



The Effect of Combined (Physical - Skill) Exercises Using a Designed Device on Developing Some Shooting Skills for Basketball Players Under 18

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Abstract

The study aimed to identify the effect of combined (physical - skill) exercises using a designed device on developing certain shooting skills for basketball players under 18 years old. The researchers used the experimental approach on a sample of 14 players, divided into an experimental group and a control group. To achieve the study's objectives, the researchers designed a basketball shooting development device, which consists of a rotating base, poles, and a main body, in addition to an electronic system that rotates the device towards the player approaching the proximity sensors. The researchers also prepared a set of physical and skill exercises using the designed device. These exercises were applied to the experimental sample for eight weeks, with three training sessions per week. The researchers concluded that the combined exercises using the designed device had a positive impact, leading to the superiority of the experimental group over the control group.

Keywords: Basketball, Device, Shooting, Combined Exercises.

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Introduction

Compound exercises are one of the most important exercises in the game basketball, which works to develop the skill and physical side of the basketball player "as it combines more than skills in one exercise or more than one physical or motor aspect with the skill and is performed in the different stages preparation (Zhang, et al, 2024), as well as its diversity that helps to increase the elements of desire and excitement when practicing it, and the nature of these exercises is close to what happens within matches or competitions from defense, attack, deception, surprise by players, change direction and other tactical methods, and these exercises are performed under physical and psychological pressure but in an organized manner that can be stopped and directed by the coach, and the shooting skill in basketball is an important skill, as shooting is the last duty that the player performs (Al-Attar, 2004, page 49) indicates that "shooting is the final stage of the team's attack, and all the skills performed in combination with the cooperation of team members are only a preparation for the shooting process on the basket." And shooting is the process of pushing the ball towards the target in the form of a throwing movement using one or two arms, as shooting aims to move the ball from the player's hand to enter the basket.

As a result of the development witnessed by the world in the game of basketball and to improve the level of performance of players and the researcher's work in the field of teaching, she noticed a weakness in the accuracy of shooting and the lack of modern sports equipment that may contribute significantly to the development of players' performance, so the researcher worked to study the issue and find solutions to overcome it to keep pace with the development by designing a proposed device to develop shooting and players' reach to the required level, so the researcher decided to design a device to develop the accuracy of shooting.

The study aimed to: Design a proposed device to develop shooting for basketball players under the age of 18, prepare complex exercises using the designed device to develop the shooting skill for basketball players under the age of 18, identify the differences between the arithmetic means of the results of the post-tests between the experimental and control groups in shooting skills.

Many researchers studied the subject of this study, including the study of (Abdullatif, 2008), which aimed to design an assistive device in learning the skill of scoring from stability in basketball and to identify the effect of using the assistive device in learning the skill of scoring from stability in basketball, and the researcher used the experimental method on a sample of basketball players The researcher concluded that the proposed device as an aid has an effective role in learning the required skill, and that the use of the proposed device saves effort and time for the trainer and the learner in learning the skill of scoring from stability well



