Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

The Effect of Specialized Exercises Based on Mechanical Principles on Diagonal Attacks from Positions (2) and (4) Among Third-Year Students in Volleyball

Rania Khaled Shaker [1], Maram Muthanna Naji [2], Maher Jaafar Ameen [3], Wathiq Thamer Taher [4], Ahmed Majid Kareem [5]

1,2.3.4.5 Al-Farahidi University / College of Education / Department of Physical Education and Sports Sciences

DOI:

https://doi.org/10.37359/JOPE.V37(2)2025.2208

Article history: Received 17/ October/2024 Accepted 4/ November/2024 Available online 28/ June/2025

Abstract

Researchers and specialists in the fields of educational sciences strive to enhance the academic level of their students. Among the most prominent of these sciences is sports science, which encompasses various specializations, curricula, and theories. This has driven professionals in this field to constantly seek the most effective, shortest, and simplest ways to achieve high-quality outcomes through experimentation and practical application. The aim of this research was to develop specialized exercises based on mechanical principles for diagonal attacks from positions (2) and (4) among third-year volleyball students. The study also aimed to determine whether these exercises are more effective than conventional training in influencing the targeted research variables. The researchers employed an experimental approach involving both a control and an experimental group, using pre- and post-tests. Two specific tests were administered, focusing on diagonal attacking skills from positions (2) and (4). The research sample consisted of 12 third-year students from the Department of Physical Education and Sports Sciences at Al-Farahidi University (academic year 2024–2025), who were deliberately selected as top-performing students and divided into two groups (experimental and control),

1 Al-Farahidi University / College of Education / Department of Physical Education and Sports Sciences, Rania.khaled.shaker@uoalfarahidi.edu.iq
2 Al-Farahidi University / College of Education / Department of Physical Education and Sports Sciences, maram.mothana@uoalfarahidi.edu.iq
3 Al-Farahidi University / College of Education / Department of Physical Education and Sports Sciences, Maher.Jaafar.Ameen@uoalfarahidi.edu.iq , https://orcid.org/0009-0007-8772-7702
4 Al-Farahidi University / College of Education / Department of Physical Education and Sports Sciences, watheq.Thamer1104d@cope.uobaghdad.edu.iq
5 Al-Farahidi University / College of Education / Department of Physical Education and Sports Sciences, ahmad.kareem.@uoalfarahidi.edu.iq

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

each comprising six students. The SPSS statistical software package was used to analyze the results. After presenting and discussing the results, the study concluded that there was a statistically significant improvement in both groups between the pre- and post-tests. Additionally, a significant difference was found in favor of the experimental group in the post-tests. The researchers recommend the adoption of these exercises due to their significant effectiveness.

Keywords: Mechanical principles, Diagonal attack, Volleyball.

Introduction

Volleyball is one of the most exciting and significant sports both locally and internationally. Like other sports, it holds a prestigious place in the academic field of sports sciences. It is taught in three academic stages in the colleges and departments of physical education and sports sciences. Volleyball is a sport that demands a high level of physical and technical performance, which cannot be achieved without the use of modern methods and renewed perspectives by integrating various sports sciences. Among the most prominent of these sciences are motor learning and sports biomechanics.

Motor learning provides learners with ample opportunities to acquire the required skill in an organized manner, enabling a sequential and complementary linking of concepts based on the learner's level. This is achieved by increasing the learner's awareness and understanding of the performance, and storing information in a way that ensures it can be retrieved when needed, especially at advanced stages of learning.

Biomechanics, on the other hand, serves as the mirror that reflects the nature of the performance to the expert eye—namely, the eye of the teacher or coach.

Based on the researchers' experience as volleyball specialists (players, coaches, and teachers) and their observations of volleyball classes in colleges and departments of physical education and sports sciences, they found that one of the most important offensive skills in volleyball is the spike. This skill often decides the points of the sets. Mastery of this skill depends on the ability to analyze it and understand its performance phases (approach, jump, and hit), as well as identifying the numerical values of its biomechanical indicators and conditions—especially at the moment of take-off when the student becomes a projectile.

Moreover, simple offensive attacks from the front zones (positions 2 and 4) were chosen because students are more capable of performing them and analyzing the player's position and the trajectory of the ball when hit diagonally to effectively impact the opponent.

Accordingly, the researchers began exploring and analyzing the key problem that may hinder learners' improvement of this skill: how to approach, jump, and hit diagonally. This was done first through observation of the external form, then through deeper quantitative analysis (assigning numerical values to the studied variables), and by drawing on their extensive

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

experience in teaching this subject continuously over many years to solve this problem from their professional perspective.

The importance and purpose of this research lie in developing specialized exercises based on mechanical principles for executing diagonal attacks from positions (2) and (4) among third-year volleyball students in colleges and departments of physical education and sports sciences. These exercises aim to enhance technical performance by integrating theoretical and applied sports sciences, thereby fulfilling all the general and specific requirements necessary for student success.

It is widely acknowledged that one of the most critical factors contributing to this success is biomechanics—specifically, how mechanical indicators can be first used diagnostically and then therapeutically by applying the principles and laws of movement sciences (mechanical foundations). The researchers regard these as theoretical sciences that are readily applicable in practical contexts.

The researchers hypothesize that there will be no statistically significant differences between the two research groups in the pre- and post-tests, and likewise, no statistically significant differences between the groups in the post-test results favoring one group over the other.

