (experimental and control) with both pre-tests and post-tests to assess learning outcomes. and this achieves one of the sustainable development goals of the United Nations in Iraq which is (Quality Education)

Keywords: Assistive tool, Age groups, Forehand and Backhand strokes

1. Introduction

Instructional tools and devices are considered among the fundamental means employed in the learning process. These tools, devices, and materials are utilized by coaches or instructors to enhance learning efficiency, reduce the time required for skill acquisition, and support learners in mastering specific motor skills. In recent years, coaches and specialists have shown increased interest in using educational aids in both teaching and training, as their application accelerates the learning process, minimizes the required time and effort, and deepens the overall training effect.

One scholar has defined instructional media as "the tools and methods used by the teacher within educational settings, while recognizing that these are merely means and not ends in themselves. They are not to be considered as standalone learning experiences for the student, but rather as instruments that

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engage all or some of the senses—including smell, touch, and taste" (Katif, 2010, p. 86). It is noted that "instructional and assistive devices constitute an educational and training system composed of a set of tools that are integrated and functionally interact within a training program to achieve its objectives. These devices and tools are organized in a sequential arrangement that allows each athlete to progress through the training program according to their individual capabilities in an active and constructive manner. The athlete is able to choose the educational or training materials that suit their needs and can be utilized within a specified time frame" (Al-Sakranah, 2014, p. 54).

The research problem stems from the difficulty beginner players face in executing tennis groundstrokes correctly, as mastering these skills requires significant effort and sustained practice. This challenge necessitates the continuous provision of new training exercises utilizing modern and user-friendly assistive tools and devices. Given that one of the researchers is an active tennis player and a coach at the Al-Jadriya Academy for the 12–14 age group, it was observed that teaching fundamental skills—particularly to younger age groups—demands extended periods of instructional time.

Accordingly, the researchers sought to examine this problem and explore potential solutions to facilitate and regulate the learning process of selected basic tennis skills. To address this issue, the researchers developed an innovative and easy-to-use assistive device designed to enhance motivation and engagement among players, thereby supporting the effective learning of the forehand and backhand groundstrokes with topspin.

The objective of this study was to develop a training device to support the learning of forehand and backhand groundstrokes with topspin in tennis for players aged 12 to 14. Specifically, the research aimed to design an instructional tool to facilitate the acquisition of these two topspin strokes and to examine the effect of using this tool on learning outcomes among the participants.

The research hypotheses posited that: (1) there would be statistically significant differences between the pre-test and post-test results of both the experimental and control groups in learning the execution of the forehand and backhand groundstrokes with topspin; and (2) there would be statistically significant differences in the post-test results between the experimental and control groups in favour of the experimental group.

The research domains included the following:

- **Human Domain:** A sample of beginner tennis players aged 12–14 years from Al-Jadriya Tennis Academy.
- **Time Domain:** From November 2, 2024, to March 6, 2025.
- **Place Domain:** The tennis courts of Al-Jadriya Tennis Academy, Baghdad – Al-Jadriya.

2. Methodology and procedures

2.1. Research methodology

The researchers adopted the experimental method utilizing a design of two equivalent groups—experimental and control—with pre- and post-tests, as it is well-suited to the nature of the research problem. The study sample consisted of beginner tennis players aged 12 to 14 years, intentionally selected from Al-Jadriya Tennis Academy. The total number of participants was 16, and they were randomly assigned to two equal groups: an experimental group and a control group, with 8 players in each. Thus, the sample represented 40% of the overall research population.

The experimental group was subjected to specialized training exercises using the newly developed instructional tool, while the control group followed the conventional training method prescribed by the coach. Given that all participants were of the same age group and had no prior experience in tennis, this contributed to the homogeneity of the sample.

To ensure equivalence between the two groups before commencing the experimental procedures, the researchers applied an independent samples t-test on the key research variable. The results indicated no statistically significant differences between the experimental and control groups, confirming their equivalence in terms of the accuracy of performing the forehand and backhand groundstrokes, as shown in Table 1.

As shown in Table 1, the significance level was (0.55), which is greater than 0.05, indicating that

Table 1. Demonstrates the equivalence of the research groups in the accuracy of performing the forehand and backhand groundstrokes.

Test	Unit of Measurement	Experimental Group		Control Group		Calculated (t) Value	Sig	Significance
		M	SD	M	SD			
Accuracy of Forehand and Backhand Groundstrokes	Score	12.60	2.31	13.20	2.09	0.60	0.55	Random

Fig. 1. Illustrates the innovative instructional device.

the differences between the experimental and control groups were not statistically significant (i.e., random). This result suggests that the two groups were equivalent at the outset of the study.

2.2. Description of the device

The purpose of the device is to assist beginner players in learning the forehand and backhand groundstrokes with topspin in tennis.