and is suitable for teaching this age group, and (Al-Araji, 2014) studied special exercises using The study aimed to identify the most important biomechanical variables of the shooting skill of young basketball players and to prepare special exercises according to some biomechanical variables using the vertimax device to perform The researcher concluded that the difference is clear in the change in the angular velocity of the swing leg as a result of the weakness of most members of the research sample, as this increase worked to positively affect the rest of the variables in the stages of promotion and departure, while the study of (Khamas, 2015) aimed to The researcher used the experimental method on a sample of 20 youth basketball players and concluded that the proposed device and its special exercises have a positive effect on the development of the accuracy of the jump shot skill for the first experimental group, and that the proposed device has a positive effect on the development of the accuracy of the jump shot skill for the second group and that the skill exercises have a positive effect on the development of the accuracy of the jump shot skill for the second group. For the first experimental group, the proposed device has a positive effect on the development of the accuracy of the jump shot for the second group, and the skill exercises have a positive effect on the development of the level of accuracy of the jump shot for the third group, and the researcher concluded that the devices used in the training units increase the motivation of the players to continue playing and excitement. The study (Wali, 2019) aimed to design an assistive device (ball collector and angle limiter) for basketball shooting skill and prepare special exercises using the designed device according to smart ball information and its effect on the accuracy of some types of shooting for advanced basketball players and to identify the effect of special exercises using the designed device according to smart ball information on the accuracy of some types of shooting for advanced basketball players and to identify the effect of special exercises using the designed device according to smart ball information in The researcher concluded the superiority of the two research groups (control and experimental) in shooting skills (from stability, jumping and three-point jumping) and in favor of the post-tests and the superiority of the experimental group that trained according to the designed device over the control group in the post-tests of the shooting skills under study. As for the study of (Mubasher, 2021), it aimed to design a motor response test device for basketball players, and to identify the effect of motor response speed exercises using the (Xtra-MAN) device The researcher used the experimental method on the research sample of (12). The study concluded that the researcher's modified Xtra-Man exercises are preferable to the exercises prepared by the trainer in the development of peaceful shooting, two-point shooting, and three-point shooting. (Jabbar and Ali, 2022). The researchers adopted the experimental method with a single group design with two pre and post tests on a sample of (12) players, and the researchers concluded that the compound exercises were effective in developing the explosive strength of the legs, the explosive strength of the arms, and the development of the skill aspect.



The study (Ali, Abdul Mohsen, and Saleh, 2024) aimed to identify the effect of TRX training using Bosu ball on the development of passing for female basketball players as well as the effect of TRX training using Bosu ball on the development of some physical abilities for female basketball players, and concluded that there are statistically significant differences between the mean of the two preliminary measurements in favor of the first experimental group using TRX using Bosu ball in favor of the first experimental group using TRX using Bosu ball, and statistically significant differences between the mean of the two dimensional measurements in favor of the first experimental group using TRX using Bosu ball on the development of passing and some physical abilities of female basketball players, and the effect was clear and canceled on the physical elements under investigation. Finally, the study (Muslim and Khudair, 2025), which aimed to know the effect of complex mental exercises on some motor abilities and offensive skills of young soccer players, the researchers used the experimental method for the suitability and nature of the research, and the experiment was carried out on a sample of young soccer players, whose number (24) players and ages (17- 19) years old and were randomly divided into two groups, with (10) players for each group, the experimental design was adopted, which is called the design of equal groups with an experimental design with a test (pre-post), and the researchers concluded that the complex mental exercises worked to develop the motor and skill abilities of young football players.

Method and Tools

The researcher used the experimental method as it is one of the method that achieves the research objectives and hypotheses, the research population included the players of the six Baghdad education directorates under the age of (18) years and their number (89) players and the research sample was selected by random method (lottery) from the six directorates and the research sample was represented by the players of Baghdad Karkh I education (17 players) and three players were excluded to conduct the exploratory experiment as the sample consisted of fourteen players, then the sample was divided equally into two control and experimental groups.

The proposed device is designed to improve aiming

The designed device consists of the Xtra Man (SKLZ DMBK-000-02 D-Man), which works as a defender, which in turn consists of the following parts:

1. Base: The base of the figure: It is a hollow plastic base with a diameter of (40) cm, which can be filled with water or sand to weigh it down.

2. Columns: The device consists of three hinged columns with two connectors, the columns are installed with each other, and then attached to the base.

3.The body of the beam: It is a frame of plastic tubes with a diameter of (0.5) cm foldable, with dimensions (12.50 x 60 x 50) cm, covered with a transparent plastic fabric (Arokanza) in the form of a grid similar to the position of the defender's movement.