Upon reviewing the relevant literature and previous studies, the researchers found that improvements in volleyball skills performance are primarily influenced by two factors: (1) the method and style of instruction, and (2) the identification of biomechanical variables affecting performance. Numerous studies in the field of volleyball have addressed important topics related to motor learning and key mechanical indicators. The most significant of these can be summarized as follows:

Study by Hussein Farhan Al-Sheikh Ali and Munadhil Adel Qasim (2024), titled "The Effectiveness of Mastery Learning Strategy in Enhancing Skill Performance in Volleyball among Students" (Kadhim et al., 2021)

This study aimed to examine the effectiveness of the mastery learning strategy in developing the level of skill performance in volleyball among students in the College of Physical Education and Sports Sciences. The nature of the research required the use of the experimental method. The researchers applied a pre-test and post-test design for the two dependent variables within the research group. The research tools included the preparation of educational materials, testing instruments, and instructional units in accordance with the mastery learning strategy using Bloom's Model, as well as fundamental skill tests in volleyball. Data were statistically processed using the SPSS software. The researchers concluded that applying the mastery learning strategy, via Bloom's Model, had a significant impact on the learning of fundamental volleyball skills. They recommended the incorporation of problem-solving strategies in teaching basic volleyball skills within the educational curricula of colleges of physical education and sports sciences. (Sheikh Ali & Qasim, 2024)

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

Study by Amer & Khalil (2022), titled "The Effect of the Jigsaw Strategy on Learning the Spike Skill in Volleyball among Second-Year Students":

This research aimed to develop instructional units based on the Jigsaw strategy for learning the spike skill in volleyball and to assess its impact. The researchers employed the experimental method using a two-group design: experimental and control. The research population consisted of 385 male second-year students at the College of Physical Education and Sports Sciences, University of Baghdad, for the academic year 2021–2022. The research sample was randomly selected through a lottery system. One class of 25 students was designated as the experimental group, while another class of 27 students was assigned as the control group. Additionally, 15 students were randomly selected for conducting the pilot study.(Kadhim, 2024)

The researchers focused on the spike skill, administering pre-tests to ensure sample equivalence, followed by the implementation of the Jigsaw strategy and post-tests to collect raw data. The data were then statistically analyzed to extract and interpret the results. The study concluded that the Jigsaw strategy had a positive effect in achieving significant improvements in the experimental group and contributed meaningfully by accounting for individual differences. The researchers recommended the use of the Jigsaw strategy in learning and proposed conducting further studies applying this strategy to other samples and skills. (Amer & Khalil, 2022)

Study by Ya'rub Abdul-Baqi Daikh (2021), titled "A Comparative Analytical Study of the Variable of Maximum Center of Mass Height During the Flight Path and at the Moment of Performing the Main Phase of Movement in the Skills of Jump Shot in Handball and Spike/Serve in Volleyball": (Fadel & Kadem, 2021)

The study aimed to identify the differences in the values of the variable *maximum height reached by the center of mass* during the flight path and at the moment of performing the main phase of movement in the jump shot skills in handball and the spike and jump serve in volleyball. The researcher used a descriptive comparative methodology. The study sample included players from the national handball and volleyball teams. Motion was captured using a Sony camera at 100 frames per second, and the analysis was performed using Dartfish software.(Kadhim, 2023)

The researcher concluded that, in handball jump shots (either forward or upward), the action is typically executed after the athlete begins descending from the peak height of the center of mass—meaning the shot occurs below the maximum height. Similarly, in the spike and jump serve in volleyball, the ball is hit after the athlete has started descending from the peak flight height. The researcher recommended emphasizing that the main phase of performance usually occurs after descent, which can lower the contact point for striking or serving the ball. Thus, it is crucial to develop exercises aimed at increasing maximum height

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

and enhancing the athlete's ability to execute the skill quickly before significant descent occurs, especially for spiking and jump serving in volleyball. (Daikh, 2021)

Study by Saadoun & Saleh (2020), titled "The Strategy of Electronic Concept Maps and Their Impact on Cognitive Achievement in Some Technical Skills in Volleyball": This study aimed to modify a cognitive achievement test for selected volleyball technical skills among second-year students in the College of Physical Education and Sports Sciences. Additionally, it investigated the effect of using instructional units based on the electronic concept map strategy on students' cognitive achievement levels. The researchers adopted an experimental approach, with 15 students assigned to each of the experimental and control groups. (Issa et al., 2024)

The experimental group received one instructional unit per week over eight weeks, using electronic concept maps. The results indicated a statistically significant difference in the cognitive achievement test results between the two groups, in favor of the experimental group that utilized electronic concept maps. The findings support the effectiveness of this strategy in enhancing cognitive understanding of volleyball skills. (Saadoun & Saleh, 2020)

Study by Khummas & Subhan (2019), titled "The Effect of Specialized Exercises Using Certain Educational Aids on Learning Some Basic Volleyball Skills for First-Year Intermediate Students":

The study highlighted the importance of using specialized exercises supported by modern educational aids, technologies, and contemporary learning tools aligned with global advancements in education. These methods were found to be highly effective in developing basic volleyball skills among beginner students. The researchers identified a general weakness and lack of attention toward learning basic volleyball skills, based on their professional experience as physical education teachers and their observations of other instructors in the field.

The research population consisted of 3,200 students from the General Directorate of Education of Baghdad/Karkh 2 for the academic year 2018–2019. The sample was purposively selected from Al-Shuhadaa Palace Intermediate School for Boys, located in the Al-Risala Al-Oula area, due to the availability of an indoor hall designated for team sports such as volleyball, basketball, and handball. The researchers employed a one-group experimental design with pre- and post-testing. The study sample consisted of 10 first-year intermediate students, and the training program was implemented over 8 weeks.

The findings showed a positive improvement in the performance of the overhead and underhand passing skills in volleyball as a result of the specialized exercises designed by the researchers. Accordingly, they recommended conducting similar studies on other variables. (Khummas & Subhan, 2019)

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

Synthesis and Relevance to the Current Study:

This review of related literature has provided the researchers with a solid scientific foundation for launching their current study. The surveyed studies offer valuable insights into selecting the most effective teaching methods and strategies for high-speed skills such as the diagonal attack in volleyball. They also underscore the importance of identifying and analyzing influential kinematic indicators through motion analysis and choosing the most appropriate methodological framework to achieve the intended research goals.

Methodology and Tools:

The researchers employed the experimental method using two equivalent groups (experimental and control), as outlined by Al-Kadhimi (2012). The research population and sample were purposively selected from third-year students of the Department of Physical Education and Sports Sciences / College of Education / Al-Farahidi University, totaling 12 students specializing as attackers from positions (2) and (4). The participants were randomly assigned by lottery into two groups: experimental and control, with 6 students in each group for the academic year 2024–2025.

