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The effect of using an educational tool according to some kinematic variables to learn the performance of the serve skill in tennis for female students

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Abstract. This research aims to design an assistive tool based on selected kinematic variables. It also aims to study the effect of this tool on improving the learning of the serving skill among the (20) female students in the study sample. One of the most important findings of the research is the effective role of the assistive tools based on the selected kinematic variables in improving the performance of the straight serve skill in the experimental group. The results also showed that repeated and varied exercises using these tools enhance the students' motivation and motivate them to continuously improve their skill performance. The researcher recommends the use of assistive tools to develop technical skills in general, while making use of all available tools and working to innovate new assistive tools and methods that serve the development of other technical skills.

Keywords. educational tool, kinematic variables, tennis, female students

1. Research Overview

1.1 Introduction and Significance of the Research

In recent years, sports have witnessed remarkable development driven by scientific research and inquiry, making them a vital and indispensable objective. Tennis, in turn, is among the sports that have experienced significant advancements. This progress is attributed to improvements in technical skills and tactical strategies, as well as regulatory changes that have heightened the game's excitement and appeal, alongside the increasing speed of play. This reality necessitates that both the learner and the player dedicate considerable effort and time to master these skills, as they constitute the foundation of any sporting activity. The serve is considered a fundamental offensive skill in tennis, enabling the player to secure points easily without the need for prolonged rallies with the opponent.

Tennis relies heavily on the mastery of technical skills. Instructional aids, devices, and tools play a pivotal role in learning and developing these skills, having become an integral component of the educational process. This is in addition to the kinematic information regarding performance that is acquired by the learner (El-Khouly & Bayoumi, 1991, p. 123).

A high-quality serve, often referred to as an "Ace," is one that the opponent finds difficult to return. It provides the serving player with a clear advantage throughout the entire match.

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Developing the serve skill requires the coach to exert effort in finding means and devices that add an engaging and interesting nature to the training, thereby enabling the trainee to perform intensive repetition during the instructional unit. Consequently, the significance of this research is highlighted by the utilization of a proposed tool designed to improve the learning of specific kinematic variables associated with the performance of the serve skill in tennis.

2-1 The Research Problem

The growing presence of tennis as an individual sport in some countries has surpassed the popularity of other games, due to the enjoyment, suspense, and excitement it offers. Through his instruction of the tennis course, the researcher observed several weaknesses among the female students in applying the correct kinematic requirements for performing the serve skill. This is manifested in the student's lack of awareness of the appropriate height of the ball at the moment of impact, which results in the striking arm not being fully extended at that moment, in addition to striking the ball from below instead of above to achieve the optimal launch angle. This is accompanied by difficulty in performing this skill according to the correct mechanical conditions.

Based on this, the researcher proposed a suitable auxiliary aid to improve certain kinematic variables, with the aim of developing the learning of the serve performance. It has now become necessary to work on developing this skill and mastering its technical execution. Furthermore, the use of this proposed aid in skill development enhances the students' enthusiasm for training and facilitates the learning process.

3.1 Research Objectives

- Designing an auxiliary aid based on specific kinematic data, with the goal of enhancing the acquisition of the serve skill in tennis.
- Analyzing the impact of using the designed aid on the progress and mastery level of the serve skill among the selected study sample.

4.1 Research Hypotheses

1. There are statistically significant differences between the pre-tests and post-tests for both the experimental and control groups.
2. There are statistically significant differences in the post-test between the experimental and control groups, in favor of the experimental group.

3. Research Methodology and Field Procedures

3.1 Research Methodology

The nature of the problem dictates the research methodology used. Therefore, the experimental method was employed, as it is appropriate for the nature of this research. (Saleh Bin Assaf, 1999, p. 23)

3-2 Research Population and Sample

The research sample was selected from the population of Third-Stage female students in the College of Physical Education and Sports Sciences, University of Babylon, for the academic year 2024–2025, whose total number was (43) students. One section was selected randomly. Students who were members of clubs and national teams, and students who failed the same stage, were excluded. The final sample size reached (40) students, representing (93.02%) of the original population.