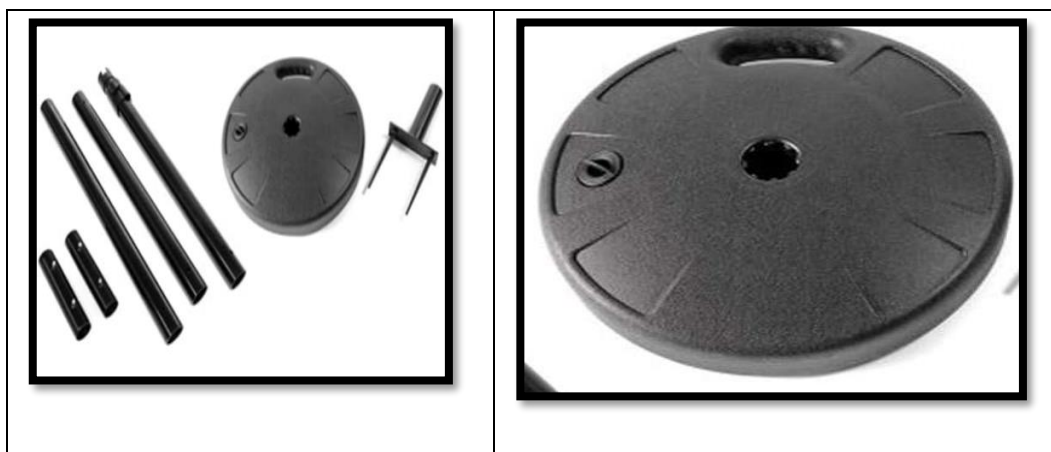


Figure 1. *Base and columns*



Figure 2. *Device body*

4.Factory electronic part.



A. Ultrasonics Sensor: Ultrasonic sensors measure the distance that is determined according to the exercise, as it emits high-frequency sound waves that the human ear cannot hear, and when these waves collide with an object, they bounce back in the form of an echo, when these waves bounce back, they are sensed and sent to the microcontroller for processing.

B. Spindle motor: A Stepper Motor was used with the following specifications: (BEMONOC 12v DC Motor 160 RPM Dc Worm Geared Motor with Metal Gear Box for Diy Parts),

This type of motor is a high-torque motor with a voltage of (12) volts that can change its speed and is one of the most powerful types of developers that are suitable for high-torque projects.

C. Microcontroller: It controls the reception of the signal from the distance sensor and is processed and then sends a signal to the stepper motor (motion developer) to move towards the attacking player to be an obstacle similar to the defender. The researcher will use the reception and control system consisting of a microcontroller (Arduino microcontroller).

Method of work

Electron beam: It is a D-man dummy It is a D-man representing the defender whose body side is opposite to the attacking player, with a height of two meters, which can be increased and decreased according to the height of the players, and rests at the bottom on a plastic base so that the vertical lip is installed on a rotating pulley and on the head of a rotating motor (motor) of a type of motor that can be rotated according to the angle required, i.e. rotating at an angle of 90, 45 or any angle according to the need in the prepared exercises That is, it rotates at an angle of 90 or 45 or any angle according to the need in the prepared exercises, and this motor is equipped with a driver (driver), which in turn is connected to a controller that responds to the signal from the distance sensor, that is, when the attacking player approaches, the doll rotates at the same angle as the attacking player is an obstacle to scoring.

Search tests

Shooting the basket from the side (Allawi & Radwan, 2001, p. 210).

- Two lines are drawn on each side of the court and 20 feet away from the basket.
- The player stands at his assigned line and shoots (10) consecutive shots at the basket and then moves to the other side of the court to shoot the other shots at the same distance.
- Total shots on the basket (20) Twenty shots, ten shots from each side



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- The player is allowed to shoot at the basket with one hand or with both hands.
 - Each player is given one attempt to practice before the test on each side.

Calculation of scores

- Two (2) points are calculated for each ball that enters the basket.
- One (1) point is calculated for each ball that touches the hoop but does not enter it.
- A player's score is the sum of the points he gets from the twenty shots.
- The maximum score is (40) points.