The first pilot study—focused on testing and camera setup—was conducted on Saturday, November 2, 2024, at 10:30 a.m. on the indoor volleyball court in the Department of Physical Education and Sports Sciences / College of Education / Al-Farahidi University. The pilot involved two students not included in the main sample. The purpose of this pilot study was to assess:

- The suitability of the location where the main experiment would be conducted.
- The functionality and reliability of the equipment and tools used in testing.
- The allocation of responsibilities among the research support team.
- The optimal placement, height, and distance of cameras relative to the movement area during the diagonal attack test.
- Potential challenges the researchers might encounter during the main experiment.

Subsequently, a second pilot study was conducted on Tuesday, November 5, 2024, also at 10:30 a.m. on the same volleyball court, again using two students outside the research sample. The objectives of this second pilot were to:

- Apply all biomechanical exercises developed by the researchers to evaluate their suitability and determine the appropriate number of repetitions for each drill.
- Assess the logical sequencing of the exercises for practical application.

All observations from both pilot studies were documented in order to avoid potential issues during the execution of the main experiment.

Subsequently, the main experiment (pre-tests) was conducted on Saturday, November 9, 2024, at exactly 10:30 a.m. at the volleyball court / the main indoor hall. The research sample underwent the diagonal spike test individually, allowing the motion analysis cameras to

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

accurately measure the variables. Two motion analysis cameras (type CASIO FH13.5) were set up, each operating at 120 frames per second.

The first camera was positioned at a height of 1.25 meters, perpendicular to the last step of the approach and take-off, and at a distance of 3.5 meters from the motion area. The second camera was placed at a height of 2.05 meters, perpendicular to the motion area at the moment of the diagonal spike. The purpose of this setup was to analyze the kinematic indicators and calculate their numerical values, which would then be used to design an appropriate educational program. The two tests were conducted as follows:

Test for Evaluating Technical Performance and Accuracy of the Diagonal Attack from Front-Row Positions (2) and (4) in Volleyball (*Taha, 1999, p. 184*)

1. Test Objective:
   To evaluate the performance and measure the accuracy of diagonal attacks from the front-row positions (2) and (4).

2. Equipment Used:
   A standard volleyball court, six official volleyballs, a metal measuring tape, colored adhesive tape to divide the court, and a camera to record the performance for motion analysis and expert evaluation, as illustrated in Figures (1) and (2).

3. Performance Procedure:
   The instructor tosses the ball upward, and the student being tested performs five diagonal attack attempts from position (2), followed by five from position (4), each set performed separately. The player aims to hit into one of the scoring zones:

   - Zone (A): Highest score
   - Zone (B)
   - Zone (C)
   - Zone (D): Lowest score

   The student must strictly attack from the designated position and direct the ball toward the corresponding target zone for maximum scoring. After completing the five attempts from position (2), the student waits for their peers to finish before returning to perform from position (4). Each set of attempts is evaluated independently in terms of score and expert judgment.

4. Scoring:
   The student receives points according to the zone in which the ball lands:

   - Correct shot to Zone A: 4 points
   - Correct shot to Zone B: 3 points

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

- Correct shot to Zone C: 2 points
- Correct shot to Zone D: 1 point
- If the ball lands outside the designated zones: 0 points
- Maximum Score for the Test: (20) points.

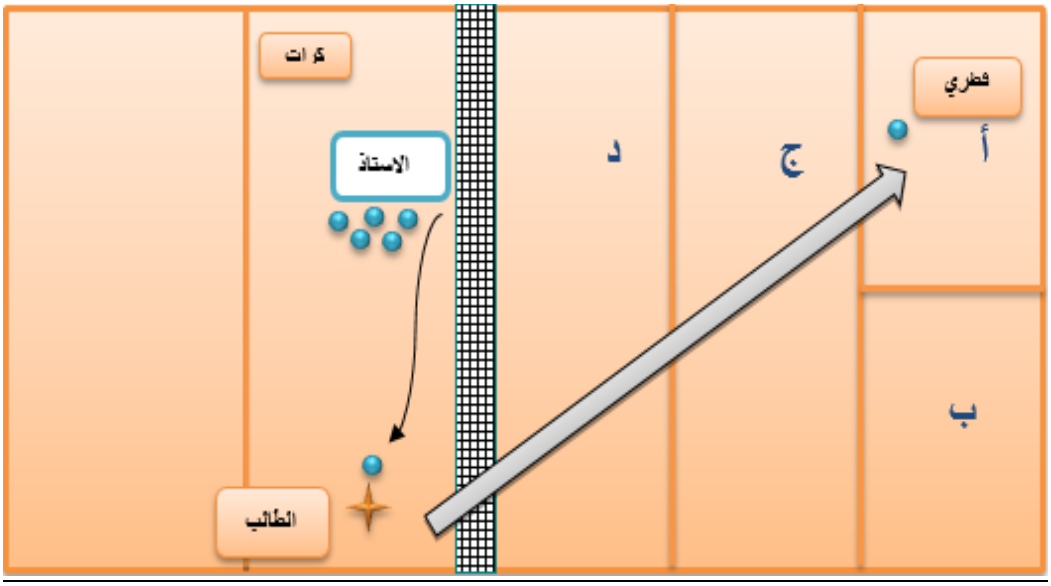


Figure (1) Illustrates the method of executing the attack from position (2).
* The performance is evaluated by the specialists:)Prof. Dr. Hussein Subhan,Prof. Dr. Basim Ibrahim,Asst. Prof. Dr. Ghaith Aryar(