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A lottery method was used to determine the control group and the experimental group. Homogeneity was established between the two groups, with (20) students for the experimental group and (20) students for the control group. Through the lottery, the experimental variable was introduced, which is the methodology used by the instructor utilizing the proposed aid on the experimental group, while the control group followed the curriculum prepared by the instructor without auxiliary aids.
To avoid factors that might affect the experimental results and to ensure the researcher could attribute any difference to the experimental factor, and to achieve homogeneity among the two groups' members, the researcher used a statistical approach to find the sample's homogeneity in the measurements of (height, age, and weight).

Table (1) Showing Sample Homogeneity

No.	Variables	Unit of Measurement	Mean	Median	Standard Deviation (SD)	Skewness Coefficient
1	Age	Years	21	21	0.66	1.23
2	Height	cm	164	159	1.68	01.09
3	Weight	kg	61	59	1.57	0.65

After identifying the experimental and control research groups, and to achieve equivalence between the members of the two groups, the working team administered the serve skill test in tennis to both the experimental and control groups to confirm sample parity (or equivalence).
Table (2) Sample Equivalence in the Serve Skill Test

Variables	**Control Group (CG)**	**Experimental Group (EG)**	**Calculated t-value (tcal)**	**Significance (p-value)**	**Interpretation**
	Mean ($\bar{x}$)	**SD**	**Mean ($\bar{x}$)**	**SD**	
Serve Skill Test	**2.52**	**0.80**	**2.55**	**0.71**	**0.256**

3-3 Research Equipment and Tools Used:

- 10 Rackets
- 30 Balls
- Camera

3-4 Biomechanical Variables
Certain biomechanical variables related to the serve skill were identified, including the following:

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- Maximum Radius Value
- Maximum Circumferential Velocity
- Hitting the ball at the highest take-off point reached by the racket
- Hitting the ball at a low launch angle

3-4 The Proposed Aid

The researcher used an auxiliary aid to facilitate the repetitive performance of the serve skill without waiting for a ball from a partner, and based on specific kinematic variables to develop the serve skill. The device consists of a cubical metal piece with a length of (1 m), containing (2) holders for fixing it to the tennis court wall, adjusted according to the wall height or the player's height. It includes a cylinder with a length of (20 cm) that holds an arm rotating 320 degrees, which contains a ring for attaching the ball rope, and a ball fixed to a rope (20 cm long) that is attached to the proposed aid.

3-5 Specifications and Method of Use of the Proposed Aid

The aid was used after being fixed to the tennis court wall. The student stood parallel to the device, in a position similar to standing behind the baseline to execute the skill. After the starting signal, the student performed repeated serves according to certain kinematic variables, namely: extending the arm to achieve the maximum radius value, maximum circumferential velocity, hitting the ball at the highest take-off point reached by the racket, and hitting the ball at a low launch angle which ensures the ball descends quickly and in a linear path to the service box, given that the point of launch is higher than the point of landing. This was performed for a specified duration within the instructional unit, interspersed with rest periods, with the goal of continuous repetition on the device to save time and effort.

Figure (1) Illustrating the Proposed Instructional Aid

3-6 Serve Skill Test

The test was modified to suit the level of the sample, as the subjects are beginner female students in tennis. (Joey Rive, Scott C. Williams, 2012, p 212)

Procedures:

1. Students must perform a thorough warm-up before the test.
2. The student performs (3) attempts from the right of the center mark and (3) attempts from the left of the center mark.
3. The service box area is divided into two zones: 2m wide and 6.40m long.
4. A rope was placed above the net, along its entire length, at a height of 1.20m

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1. An attempt that lands in the area close to the singles sideline is awarded (4) points, and (2) points are awarded to the middle zone, provided the ball passes between the rope and the net.
2. The maximum score attainable by the student is (24) points.

3-8 Scientific Basis

1. Test Validity

A test is considered valid if its content measures what it was designed to measure. To determine the test's validity, the researcher used content validity by presenting the tests to specialists in the field of testing and measurement, and sports training in tennis. They unanimously agreed on the validity of the test in measuring the intended tennis serve skill. (Mohammed Sobhy Hassanein, 1992, p 117)

2. Test Objectivity

The execution of the tests is kept free from self-assessment, which indicates the objectivity of these tests. The test objectivity was established by having the accuracy scores for the skill recorded by two specialized raters. A comparison between the raters' results demonstrated that the tests possessed high objectivity. (Mohammed Sobhy Hassanein, 1992, p 119) .