One of the key features of this device is that it can be used by two players simultaneously. The first player stands to the right of the ball-holding post to practice the backhand technique, while the second player stands to the left of the post to practice the forehand technique. The device is made of iron and is designed in the shape of a half-circle (∩), following biomechanically appropriate movement paths for learning the topspin forehand and backhand groundstrokes. It accommodates players of various body sizes and is supported on the ground by three adjustable legs, allowing for height modifications according to the learner's center of gravity.

For safety purposes, both players are positioned in alignment with the main base of the device during use. See Fig. 1.

2.3. Advantages of using the device

1. Teaches the correct topspin stroke technique by guiding both the backswing and forward swing motions.
2. Enhances skill acquisition in the shortest possible time.
3. Promotes enjoyment and motivation among players during training.
4. Can be manufactured at a reasonable cost.

2.4. Pilot study

The pilot study is a preliminary investigation conducted by researchers on a small sample prior to the main research, with the aim of selecting appropriate research methods and tools.

Accordingly, the researchers carried out a pilot study involving four beginners who were not part of the main research sample. The study took place on Saturday, November 21, 2024, at 3:00 p.m., on the tennis courts of Al-Jadriya Tennis Academy.

2.5. Purpose of the pilot study

1. To determine the feasibility of administering the tests to the research sample.
2. To gain insight into the sample's skill level and the suitability of the tests.
3. To identify and avoid potential errors during test implementation.

2.6. Findings of the pilot study

- The time required to conduct the tests was determined.
- A suitable environment was prepared for implementing the instructional device.
- The researchers identified the difficulties and obstacles encountered during the testing process.

2.7. Pre-tests

The researchers conducted the pre-tests for the research sample on the skills included in the study on Saturday, November 28, 2024, at 3:00 p.m. at the tennis courts of Al-Jadriya Academy, located within Al-Nahrain University. The tests were administered under the supervision of the researchers, the coach, and the supporting team. Prior to the testing, two introductory instructional units were delivered to familiarize the beginner learners with the required skills.

2.8. Procedures and testing

The researchers selected the forehand and backhand accuracy test approved by the International

Table 2. Presents the mean, standard deviation, mean differences, standard error, and t-value for the pre- and post-test of the experimental group.

Skill	Unit of Measurement	Pre-Test		Post-Test		Mean Difference	Standard Error	Calculated t-value	Sig	Statistical Significance
		M	SD	M	SD					
Accuracy of Forehand and Backhand Groundstrokes	Score	12.60	2.31	27.70	1.63	15.10	0.80	18.66	0.00	Significant

Table 3. Presents the mean, standard deviation, mean differences, standard error, and t-value for the pre-test and post-test results of the control group.

Skill	Unit of Measurement	Pre-Test		Post-Test		Mean Difference	Standard Error	Calculated t-value	Sig	Statistical Significance
		M	SD	M	SD					
Accuracy of Forehand and Backhand Groundstrokes	Score	13.20	2.09	21.60	1.43	8.40	0.88	9.49	0.00	Significant

Tennis Federation (Appendix 1). A total of 24 instructional units were implemented, with three sessions scheduled per week (Thursday, Friday, and Saturday). Prior to the instructional program, an introductory unit was conducted to familiarize players with the procedures for performing the exercises using the innovative device.

Each instructional unit lasted 70 minutes, divided as follows:

- **Preparatory section**: 10 minutes
- **Main section**: 50 minutes, including a 5-minute theoretical component explaining the designed exercises and a 45-minute practical session utilizing the device.
- **Concluding section**: 10 minutes

The main instructional phase included both theoretical and applied aspects, with learners performing a variety of exercises targeting the forehand and backhand strokes using the innovative device. The device proved effective in enhancing technical execution and increasing motivation among younger players, particularly by introducing an element of enjoyment and engagement. The exercises were designed and supervised by a specialized coach, without the use of additional instructional tools, and aligned with the academy's approved curriculum.

Each exercise lasted 60 seconds, with a 60-second rest interval between exercises. Rest between sets was also set at 60 seconds, with each exercise repeated eight times over two sets. The transition time between exercises was 60 seconds.

The data from the pre- and post-tests were analyzed using statistical procedures in SPSS, including the calculation of the arithmetic mean, standard deviation, independent samples t-test, and paired samples t-test.

3. Results

Based on Table 2, the pre-test mean score for the experimental group was 12.60 with a standard deviation of 2.31, while the post-test mean increased to 27.70 with a standard deviation of 1.63. The calculated *t*-value was 18.66 with a significance level of 0.00, indicating statistically significant differences between the pre- and post-test scores in favor of the post-test.