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

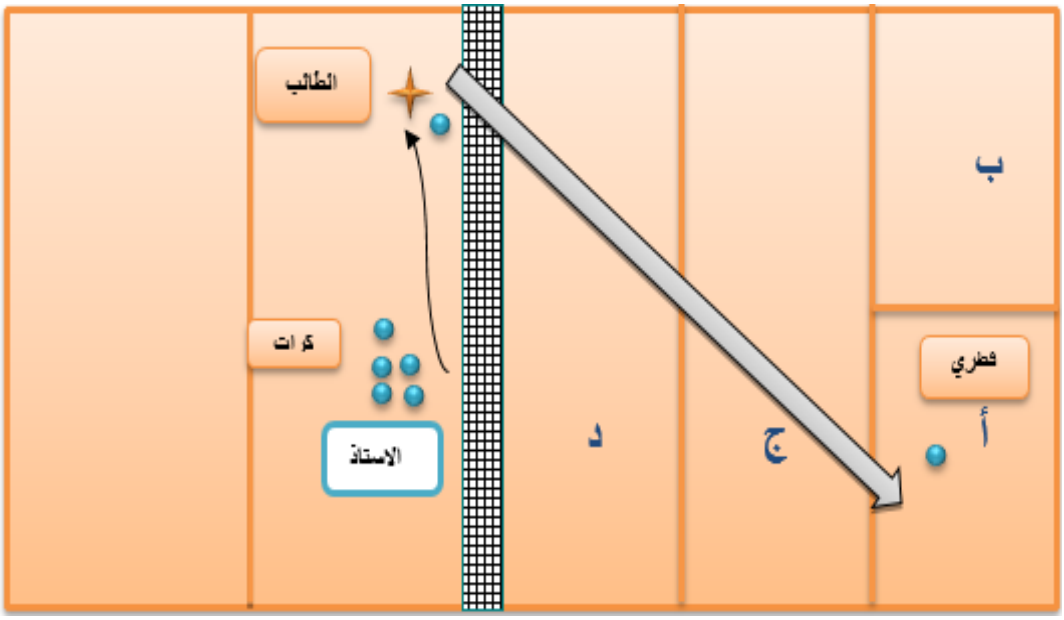


Figure (2)
Illustrates the method of executing the attack from position (4).

How to Calculate Kinematic Indicators Using the Analysis Software (Kenova):

1. Approach Speed in the Final Step:
This is calculated by dividing the horizontal distance between the front of the foot at the start of the final step and the front of the foot at the moment of ground contact by the time taken.
(S = D / T)
As illustrated in Figure (1).
(Al-Azzawi, 2014)

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

Figure (1)
Illustrates how to calculate the approach speed in the final step.

2. Ball Launch Speed:
The linear speed of the ball at launch is calculated by determining the scale of the diagram and the time it takes for the ball to move from one point to another, as shown in Figure (2).
(Akour, 2000)

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

Figure (2) Illustrates how to measure the ball's launch speed.

Homogeneity and Equivalence of the Research Groups: Before applying the specialized exercises based on biomechanical principles to the research sample, two important procedures must be carried out:

- The first is to determine the homogeneity among the sample members. This was done by calculating the coefficient of skewness to verify the homogeneity among the individuals—i.e., to ensure a normal distribution of the anthropometric measurement variables within the standard bell curve. Table (1) presents this data.

Statistical Parameters Variable	Unit	Mean	Median	Deviation Skewness	Coefficient
Length	poison	174	174.5	2.25	0.622
Mass	kg	72.33	72.5	2.77	- 0.485
Chronological age	year	21.36	21.5	1.28	0.144

Table (1): Shows the Homogeneity of the Sample Members

Table (1) shows the values of the mean, standard deviation, and skewness coefficient for the anthropometric variables. The mean values are greater than the standard deviations, indicating no significant dispersion among the members of the research sample. The skewness coefficients ranged between (0.622 to -0.485), which falls within the range of (±1), indicating that the data follows a normal distribution curve.

As for the equivalence of the groups, the researchers sought to verify the equivalence between the experimental and control groups. *"The researcher should form equivalent groups, at least regarding the variables related to the research"* (Vandalen, 1985).
To control for variables that could affect the accuracy of the results—and to ensure that any differences in outcomes are due solely to the independent variable (the exercises designed according to biomechanical principles)—the researchers conducted an equivalence check between the two groups in the pre-test using the T-test for independent samples across all variables investigated in the study, as presented in Table (2).

Table (2) shows the equivalence process between the pre-tests of the two research groups.

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

Variable	Unit Measurement	Experimental Group (Pre-test)		Control Group (Pre-test)		Calculated t-value	Sig. Value	Significant
		M	SD	M	SD			
Center approach step speed (2)	m/s	3.22	0.132	3.23	0.085	0.352	0.721	Not significant
Ball Starting Speed Center (2)	m/s	12.29	0.761	12.41	0.592	1.274	0.318	Not significant
Precision Attack Center diagonal (2)	degree	12.45	0.711	12.66	0.592	1.276	0.219	Not significant
Country Attack Performance Assessment Center (2)	degree	4.75	0.393	4.592	0.285	1.154	0.262	Not significant
Speed Approach Step Center (4)	m/s	3.25	0.126	3.24	0.082	0.354	0.788	Not significant
Ball Starting Speed Center (4)	m/s	12.31	0.756	12.36	0.599	1.278	0.218	Not significant
Accuracy Attack Center (4)	degree	12.87	0.744	12.84	0.522	1.278	0.342	Not significant
Country Attack Performance Assessment Center (4)	degree	4.89	0.391	4.98	0.282	1.157	0.265	Not significant
Moral at ≥ error rate (0.05) and in front of a degree of freedom (10)								

The results in Table (2) show that the two groups are equivalent in all research-related variables, as there are no significant differences between the participants in either group.

Exercises Designed According to Biomechanical Principles:

- The exercises prepared by the researchers were applied starting on Sunday, November 10, 2024, and continued until Thursday, January 2, 2025, at a rate of two instructional units per week for a period of eight weeks.
- The Sunday session represented the official volleyball class as part of the curriculum for third-year students in the Department of Physical Education and Sports Sciences, College of Education, Al-Farahidi University. The second instructional unit was conducted on Thursdays as an additional session in agreement with the research sample (both the experimental and control groups) and the course instructor.