Table (3) Showing the Reliability and Objectivity of the Research Test

No.	Test Name	Reliability	Objectivity
1	Serve	0.912	0.922

3-9 The Pilot Study (Exploratory Experiment)

The pilot study was conducted on Wednesday, 10/12/2024, to identify any obstacles faced by the researcher, and to verify the soundness of the tests and their suitability for the sample members. It was also carried out to check the suitability of the location, the functionality of the equipment and tools used, to determine the necessary time required to administer the tests for consideration in the main experiment, and to ensure the understanding and competence of the assistant working team in executing the tests and recording the results.

3-10 Field Research Procedures

3-10-1 Pre-tests:

The pre-test was conducted on 15/12/2024 for the research sample. It included the modified International Federation test specific to the serve skill.

Following the pre-tests, the researcher implemented the methodology on Wednesday, 20/12/2024, for the experimental group, utilizing the auxiliary aids (for developing the serve skill in tennis). The duration of the program lasted (4) weeks, concluding with the final instructional unit on Sunday, 21/1/2025. The program consisted of (12) units, with two units per week. By agreement with the instructor, 20 minutes were allocated to the experimental group out of the total training time of 90 minutes according to the curriculum prepared by the instructor. The exercise started simultaneously for both the control and experimental groups. After the allocated exercise time based on the researcher's methodology, the working team returned the experimental group to the class to complete the training of the remaining skills with the instructor. Exercises for the serve skill were given to both groups at the beginning of the main section. The experimental group trained using the auxiliary aids, while the control group trained without auxiliary aids.

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3-10-2 Post-tests:
The post-tests were conducted on Wednesday, 25/01/2025, for the research sample, using the same method and conditions under which the pre-test was conducted.

3-11 Statistical Means:
The researcher utilized the Statistical Package for the Social Sciences (SPSS) to suit the nature of the research, applying the following statistics:

1. Mean
2. Standard Deviation (SD)
3. T-test
4. Skewness Coefficient

4 Research Results, Analysis, and Discussion

4-1 Presentation and Analysis of Serve Skill Test Results

Table (4) shows the Means , Standard Deviations (SDs) of the differences, and the Calculated T-test Value for the pre-tests and post-tests for both the experimental and control groups in the serve skill test.

Groups	Pre-test	Post-test	Calculated T-test Value (tcal)	Significance (p-value)	Interpretation
	Mean ($\bar{x}$)	SD	Mean ($\bar{x}$)	SD	
Experimental Group (EG)	2.60	0.70	8.50	1.83	12.05
Control Group (CG)	2.20	01.02	06.01	1.60	08.01

Table (3) illustrates the results of the serve skill test between the pre-test and post-test for both the experimental and control groups.
The mean value for the Experimental Group in the pre-test was (2.20) with a standard deviation of (0.24). In the post-test for the same skill, the mean value reached (12.20) with a standard deviation of (3.20). The calculated t-test value was (12.29), and the value was (0.00), which is statistically significant below the error level of alpha = (0.0802) . This indicates the presence of significant differences between the pre-test and post-test scores for the experimental group.
As for the mean score for the Control Group in the serve skill pre-test, it was (2.20) with a standard deviation of (0.91). In the post-test for the same skill, the mean reached (2.22) with a standard deviation of (1.43). The calculated t-test value was (10.20), and the value was (0.00), which is statistically significant below the error level of alpha = (0.02) This also indicates the presence of significant differences between the pre-test and post-test scores for the control group.