Jump Shooting Accuracy Test (Almajid and Majeed, 2016, page 8)

The player shoots the ball at the basket in three sets of (5) consecutive shots from the center of the free throw area and on both sides, and each player gives one appropriate time between each set as shown in the figure

Calculation of points: Two points are calculated for each ball that enters the basket and one point for each ball that touches the hoop and does not enter, while the tester's score is equal to the sum of the points obtained in the fifteen attempts, noting that the maximum score is 30 points

Shooting test from the peaceful movement after performing the dribble (Cesar, 2022, page 7)

Method of performing the test: The tester performs the dribble from the center of the court towards the target to perform the triple and then the peaceful shooting

Test conditions: The tester will be given (10 attempts) to shoot and must perform the dribble and triple legally.

Points are calculated, and each successful attempt is worth one point. The highest point total that can be obtained by the tester is ten points

Application of exercises

The researcher worked on the application of the prepared exercises, which contains compound exercises (physical and skill) in addition to the designed device and after it was presented to experts to ensure the realization of compound exercises consisting of 24 training units, the researcher used the method of repetitive training and high-intensity interval training.

The duration of the proposed main experiment lasted (8 weeks) and the number of total training units (24) training units (3) units per week and the time of one training unit from (30 - 45) minutes at the beginning of the main section of the training unit.

Result

Table 1. Mean Scores, Standard Deviations, and t-test Results for Pre- and Post-shooting Tests of the Control Group

Test	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	t-value	Sig.	Significance
Standing shot from the right side	8.000	1.528	12.000	2.236	5.53	0.001	Significant
Standing shot from the left side	8.429	1.618	10.571	3.309	2.50	0.047	Significant
Jump shot	20.000	3.367	23.429	4.392	4.77	0.003	Significant
Lay-up shot	3.000	1.414	6.286	1.704	5.42	0.002	Significant

Note. Results are statistically significant at $p \leq 0.05$ with 6 degrees of freedom.

Table 2. Mean Scores, Standard Deviations, and t-test Results for Pre- and Post-shooting Tests of the Experimental Group

Test	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	t-value	Sig.	Significance
Standing shot from the right side	9.714	2.812	16.714	1.380	7.000	0.000	Significant
Standing shot from the left side	10.286	1.704	15.286	2.138	6.355	0.001	Significant
Jump shot	19.857	1.952	26.143	2.268	8.800	0.000	Significant
Lay-up shot	3.286	2.360	8.714	0.951	5.729	0.001	Significant

Note. All differences are statistically significant at $p \leq 0.05$ with 6 degrees of freedom.

Table 3. Differences Between Post-Test Skill Performance of the Experimental and Control Groups

Test	Experimental Group Mean	SD	Control Group Mean	SD	t-value	Sig.	Significance
Standing shot from the right side	16.71	1.38	12.00	2.24	5.47	0.000	Significant
Standing shot from the left side	15.29	2.14	10.57	3.31	3.17	0.010	Significant
Jump shot	26.14	2.27	23.43	4.39	2.55	0.030	Significant
Lay-up shot	8.71	0.95	6.29	1.70	3.29	0.010	Significant

Note. Differences are statistically significant at $p \leq 0.05$ with 12 degrees of freedom.



Discussing

The results achieved for the experimental group came as a result of the compound exercises applied by the researcher to this group, and her regulation of the components of sports training load, as the process of advancing in the level of various physical abilities occurs as a result of organizing the components of training and the correct exchange between work and rest (Johe, 2020, p. 266), as "organization in training is one of the most important fundamentals for the success of the training process, as it relies on achieving training goals. It includes organizing all training components, the number of units, timing, performance method, and everything related to the training process (Bompa & Buzzichelli, 2018). Considering that this principle is closely related to the priority principle in training by providing exercises and components that yield better training outcomes and prioritizing them when organizing training programs, it becomes a foundation thru which the athlete follows the training process.

On the other hand, the researcher attributes the achieved results to the effectiveness of using the manufactured device, which in turn reflected the shooting skill, as the manufactured device and through being a mobile device that rotates towards the player's location and the exact time of arrival, which simulates what happens inside the field, as the researcher believes that this feature of the designed device and the compound exercises prepared by the researcher had a great and comprehensive impact on the player's body, whether in the quality of performance or the level of performance, in addition to that, the researcher believes that the factor of excitement and renewal "is one of the conditions that must be met by the exercises must be different and varied for the purpose of the comprehensive impact on the body and away from boredom and instilling a spirit of challenge. The researcher believes that the factor of excitement and renewal "is one of the conditions that must be met by the exercises must be different and varied for the purpose of the comprehensive impact on the body and away from boredom and spreading the spirit of challenge, as the use of different means, training tools and devices makes the sports training process more effective and positive because their use helps to build the player's motor perception and makes him live in an atmosphere similar to the game and thus the options he has during performance are many.