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

- The researchers ensured that the exercises were designed to align with the participants' characteristics by satisfying internal conditions (learner-specific factors such as abilities, skills, and motivation) as well as external conditions (factors related to the learning environment, such as skill progression and instructional delivery, etc.).
- A blend of exercises was implemented that could help learners improve performance with each repetition, by applying biomechanical principles, especially in take-off and spiking. Mechanical aids were used, such as:
- A spring board to assist in higher jumps,
- Appropriately tall barriers,
- Occasionally a box,
- And a barrier set at net height to ensure diagonal spiking, etc.
- The exercises also focused on:
- Capturing and maintaining the learner's attention,
- Communicating the desired learning outcomes,
- Stimulating recall of information,
- Presenting and guiding the learned skill,
- Providing appropriate feedback,
- Encouraging self-assessment,
- Reinforcing learning retention,
- And promoting transfer of learning.
- The designed exercises included 16 instructional units over two months. Each session lasted 90 minutes, divided as follows:
- 15 minutes: Preparatory segment,
- 65 minutes: Main segment, which included:
    - 10 minutes: Educational task,
    - 55 minutes: Practical task (with an average of 5 exercises),
- 10 minutes: Concluding segment.
- The researchers designed 20 specific exercises focused on attacking from positions (2) and (4)—with 5 exercises per instructional unit. These varied from week to week:
- After the first 4 instructional units, the same exercises were repeated in the next 4 units, but with modified repetitions and increased difficulty.
- In the third and fourth sets of 4 units each, exercises were rearranged in a randomized sequence to serve the instructional goal of each unit—whether targeting approach, take-off, or spiking.
- The researchers took care to maintain experimental control through the following steps:

1. The course instructor implemented and applied the instructional units to the research sample under their supervision for both the experimental and control groups.

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

2. Both the experimental and control groups were taught the same skill (attacking from positions 2 and 4) exclusively in volleyball.
3. The tools and aids used in the exercises were selected to make the instructional units more engaging and enjoyable for the students.

Post-Tests:
The post-test was conducted on the research sample on Sunday, January 5, 2025, at exactly 10:30 a.m. in the main indoor volleyball court, under the same conditions as the pre-test.

Statistical Tools:
The researchers used appropriate statistical tools via SPSS software (version 26) for data analysis.

Results

Table (3) shows the results of the pre-tests and post-tests for the control group participants.

Variable	Unit Measurement	Control Group Post-Test		Control Group Post-Test		Calculated T value	Sig value	Significant
		M	SD	M	SD			
Approach step speed – Position (2)	m/s	3.23	0.085	3.85	0.085	2.651	0.150	Not sign
Ball launch speed – Position (2)	m/s	12.41	0.592	12.74	0.592	2.780	0.035	Sign
Diagonal attack accuracy – Position (2)	degree	12.66	0.592	13.23	0.592	2.575	0.222	Not sign
Diagonal attack performance evaluation – Position (2)	degree	4.592	0.285	5.878	0.285	2.843	0.034	sign
Approach step speed – Position (4)	m/s	3.24	0.082	3.92	0.082	2.559	0.156	Not sign
Ball launch speed – Position (4)	m/s	12.36	0.599	13.45	0.599	3.009	0.008	sign
Diagonal attack accuracy – Position (4)	degree	12.84	0.522	13.13	0.522	2.512	0.276	Not sign
Diagonal attack performance evaluation – Position (4)	degree	4.98	0.282	5.61	0.282	2.782	0.031	Sign
(0.05) and in front of a degree of freedom (5)								

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

Table 4
Shows the results of pre-posttests for members of the experimental group

Search variables	Unit of measurement	Pre-test Experimental Group		Experimental Group Post-Test		Calculated T value	Sig value	Significant
		M	SD	M	SD			
Center approach step speed (2)	m/s	3.22	0.132	4.46	0.089	2.952	0.038	Significant
Ball Starting Speed Center (2)	m/s	12.29	0.761	13.47	0.690	3.112	0.009	Significant
Precision Attack Center diagonal (2)	degree	12.45	0.711	13.26	0.694	2.420	0.165	Not Sign
Country Attack Performance Assessment Center (2)	degree	4.75	0.393	6.054	0.282	3.105	0.020	Significant
Speed Approach Step Center (4)	m/s	3.25	0.126	4.56	0.084	3.098	0.026	Significant
Ball Starting Speed Center (4)	m/s	12.31	0.756	13.83	0.684	3.100	0.015	Significant
Accuracy Attack Center (4)	degree	12.87	0.744	13.93	0.527	2.422	0.043	Significant
Country Attack Performance Assessment Center (4)	degree	4.89	0.391	6.55	0.288	3.122	0.000	Significant
Significant at the error rate oφ ≥ (0.05) and in front of the degree of freedom (5)								

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

Table (5) Shows the results of post-post-tests among members of the control and experimental groups

variables	Unit of measurement	Experimental Group Post-Test		Control Group Post-Test		Calculated T value	Sig value	Significant
		M	SD	M	SD			
Center approach step speed (2)	m/s	4.46	0.089	3.85	0.085	2.202	0.041	Significant
Ball Starting Speed Center (2)	m/s	13.47	0.690	12.74	0.592	2.182	0.046	Significant
Precision Attack Center diagonal (2)	degree	13.26	0.694	13.23	0.592	1.879	0.160	Not sign
Country Attack Performance Assessment Center (2)	degree	6.054	0.282	5.878	0.285	1.911	0.127	Not sign
Speed Approach Step Center (4)	m/s	4.56	0.084	3.92	0.082	2.196	0.048	Significant
Ball Starting Speed Center (4)	m/s	13.83	0.684	13.45	0.599	1.950	0.140	Not sign
Accuracy Attack Center (4)	degree	13.93	0.527	13.13	0.522	2.222	0.043	Significant
Country Attack Performance Assessment Center (4)	degree	6.55	0.288	5.61	0.282	2.523	0.002	Significant
Moral at ≥ error rate (0.05) and in front of a degree of freedom (10)								

Discussion:

The results in Table (3), which pertain to the control group tests, showed statistically significant differences between the pre-tests and post-tests in favor of the post-tests for four variables:

- Ball launch speed from position (2)
- Evaluation of diagonal attack performance from position (2)
- Ball launch speed from position (4)
- Evaluation of diagonal attack performance from position (4)

As for the remaining four variables:

- Approach step speed from position (2)
- Diagonal attack accuracy from position (2)
- Approach step speed from position (4)

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

- Diagonal attack accuracy from position (4) they did not show statistically significant differences, although there was a slight improvement in the mean values in favor of the post-test.