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Table (5) Means, Standard Deviations, Calculated t-test Values, and Significance of Differences between the Experimental and Control Groups in the Serve Skill Post-test

Skill / Kinematic Variable	Experimental Group (EG)	Control Group (CG)	Calculated t-value (tcal)	Significance (p-value)	Interpretation
	Mean ($\bar{x}$)	SD	Mean ($\bar{x}$)	SD	
Flat Serve Skill Test	8.50	1.83	06.01	1.60	8.12
Hitting Ball at Low Launch Angle	25	0.87	30	1.38	7.31
Maximum Radius Value	155	1.89	123	1.88	6.39
Maximum Circumferential Velocity	15 sec	0.87	11 sec	1.66	7.10
Hitting Ball at Racket's Highest Point	198	1.76	176	1.34	6.55

Table (2) shows the results of the serve skill test and certain biomechanical variables in the post-test for the experimental and control groups. The p-value (sig) was (0.00), which is statistically significant below the error level of (α=0.05) . This indicates the presence of a significant difference in the post-test between the experimental and control groups in the serve skill and the biomechanical variables under study, in favor of the Experimental Group.

4-2 Discussion of Results

Table (4) shows the results of the serve skill test. It reveals the presence of significant differences between the pre-test and post-test for both the experimental and control groups, in favor of the post-test. This confirms that the curriculum, utilizing the auxiliary aids, had a positive effect on teaching the serve skill to the experimental group.

The researcher attributes this development in the serve skill to the action of the auxiliary aid, based on specific kinematic variables, which forced the student (the sample) to achieve full arm extension at the moment of impact by calculating the appropriate ball height relative to the student's height. This increased the radius of rotation of the striking arm, consequently increasing the velocity, which contributed to the students' improved serving ability and decision-making. (Afaf Ahmed Tawfiq, 1994, p 32)

The development observed in the students' skill resulted from continuous and varied repetition in the instructional exercises using the auxiliary aid. Instructional aids make the student more

focused on the skills to be learned and developed, and they help introduce variety and stimulate the student to improve performance. The researcher suggests, through these results, that using appropriate auxiliary aids for any game, including tennis, contributes to the development and enhancement of performance for any technical skill. "The variety in using auxiliary aids contributes to the development of technical skills in games, including individual sports." (Naseer Mazhar Abboud, 2002, p 76)

Comparison of Group Outcomes (Table 5)

The results in Table (5) demonstrated the presence of significant differences between the experimental and control groups in the post-test, in favor of the Experimental Group, in the serve skill and some of the biomechanical variables.

The researcher attributes this difference between the two groups to the use of the auxiliary aids, which contributed to facilitating and improving performance. This is because the aid provided the student with a clear mental image for taking the appropriate stance and moving towards the ball contact point with the racket. Since the ball is a projectile determined by several factors (launch angle, launch height, and launch velocity), the student performed continuous repetition of hitting the ball from the highest point the racket can reach (the highest launch height), while maintaining a low and suitable launch angle. This trajectory ensures the ball descends quickly and in a linear path to the opponent's service box with maximum horizontal velocity, given that the launch point is higher than the landing point. Furthermore, the aid enabled continuous repetition of the skill without waiting for balls from a partner.

Motor imagery increases the speed of technical skill acquisition, improves performance and accuracy, and gives the student more confidence and the ability to eliminate undesirable performance habits. Furthermore, auxiliary aids move students away from traditional learning methods, fostering the development of any technical skill. (Yousif Qatami, 1994, p 98)

Auxiliary aids also alleviate boredom among students by stimulating excitement and desire, which drives students to exert more effort to improve their level. This helps develop and master skills as quickly as possible. As asserted: "Auxiliary aids make the learner more focused on the skills to be learned and mastered, and help in varying and stimulating learners to improve performance." (Ya'rab Khayoun, 2000, p 54). Devices and aids form the basis of the new training model, which removes many of the burdens of instruction.

The researcher believes that using auxiliary aids captures the student's attention and interest, helping to increase their inclination toward skill development. It also contributes to innovation and variety in exercises, moving away from the traditional style, which increases excitement and appeal among students. Aids and means also help clarify the mental image for the player, increasing their understanding and comprehension of the required exercise. (Qasim Lazim et al., 2002, p 38). The use of auxiliary aids in the learning process leads to the formation of a movement schema in the player's mind, increasing the kinesthetic sense (sense of movement), which in turn develops accuracy. As stated: "The increase in movement led to an improvement in the accuracy of movement performance, which is attributed to the influence of the relationship between the clarity of the kinesthetic sense and the accuracy of movement performance." (Dave Miley, 2010, p 127)

5- Conclusions and Recommendations

5-1 Conclusions:

1. The use of auxiliary aids plays a fundamental role in improving the performance of the flat serve skill for the experimental research group.