The researcher attributes the achieved results to the effect of the designed device, as this device transfers the skill performance from silent performance to high-stimulation motor performance. The movement of the device toward the player during the shooting skill gave the individuals in this sample a greater opportunity to harmonize with the exercises, providing a positive addition that makes the skill performance more exciting and engaging. This achieved an important goal, which is that the repetitions of the compound exercises prepared by the researcher were performed with strength and speed, precise performance, and the



player's attempt to harmonize with the movement of the device and its movement toward the player at the moment of shooting. Sources indicate that the correct repetition of physical or skill performance is one of the most important factors in achieving the desired goal of the exercise (Khasaf, 2023). This aligns with what Jabar and Ali (2022, p. 9) mentioned, that compound exercises are one of the modern training approaches characterized by significant difficulty and challenge, which greatly benefit the development of abilities and skills in basketball and the advancement of players' levels, especially among age groups.

The researcher believes that compound exercises using the designed device have created the required harmony and synchronization between the muscular and nervous systems by speeding up the transmission of impulses from nerve cells to muscle cells, the rapid transfer to the entire muscle, and their coordination in working with other muscles, as well as the performance compatibility between the muscles. "All of this leads to a state of functional adaptation in the muscular-nervous work."

The researcher attributes this superiority to the compound exercises applied to the members of the experimental group, which included a set of physical and skill exercises using the designed device. These exercises encompassed upper and lower body muscle exercises, trunk muscles, as well as transitions during performance on the designed device, which faces the athlete during performance. These movements and transitions made the performance similar to that on the court, with movement in different directions. Bhardwaj & Kathayat (2021, p. 2) indicate that basketball is characterized by dynamism, continuous and sudden fast sprints along the court, with or without the ball. It is also characterized by variations in rhythm, as well as continuous movements in all directions, receiving, passing, moving to assist or block, and shooting. 2) that basketball is characterized by dynamism, continuous and sudden fast sprints along the court, with or without the ball. It is also characterized by variations in rhythm, as well as continuous movements in all directions, receiving, passing, moving to assist or block, and shooting. Here, the researcher indicates that the exercises on the designed device directly targeted the abilities that contribute directly to the development of explosive strength capabilities characterized by speed, agility, balance, and motor coordination. These "abilities and others are what a basketball player relies on within the court" (Wali, 2019, p. 7).



Appendix

Appendix 1. The exercises used

Exercise (1) Front Support. Exercise (1) Front support.

Exercise (2) varied abs. Exercise (2) varied abs.

Exercise (3) Knee Flexion and Extension. Exercise (3) Knee Flexion and Extension.

Quick run 20 meters. Exercise (4) Sprint 20 meters.

Jumping as high as possible with both feet while throwing a medicine ball. Exercise (5) Jump as high as possible with both feet while throwing a medicine ball.

Exercise (6) Various abdominal exercises. Exercise (6) Varied abdominal exercise.

Front plank on a medicine ball. Exercise (7) Front support on a medicine ball.

Exercise (8) Cross-legged between two partners, performing an abdominal exercise while alternating throwing the medicine ball between them. Exercise (8) Foot entanglement between two partners performing an abdominal exercise with alternating throws of a medicine ball between them.

Exercise (9) Bending and extending the knees while throwing the medicine ball upwards during the extension. Exercise (9) Bending and extending the knees while throwing the medicine ball upwards during the extension.

Exercise (10) Hop for a distance of 10 meters. Exercise (10) hop for a distance of 10 meters.

Exercise (11) from lying down, lifting the legs up.

Exercise (12) Jumping over 10 low-height hurdles for a distance of 5 meters.