The researchers attribute this improvement to the exercises included in the official curriculum, designed by subject instructors—who are a group of specialized professors—as well as the commitment of the control group members to both official and additional instructional sessions.

The researchers believe that one of the key reasons for the success of any instructional, training, or rehabilitative program lies in precision and sound scientific planning aimed at achieving the desired goals and outcomes.

They also believe this success is due to the diligence of the subject specialists and their diverse academic backgrounds. The researchers agree with Saad Mohsen, who emphasized: *"Regardless of the differences in scientific and practical methodologies, an educational program will undoubtedly lead to improved performance if it is built on a scientific foundation—by organizing and programming the educational process, applying appropriate and progressive intensity, observing individual differences, using optimal repetitions and effective rest intervals, and ensuring supervision by specialized teachers and coaches under proper learning or training conditions in terms of space, time, and tools."* (Ismail, 1996)

As for Table (4), which relates to the experimental group, the results showed statistically significant differences between the pre-tests and post-tests in favor of the post-tests across all variables, except for diagonal attack accuracy from position (2), which, despite showing notable improvement, did not reach statistical significance.

The researchers attribute the reason for these significant differences to their specially designed exercises, which were based on sound mechanical principles and rigorous scientific foundations in order to achieve their intended goal.

Regarding the variables of approach and its speed, the researchers believe that stride length is one of the key factors in increasing the speed of this step, particularly the final step before take-off. This step reflects the student's ability in terms of the speed achieved. It is known that any high horizontal speed results, during the braking phase, in a good vertical lift for the spiker. Therefore, special attention must be given to the final step, up to a certain point: the shorter and deeper this last step is in terms of time, the better the speed, and the more accurate the spike (Nafe' & Ghanem, 2009).

Hamid (2001) explains that "the horizontal speed of the body's center of gravity is related to increased motion speed and acceleration, and the higher the horizontal speed, the more it contributes to enhanced jumping and the conversion of horizontal speed into vertical speed after braking." Hochmuth also points out that there is a direct relationship between increased body speed and body extension, which requires synchronization in performance and motor

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

coordination between body parts and force application simultaneously in the shortest time possible (Hussein & Shakir, 1998).

Furthermore, Suleiman Ali Hassan and others assert that the coordination and harmony between the player's movement and progress, along with applying biomechanical principles in the shortest possible time, is what leads to a good performance (Hassan et al., 1980). This aligns with the mechanical principle that time is a critical factor for differentiating between the movements of bodies

This is exactly what the students in the experimental group achieved—reaching the shortest possible time. Thus, the rhythm is fundamentally (right, left, right, left), with the last two steps executed almost simultaneously (Crosiers & others, 2005).

Regarding the take-off and the strike, the researchers believe that increasing vertical speed leads to gaining greater vertical distance by enhancing the take-off speed and reducing the duration of the take-off. Qasim Hassan and Iman Shakir point out that vertical speed is directly related to the body's launch angle (Hussein & Shakir, 1998). The determination of the horizontal distance achieved by the student's body and the projectile in the air depends on the horizontal component of the launch speed at the moment of take-off. The greater the horizontal component of the launch speed, the longer the horizontal distance the projectile can travel (Hossam El-Din, 2014).

Alaa Mohsen Yasser, citing Sareeh Al-Fadhli, confirmed that the height of the body's center of mass is related to the time at the moment of push-off and the body's speed during launch. This relationship allows the body to gain substantial momentum with reduced push-off time, indicating the use of high force in a very short time, which results in the athlete achieving greater height (Yasser, 2007).

As for the performance evaluation by the expert assessors specialized in this field, the results aligned with the observed improvements across all kinematic indicators—naturally reflecting the enhancement in performance, which in turn led to the current results.

Regarding the results presented in Table (5), which pertains to the post-post tests between the two research groups, a statistically significant improvement was found in five variables in favor of the experimental group. These variables are:

- Approach step speed at position (2)
- Ball launch speed at position (2)
- Approach step speed at position (4)
- Diagonal attack accuracy at position (4)
- Diagonal attack performance evaluation at position (4)

The remaining three variables—diagonal attack accuracy at position (2), diagonal attack performance evaluation at position (2), and ball launch speed at position (4)—did not show statistically significant differences, although they all showed slight improvements in favor of the experimental group.

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

The researchers attribute this superiority to the special exercises based on mechanical principles, which precisely and accurately defined the required performance criteria. Additionally, they provided a comprehensive conceptualization of the movement and a methodical breakdown of the skill into components, each taught separately before integrating them into a complete, sequenced movement The researchers adopted a gradual progression in their prepared training, moving from the simple to the complex, which played a role in organizing the educational content in a sequential manner, thereby facilitating the learning of the required material. Among the factors influencing a learner's acquisition of movements is the guidance provided by the instructor (Obaid, 2006).The researchers affirm what has been emphasized by Al-Rubaie and others, namely that "those responsible for the educational process help equip players with knowledge and capabilities, and create new and innovative ideas to systematically and purposefully raise their practical engagement" (Al-Rubaie et al., 1999).The researchers also took into account all mechanical aspects and conditions in their prepared training, which was reflected in their results. This is because the process of learning skills aims "to teach, master, and solidify motor skills in order to reach the best possible level through the methodology planned and implemented by the coach in training the players" (Al-Kadhimi & Al-Taie, 2012). The findings of this study align with several others, including the study by Ithraa et al. (Khader Abbas, Mushref, & Ameen, 2024). Thus, the research hypotheses were confirmed: there were no statistically significant differences between the two research groups in the pre- and post-tests, nor were there statistically significant differences in the post-tests in favor of either group. Therefore, the null hypothesis is rejected, and the alternative hypothesis—indicating statistically significant differences among individuals—is accepted.