2. Continuous and varied repetition in developmental exercises using auxiliary aids increases the students' motivation towards optimal development in skill performance.
3. Auxiliary aids provided the learner with a clear mental image (motor imagery) for taking the appropriate stance and moving according to the performance requirements.
4. Using an auxiliary aid based on specific biomechanical variables for performing the serve skill made the correct application of the skill, according to the mechanical requirements, easier for the research sample.

5-2 Recommendations:

1. The necessity of using specialized aids to improve technical abilities and utilizing all available resources.
2. The development of numerous auxiliary tools and means that work to enhance other technical skills.
3. The need for variety in developmental exercises, utilizing specialized aids, to prevent player boredom.
4. The necessity of conducting similar research and studies using specialized aids in various sports (both individual and team) and across all age groups, to determine the extent of benefit from auxiliary aids for other sports.

References and Sources

Arabic Sources (المصادر العربية)

1. Al-Khouli, A. A., & Bayoumi, A. H. (1991). *Al-Jihaz al-Tarbawi lil-Atfal al-Nashi'* [The Educational System for Emerging Children]. Cairo: Dar al-Fikr al-Arabi.
2. Bin Assaf, S. (1999). *Al-Madkhal ilā al-Baḥth fī al-'Ulūm al-Sulūkiyya* [Introduction to Research in Behavioral Sciences]. (1st ed.). Riyadh: Al-Abeikan Library.
3. Tawfiq, A. A. (1994). Fa'iliyyat Istikhdām Ba'd al-Wasā'il al-Ta'līmiyya fī Ta'allum Mahārat al-Irsāl fī al-Kura al-Ṭā'ira 'alā Taḥqīq al-Aḥdāf al-Ta'līmiyya [The effectiveness of using some instructional aids in learning the serve skill in volleyball on achieving educational goals]. *Majallat 'Ulūm wa Funūn* [Journal of Arts and Sciences], Vol. 3, Helwan University.
4. Lazzam, Q., et al. (2002). *Usus al-Ta'allum wa al-Ta'līm wa Taṭbīqātuhā fī Kurat al-Qadam* [Foundations of Learning and Instruction and their Applications in Football]. Baghdad.
5. Hassanein, M. S. (1992). *Al-Qiyās wa al-Taqwīm fī al-Tarbiyah al-Riyāḍiyyah* [Measurement and Evaluation in Physical Education]. (3rd ed.). Cairo: Dar al-Fikr.
6. Abboud, N. M. (2002). *Ta'thīr Istikhdām al-Wasā'il al-Ta'līmiyya al-Muta'addidat al-Aghrāḍ 'alā Ta'allum wa al-Iḥtifāẓ bi-Ba'ḍ al-Mahārāt al-Asāsiyya bi-Kurat al-Qadam* [The effect of using multi-purpose instructional aids on the learning and retention of some basic football skills]. Unpublished Master's Thesis, College of Physical Education, University of Baghdad.
7. Khayoun, Y. (2000). *Al-Ta'allum al-Ḥarakī Bayna al-Mabda' wa al-Taṭbīq* [Motor Learning Between Principle and Application]. Baghdad: Al-Sakhra Publishing.
8. Qatami, Y. (1994). *Sīkūlūjiyyat al-Ta'allum wa al-Ta'allum al-Ṣaffī* [Psychology of Learning and Classroom Learning]. (1st ed.). Amman: Dar Al-Shurooq.

Foreign Sources (المصادر الأجنبية)

1. Miley, D. (2010). *ITN On Court Assessment*. International Tennis Federation (ITF).

2. Rive, J., & Williams, S. C. (2012). *TENNIS SKILLS & DRILLS*. United States: Human Kinetics. (Library of Congress-in-Publication data).