According to Table 3, the pre-test mean score for the control group was 13.20 with a standard deviation of 2.09, whereas the post-test mean score reached 21.60 with a standard deviation of 1.43. The calculated *t*-value was 9.49 with a significance level of 0.00, which also indicates statistically significant differences between the pre- and post-test results in favour of the post-test.

According to Table 4, the post-test mean score for the experimental group was 27.70 with a standard deviation of 1.63, while the control group recorded a mean score of 21.60 with a standard deviation of 1.43. The calculated *t*-value was 8.87, with a significance level of 0.00. This indicates the presence of statistically significant differences in the post-test scores between the two groups in favour of the experimental group.

The results presented in Table 4 show that the experimental group's post-test mean was 27.70

Table 4. Presents the mean, standard deviation, calculated t-value, and significance level for the post-test results of the experimental and control groups.

Test	Unit of Measurement	Experimental Group		Control Group		Calculated t-value	Sig	Statistical Significance
		M	SD	M	SD			
Accuracy of Forehand and Backhand Groundstrokes	Score	27.70	1.63	21.60	1.43	8.87	0.00	Significant

(SD = 1.63), whereas the control group's mean was 21.60 (SD = 1.43). The computed *t*-value of 8.87, at a degree of freedom of 10 and a significance level (sig) of 0.00, which is less than 0.05, provides clear evidence of a statistically significant difference between the two groups in the post-test scores. The results favour the experimental group in the test measuring the accuracy of forehand and backhand groundstrokes.

4. Discussion

Referring to the results in Table 3, the mean values for the pre-test and post-test in the control group differed significantly in skill performance, with a margin of error less than 0.05. This indicates that there were statistically significant differences between the pre- and post-test results in favour of the post-test. The researchers attribute this improvement to the influence of the instructional program designed by the coach, which was implemented with the control group. Additionally, the enhancement in players' performance may be due to the inclusion of various activities and competitive elements within the instructional units. These elements likely increased the players' engagement and motivation toward the coach's program, thereby contributing to the improvement in their learning of the targeted skills.

The researchers attribute the improvement in players' performance to the structured exercises prescribed by the coach, which were designed with specific repetition counts and time intervals, and progressed from simple to complex. Furthermore, the incorporation of competitive elements within the training sessions, fostered by the coach, increased the players' motor engagement and elevated their levels of excitement, motivation, and eagerness to learn the skills. This is consistent with Mahjoub (2002), who emphasized that "it is important for individuals to be motivated when learning motor tasks in order to achieve optimal learning; if the learner perceives the task as meaningless or unappealing, the learning process will be limited. If the motivation is very low, learning may not occur at all." (p. 144)

In addition, the improvement in outcomes was supported by the repeated practice of the skill, the correction of errors by the coach, and the increased repetitions of response-speed exercises tailored by the coach. The researchers also attribute the significant differences in post-test results to the players' interest in tennis, their continuous effort, regular practice, and commitment to the instructional units.

Referring also to the results presented in Table 4, it is evident that there are statistically significant differences between the pre- and post-test results for the experimental group in the studied skills, in favor of the post-test. This supports the research hypothesis. The researchers attribute the improvement in post-test performance to the role of the assistive device, which contributed to the enhanced performance of the sample participants. This is because the device was designed in accordance with the nature of the skill execution. As Al-Saadoun (2014) affirmed, "The use of modern tools and devices that align with the form and method of performing the skill, and which differ from traditional methods of learning, leads to noticeable improvement in the performance of that skill—provided that such tools and devices are employed correctly and scientifically." (p. 107)

This provides significant benefits at the onset of instructional units, as beginners typically experience errors and difficulty executing skills correctly, along with challenges in generating quick responses. To address this, the researchers ensured that sufficient time was allotted at the beginning of the learning process for players to prepare, focus, and perform the skill accurately—striking the ball properly and achieving the intended purpose of the tool and the objective of the exercise. As the instructional units progressed, the players began to receive information more effectively and developed a better understanding of the motor pathways required for proper skill execution.

The researchers further attribute the statistically significant differences observed in skill performance, as reflected in the post-test mean values, to the role of the assistive device. The device was designed with careful consideration for both simplicity and difficulty, ensuring suitability for the sample group. It also adhered to the principle of gradual progression in the exercises, advancing from simple to more complex tasks.

Numerous researchers emphasize that the use of multimedia and modern technological devices significantly contributes to learning skill performance. They assert that "learning through modern devices and assistive tools promotes speed in the learning process, reduces learner boredom, and enhances memory retention of sports skills. It also increases learners' motivation and desire to learn, while helping them to develop their athletic abilities" (Salah & Mutaeb, 2014, p. 194).