Exercise (13) Jumping on both sides of the platform.

Exercise (14) Bending and extending the knees while jumping upwards.

Exercise (15) Passing in front of the sensor and when the device rotates, shooting by jumping.

Exercise (16) Tapping and passing, then receiving and passing in front of the sensor, and when the device rotates, shooting by jumping.

Exercise (17): Running and passing in front of the sensor while receiving the ball, and when the device rotates, shooting while jumping.

Exercise (18): Running from two players, one from the left and the other from the right, to pass in front of the sensors with a 3-second delay between them to reach the device and perform a jump shot.

Exercise (19): Receive the ball, then pass in front of the right sensor and perform a smooth shot after the device turns toward the player. Then run toward the left sensor, receive the ball, perform a jump shot, and change direction.

Exercise (20) Upon command, the player runs without the ball, then receives the ball from the assistant near the free-throw area and performs a jump shot in front of the designed device.

Exercise (21) Upon the signal, the player runs and receives the ball from the assistant, then performs dribbling and shooting by jumping in front of the designed device.

Exercise (22) Upon command, the player runs quickly and receives the ball from the assistant, who stands near the free throw area, then performs a stationary shot in front of the designed device.

Exercise (23) Upon command, the player runs quickly, receives the ball from the assistant, and



shoots from a stationary position in front of the designed device.

Exercise (24) Upon command, the player runs quickly and receives the ball from the assistant, who stands along the sideline of the basketball court, and performs dribbling and shooting from a stationary position in front of the designed device.

Exercise (25) Upon command, the player runs quickly and receives the ball from the assistant, who stands near the free-throw area, and performs a smooth shot in front of the designed device.

Exercise (26) The player runs without the ball, then receives the ball from the assistant near the free-throw area and shoots by jumping in front of the designed device.

Exercise (27) Upon command, the player runs and receives the ball from the assistant, then performs a dribble and a jump shot from in front of the designed device.

Exercise (28) Upon the command, the player runs quickly and receives the ball from the assistant, who stands along the sideline of the basketball court, and performs dribbling and a smooth shot in front of the designed apparatus.

Appendix 2. A sample of the training units

Training Program Schedule – Week Two (Intensity: 80%)

Exercise	Exercise Duration (s)	Repetitions	Rest Between Repetitions (s)	Sets	Rest Between Sets (s)	Total Exercise Time (min)
First Training Unit						
Exercise (7) + Exercise (15)	30	5	60	2	90	14:30
Exercise (8) + Exercise (16)	30	5	60	2	90	14:30
Exercise (9) + Exercise (17)	30	5	60	2	90	14:30
Second Training Unit						
Exercise (1) + Exercise (15)	30	5	60	2	90	14:30
Exercise (2) + Exercise (16)	30	5	60	2	90	14:30
Exercise (3) + Exercise (17)	30	5	60	2	90	14:30
Third Training Unit						
Exercise (10) + Exercise (18)	30	5	60	2	90	14:30
Exercise (11) + Exercise (19)	30	5	60	2	90	14:30
Exercise (12) + Exercise (20)	30	5	60	2	90	14:30
Fourth Training Unit						
Exercise (9) + Exercise (21)	15	4	60	2	120	10:00



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Exercise (10) + Exercise (22)	15	4	60	2	120	10:00
Exercise (11) + Exercise (23)	15	4	60	2	120	10:00
Fifth Training Unit						
Exercise (12) + Exercise (24)	15	4	60	2	120	10:00
Exercise (13) + Exercise (25)	15	4	60	2	120	10:00
Exercise (14) + Exercise (26)	15	4	60	2	120	10:00
Sixth Training Unit						
Exercise (4) + Exercise (26)	15	4	60	2	120	10:00
Exercise (5) + Exercise (27)	15	4	60	2	120	10:00
Exercise (6) + Exercise (28)	15	4	60	2	120	10:00

Note. The training load for Week Two was set at **80% intensity**, with controlled volume and standardized rest intervals to ensure progressive overload and recovery balance.



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