Conclusions:

1. The specialized exercises based on mechanical principles had a positive effect on some kinematic indicators and on learning the skill of diagonal attack from positions (2) and (4) in volleyball for the students.
2. The improvement in some kinematic indicators (in the experimental group) was reflected in the results of the visual evaluation of the skill's form as assessed by performance experts.
3. The results also showed improvement in the performance of the control group members, attributed to the dedication and strong commitment of the subject teachers.

Recommendations:

1. Emphasize the preparation of specialized exercises based on mechanical principles due to their positive impact on learners.
2. Stress the necessity of applying exercises that target mechanical indicators, given their fundamental and effective role in learning technical performance.
3. These exercises can be applied to other student samples or youth groups and can be adapted to different sports or athletic activities.

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

Appendix (1) Table of Educational Units

weeks	Sunday / basic educational unit	Thursday/ Additional Educational Unit	weeks	Sunday / basic educational unit	Thursday/ Additional Educational Unit
first	10/11/2024	14/11/2024	fifth	8/12/2024	12/12/2024
Second	17/11/2024	21/11/2024	Sixth	15/12/2024	19/12/2024
Third	24/11/2024	28/11/2024	Seventh	22/12/2024	26/12/2024
Fourth	1/12/2024	5/12/2024	Eighth	29/12/2024	2/1/2025

Appendix (2) A model of an educational unit from the prepared courses

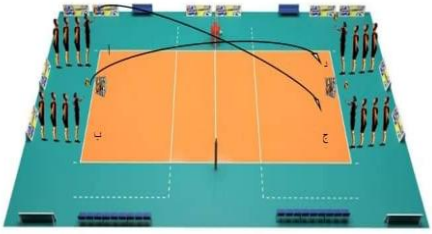
t	Sections of the educational unit	Time	Module content	marshalling	Observations
	Preparatory Department	15 min			
1	Introduction	3 min	Stand in one format to give some directions	××××××××× ▲	Emphasize that physical exercise is performed correctly.
	General warm-up	5 min	General preparation for all organs of the body to raise the basic physical capabilities of the body.	××××××××× ××××××××× ◙	
	Private warm-up	7 min	Various and comprehensive exercises for the whole body serving the main part of the educational unit and special warm-up exercises by balls.		
2	Main section	65 min			
	Educational aspect	10 min	Explain the skill and present a model from the teacher and a quick replay of what was discussed in the previous unit	×××× × ×××× ×××× ◙ ××××	Emphasis on clarification, simplification of explanation, and students' understanding of the technical aspects of performance

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

	Sections of the educational unit	Time	Module content		
	Applied side	55 min The time of each exercise ranges from (11) d	Exercise: (P5، 4P ، 3P ، 2P ، 1P) Students apply the exercises with as many repetitions as possible within the time specified for each 11-minute exercise	××××××××× ◙ ×××××××××	Emphasize the performance of exercises well and correct the mistakes that occur
3	Concluding Section	10 min 5 min 5 min	Conduct a test to see the extent to which players understand the performance of this level of training to take them to a higher level Feedback and departure.	××××××××× ▲	Adherence to the system.

		
The five exercises are applied sequentially, with each exercise lasting 10 minutes of activity followed by one minute of rest. It is worth noting that performance correction is carried out with low to moderate effort and a high number of repetitions.	0 	

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

Appendix (3) Sample Exercise Content Prepared (12 of 36) Applied Exercise

Icon	Exercise content	Learning Objective
P1	Learners stand in the form of two groups, each group in a playground in front of the net, and each learner performs approximate steps without using the ball	Emphasize the correct performance of approximate steps for the skill of overwhelming beating
P2	Learners stand in the form of two groups, each group in a court in front of the net, and each learner performs approximate steps with the use of the ball	Emphasize the correct performance of approximate steps for the skill of overwhelming beating
P3	Learners stand in two groups, each group next to the sides of the playground and each learner performs the three approximate steps with the help of three colored signs representing each step marker, then promotion and relegation.	Learn approximate steps correctly for the skill of overwhelming beating
P4	Dividing learners into two groups separated by the net The group stands sideways behind the offensive line, and each learner hits the ball on the ground from the bottom of the net to bounce to the colleague standing in front of him in the opposite field	Directing the ball to the wrist
P5	Each of the two learners stands together in front of the wall, constantly hitting the ball from standing on the floor to bounce off the wall mutually with a focus on wrist movement and full striking hand extension.	Teaching the skill of crushing hitting and emphasizing the movement of the wrist while not hitting the ball the wall
P6	Learners stand in the form of two groups in front of the network in front of each group a number of signs, and each learner runs between the signs and then upgrades and performs the skill of overwhelming beating without a ball	Teaching the skill of overwhelming beating and developing agility for the student
P7	Learners stand in the form of two groups in front of the net in front of each group a number of signs, and each learner runs between the signs and then upgrades and performs the skill of overwhelming beating with a ball / diagonal in front of me	Teaching the skill of overwhelming beating and developing agility for the student

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

Icon	Exercise content	Learning Objective
P8	Learners are divided into two groups, each group is in the form of a circle, one of them stands in the middle of the circle and numbers the ball to one of his colleagues to do the crushing beating to the student in the middle who raises it to the other	Teaching the skill of overwhelming hitting and the feeling of directing the ball towards a specific target
P9	The learners stand in the form of two groups in front of the network in front of each group a number of signs, and each learner runs between the signs, then performs the three approximate steps with the help of three colored signs, then rises to perform the skill of overwhelming beating without a ball and landing	Learn the approximate steps of the technical performance of the Overwhelming Beating Skill
P10	The learners stand in the form of two groups in front of the net in front of each group a number of signs, and each learner runs between the signs, then performs the three approximate steps with the help of three colored marks, and then rises to perform the skill of overwhelming beating with a ball and landing.	Learn the approximate steps of the technical performance of the crushing hitting skill and correctly direct the ball towards the specified target
P11	The learners stand in the form of two groups on both sides of the field in the form of a locomotive and the teacher stands on a deck behind the net holding the ball and the learners make approximate steps and perform the skill of overwhelming beating and touching the ball held	Learn approximate steps, correct elevation and extending a striking hand to touch the caught ball
P12	Two learners stand in front of the wall at a distance of (3 m), one of them numbers the ball to his colleague who does the overwhelming beating on the square drawn on the wall and measuring (60 cm x 60 cm) and then the switch is made after performing (3) repetitions for each student	Teaching the performance of overwhelming beating with the accuracy of directing the ball on the square drawn wall

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

References:

Ahmed Ameen Akour. (2000). *Kinematic analysis and its relationship with the accuracy of the volleyball spike in both low and high types*. Master's thesis, University of Baghdad, College of Physical Education.