The researchers attribute the improvement in skill performance among the experimental group—as evidenced by fewer execution errors—to the customized exercises incorporated with the assistive tool. These exercises were carefully designed to suit the characteristics of the sample and to incorporate variety, thereby minimizing boredom and maintaining learners' engagement.

The introduction of novel exercises using assistive tools facilitated better learning outcomes. This is consistent with the assertion that "technological devices help simplify and enhance the learning process by making it more engaging and stimulating. They transform the movements performed by the learner into purposeful and meaningful experiences, optimizing time, effort, and cost to achieve superior learning outcomes" (Al-Hadithi, 2013, p. 184).

5. Conclusions

The use of the assistive device significantly contributed to learning the forehand and backhand topspin strokes. Moreover, the implementation of this tool enhanced learners' motivation and excitement, leading to greater precision in executing repeated movements.

6. Recommendations

It is recommended to adopt assistive tools for teaching other fundamental tennis skills. Additionally, the use of various instructional devices is encouraged during the learning process due to their role in increasing learners' motivation and engagement.

Conflict of interest

There weren't any conflicts faced by the researchers.

Author's contributions

All contributions of this study were done by the researchers (Hasan Raed Haseeb, Niaam Riyadh Haseeb and Suhad Haseeb) who get the main idea and work on writing and concluding also with number of experts, Hasan Raed in statistics, Muhammed Hasan in revision and Taj Uldin in translating.

Ethical-clearance

This manuscript proved by practical experience applied at Al-Jadriya Academy at Al-Nahrain University on 2/11/2024 – 6/3/2025.

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Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Appendix 1: Groundstroke Accuracy Test (Forehand and Backhand) – ITF Tennis

Prior to commencing the test, it must be ensured that all participants have completed their warm-up and are fully prepared to undertake the test.

Test Objective:

To measure the accuracy of the forehand and backhand groundstrokes.

Required Equipment:

15 rackets, 60 tennis balls, a standard full-size tennis court, and a scoring form.

Procedures:

1. The player earns points by placing the ball within the singles court, as illustrated in Fig. 1.
2. The player is given six balls to hit—alternating between forehand and backhand—aiming to hit each ball in a straight line within the singles court.
3. The player is then given another six balls—again alternating between forehand and backhand—and instructed to hit each ball diagonally within the singles court.
4. Points are awarded based on the location where the ball lands.
5. The assisting player must toss the ball into the middle area between the service line and the baseline. Either the assisting player or the hitter has the right to reject and repeat any irregular ball that lands outside the correct target area.

Scoring of Forehand and Backhand Groundstrokes:

1. **One point** is awarded when the ball lands inside the singles court but outside the designated target zones.
2. **Two points** are awarded when the ball lands within the designated target zone located before the service line.
3. **Three points** are awarded when the ball lands in the rear target zone specifically designated for accuracy, situated in the deep area of the singles court.

Note: The maximum total score for the test is 36 points, as illustrated in Fig. 2.

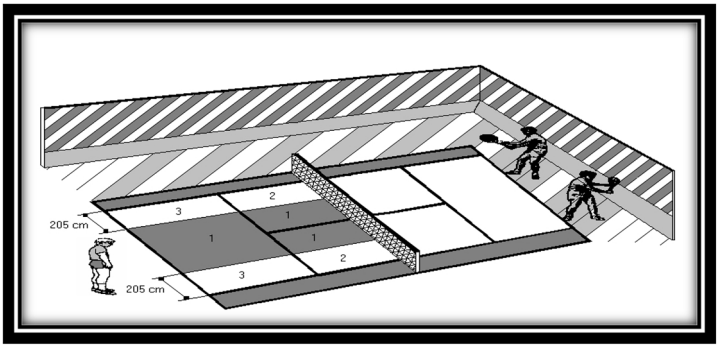

Fig. 2. Illustrates the assessment markers indicated on the court and the designated scoring zones.

Sample Educational Unit

Unit One and Two

Category: Players from Al-Jadriya Tennis Academy
Number of Learners: 6 players
Objective: Teaching the forehand groundstroke
Duration of Exercises: 70 minutes

Main Section	70 min.	Theoretical and Practical Components						
Theoretical Component	10 min.	A comprehensive explanation of each exercise included in the instructional unit, detailing how each exercise is performed, including the specific positions and movements required for each activity.						
Practical Component	60 min.	Exercise	Exercise Duration	Rest Between Exercises	Repetitions	Sets	Rest Between Sets	Total Exercise Duration
		Exercise (1)	1 min.	1 min.	Four times.	2	1 min.	15 min.
		Exercise (2)	1 min.	1 min.	Four times.	2	1 min.	15 min.
		Exercise (3)	1 min.	1 min.	Four times.	2	1 min.	15 min.
		Exercise (4)	1 min.	1 min.	Four times.	2	1 min.	15 min.