Alaa Mohsen Yasser. (2007). *Comparison of some biomechanical variables in high front and back setting skills from standing and jumping in volleyball*. Ph.D. thesis, College of Physical Education, University of Baghdad.

Ali Mustafa Taha. (1999). *Volleyball – History – Education – Training – Analysis – Rules*. Cairo: Helwan University, Dar Al-Fikr Al-Arabi.

Aws Saadoun & Mohammed Saleh. (April 28, 2020). *The strategy of electronic concept maps and its effect on the cognitive achievement of some technical volleyball skills*. https://jcope.uobaghdad.edu.iq/index.php/jcope/article/view/9, pp. 9–41.

Ban Faisal Al-Azzawi. (2014). *Quantitative analysis of some biomechanical variables and accuracy and speed of serving and spiking skills in volleyball*. Unpublished Master's thesis, University of Baghdad – College of Physical Education and Sport Sciences for Women.

Crosiers, J. L., & Others. (2005). *Factors correlated with volleyball spike*. American Journal of Sports Medicine.

Dhafer Al-Kadhimi & Mazen Al-Taie. (2012). *Tennis – Technical preparation and tactical performance (education – development – training – rules)*. Najaf: Dar Al-Dhiaa.

Dhafer Hashem Al-Kadhimi. (2012). *Practical applications for writing educational and psychological theses and dissertations*. Baghdad: University of Baghdad.

Fadel, G. A., & Kadem, M. J. (2021). Youth and Sports Forums' Administration and Their Relationship with Baghdad's Youth and Sport Directorates Forum Organizational Culture from Workers' Point of View. *Journal of Physical Education*, *33*(3).

Hamed Youssef Hameed. (2001). *A study of some biomechanical variables during the take-off phase and their relation to high jump performance (Fosbury Flop)*. Unpublished Ph.D. thesis, University of Baghdad – College of Physical Education.

Issa, F. A. W., Mohaif, S. M., & Kadhim, M. J. (2024). The effect of functional strength training according to gradually increasing load in developing some physical abilities and achievement for men's 100-meter competition runners. *Journal of Physical Education*, *36*(2).

Kadhim, M. J. (2023). Examining The Relationship Between Social Classes And The Culture Of Poverty: A Case Study. *International Journal of Social Trends*, *1*(1), 23–27.

Kadhim, M. J. (2024). Social Networks' Place in Contemporary Political Movements. *International Journal of Social Trends*, *2*(2), 51–59.

Kadhim, M. J., Shihab, G. M., & Zaqair, A. A. (2021). The Effect of Using Fast And Direct Cooling after Physical Effort on Some Physiological Variables of Advanced Football Players. *Annals of the Romanian Society for Cell Biology*, *25*(6), 10014–10020.

Khader Abbas, I., Mushref, A., & Ameen, M. J. (2024). *The effect of corrective exercises accompanied by mechanical feedback on some kinematic indicators and learning how*

Journal of Physical Education

Volume 37 – Issue (2) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

to perform volleyball spiking for students. Journal of Studies and Research in Physical Education, 34(3), 342–360. https://doi.org/10.55998/jsrse.v34i3.691

Maher Amer & Riyadh Khalil. (September 28, 2022). *The effect of the Jigsaw strategy on learning the volleyball spiking skill among second-year students*. https://jcope.uobaghdad.edu.iq/index.php/jcope/article/view/13, pp. 34–522.

Mahmoud Dawood Al-Rubaie & Others. (1999). *Theories and methods of physical education*. Baghdad: Directorate of Book Printing and Publishing.

Qasim Hassan Hussein & Iman Shakir. (1998). *Research methods in biomechanics*. Amman: Dar Al-Fikr Al-Arabi.

Raad Khamees & Hussein Subhan. (September 28, 2019). *The effect of special exercises using some educational aids in learning basic volleyball skills for first intermediate students*. https://jcope.uobaghdad.edu.iq/index.php, pp. 9–32.

Rola Miqdad Obaid. (Vol. 5, No. 2, 2006). *The effect of cooperative learning on acquiring some offensive skills in fencing*. Journal of Physical Education Sciences, University of Babylon, p. 12.

Saad Mohsen Ismail. (1996). *The effect of training methods for developing explosive power of the legs and arms on the accuracy of high jump shooting in handball*. Ph.D. thesis, University of Baghdad, College of Physical Education.

Saad Nafe & Waleed Ghanem. (Vol. 9, No. 3, 2009). *A study on the accuracy of volleyball spiking and its relationship with some kinematic variables*. Al-Qadisiyah Journal for Physical Education Sciences.

Sheikh Ali, H. F., & Qasim, M. A. (2024, March 15). *The effectiveness of mastery learning style in developing skill performance in volleyball among students*. Journal of Studies and Research in Physical Education, 34(2), 129–146. https://doi.org/10.55998/jsrse.v34i2.498

Suleiman Ali Hassan & Others. (1980). *Track and field competitions*. Egypt: Dar Al-Maaref.

Talha Hossam Al-Din. (2014). *Basics of movement sciences: Descriptive and functional kinesiology*. Cairo: Modern Book Center, 1st ed.

Vandalen. (1985). *Research methods in education and psychology* (Translation: Mohammed Nabil and others). Cairo: Anglo Egyptian Bookshop.

Yaareb Abdul-Baqi Dayekh. (September 15, 2021). *A comparative analytical study of the maximum height reached by the center of mass in flight and at the moment of executing the main phase in jump shot skills in handball and volleyball spiking and serving*. Journal of Studies and Research in Physical Education, 31(3), 123–132. https://jsrse.edu.iq/index.php/home/article/view/112