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ORIGINAL STUDY

The Impact of Educational Exercises Using Assistive Tools on the Technical Performance of the Shot Put Event for Female Students

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Abstract

The importance of this research lies in using assistive tools that help female students learn the technical phases of the shot-put event in a simplified manner. The goal is to reduce the effort and time required for teaching the event, which reflects positively on improving technical performance and minimizing common mistakes. Through practical observation, the researchers noted that female students face difficulties acquiring the correct technical performance of the shot put despite traditional teaching methods. The research problem centers around the limited use of assistive tools, which leads to weak motor coordination and a lack of accuracy in performance. This necessitated exploring the possibility of using educational assistive tools to facilitate the learning of technical skills for female students. The research used the experimental method. The study population was first-year female students at the College of Physical Education and Sports Sciences for Women, University of Baghdad. Section (B) was selected, consisting of 20 students, and they were divided into two groups: an experimental group and a control group, with 10 students in each group. The most significant conclusion was that educational exercises using assistive tools positively impacted the technical performance of the shot-put event for female students. One of the key recommendations is the necessity of using assistive tools in teaching track and field events, especially the shot put. This finding can be applied in various fields, such as robotics and sports. and this achieves one of the sustainable development goals of the United Nations in Iraq which is (Quality Education)

Keywords: Educational exercises, Assistive tools, Shot put event

1. Introduction

The sports field is considered one of the most critical areas in nations' lives. Therefore, continuous attention has been given to athletic movement to achieve the highest levels of athletic performance—whether through the use of theoretical and applied sports sciences or modern educational tools and technologies. Scientists in sports have made significant contributions, particularly in athletics and, more specifically, in the shot-put event.

Since track and field events are among the core practical subjects, the technical stages of shot put are essential steps through which the athlete can achieve the correct positioning, execute the glide technique correctly, and ultimately reach the pushing phase to attain the farthest possible distance. Due to the difficulty female students face in learning the motor technical phases of this event, there has been a growing need to use educational tools to simplify learning and enhance technical performance.

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Hence, the importance of this research lies in using educational tools that help female students learn the technical stages of the shot-put event in a simplified manner, which in turn contributes to improved technical performance and a reduction in common mistakes.

1.1. Research problem

Through practical observation, the researchers noticed that female students face difficulties acquiring the correct technical performance of the shot put despite traditional teaching methods. The core of the problem lies in the limited use of assistive tools during performance, which has led to the need to reduce the effort and time spent by instructors by using specifically designed educational tools that facilitate learning the technical stages of shot put. Therefore, the researchers aimed to simplify technical performance by developing and implementing educational exercises based on sound scientific principles to enhance the learning process of this event.

1.2. Research objectives

- To design educational exercises using assistive tools for improving the technical performance of the shot-put event among female students.
- To identify the effect of these educational exercises with assistive tools on the technical performance of female students in shot put.

1.3. Research hypotheses

1. The technical performance of the shot-put event was statistically significantly different between the pre-and post-tests of the experimental and control groups.
2. There are statistically significant differences between the post-test results of the experimental and control groups in favour of the experimental group regarding the technical performance of the shot-put event.

1.4. Scope of the research

- **Human Scope:** First-year female students for the academic year 2023–2024 at the College of Physical Education and Sport Sciences for Women, University of Baghdad.
- **Spatial Scope:** Al-Kashafa Stadium.
- **Temporal Scope:** From March 20, 2023, to May 5, 2024.

2. Methodology and procedures

The researchers used the experimental method with a design of equivalent groups (experimental and control), as it is appropriate to the nature of the study. Mahdi defines the experimental method as: "The objective observation of a specific phenomenon that occurs in a situation characterized by tight control and involves one or more independent (manipulated) variables, while keeping the other variables (factors) constant" (Schiffer, 2010, p. 25).

2.1. Research population and sample

The research population consisted of first-year female students for the academic year 2023–2024, totaling 77 students across five sections. The sample was selected using the simple random method from Section (B) through a lottery system. The total number of students chosen was 23, and they were divided into two groups:

- Experimental group: 10 students
- Control group: 10 students

The remaining three students were excluded from the study due to irregular attendance.

2.1.1. Sample homogeneity

The skewness coefficient value ranges between ± 1, indicating that the population distribution is normal. Equivalence of the research sample individuals.

Table 1 shows the homogeneity of the research sample in the variables of height, with a mean of 150.000, weight, with a mean of 75.45, and age, with a mean of 20.52.

Table 2 shows the equivalence of the research sample in the variables of the technical performance phases in the shot put event (the preparation stance phase, the crouch phase, the glide phase, the release phase, and the recovery phase), indicating the absence of significant differences.

Table 1. Illustrates the homogeneity of the sample.

Variables	Measurement Unit	Arithmetic mean	Median	Standard Deviation	Skewness Coefficient
Height	m	1.65	150.000	4.432	0.876
Weight	Kg	75.45	48.000	2.241	0.751
Age	Year	20.52	13.000	3.377	0.925

Table 2. Equivalence of the research sample participants.

Variables	Measurement unit	Experimental group		Control group		Calculated T value	Error level	Statistical Significance
		A M	STD	A M	STD			
Preparation Phase	Degree	5.459	0.189	4.564	0.0319	1.866	0.167	Non-Significant
Crouch Phase	Degree	4.632	0.5233	4.005	0.0244	1.098	0.389	Non-Significant
Glide Phase	Degree	5.002	0.4999	4.661	0.0533	0.945	0.333	Non-Significant
Release Phase	Degree	4.589	1.739	4.005	0.444	0.489	0.644	Non-Significant
Exchange Phase	Degree	5.434	2.678	4.567	1.522	2.411	0.498	Non-Significant

Statistically Significant at a Significance Level of ≤ 0.05 and Degree of Freedom = 18.

2.1.2. *Means of data collection*

- Observation
- Tests and measurements
- Arabic and foreign sources
- The Internet (global information network)

2.2. *Tools and equipment used in the research*

Lightweight medicine balls (weighing 1–2 kg), Colored ground circles to define movement paths (20 pieces), cones (40 pieces), Sandbags ranging in weight from 500 g to 2 kg, Wooden boxes (50 pieces), Elastic bands for guiding arm movements (20 pieces), Stopwatches (2 pieces), Whistle, Measuring tape (30 meters), White chalk, Video camera (Sony) with a frame rate of 60 fps (1 piece), Laptop (Dell), Electronic medical scale (1 piece), Two flags (one red, one white).

2.3. *Tests used in the research*

Measuring the Level of Technical Performance in Shot Put:

The researchers prepared a questionnaire form that divided the motor phases of the shot and put the skill into sections, assigning a score for each part of the event. Each phase was given a score of 10 points, and the phases of technical performance in the shot-put event were categorized as follows: Preparation Phase, Crouch Phase, Glide Phase, Release Phase, Exchange phase)

Making a total of 50 points.

2.4. *Pilot study*

The researchers conducted the pilot study on three female students from the research sample. The experiment involved filming the shot-put event's technical (motor) performance. The purpose of the pilot study, as stated by Raheem et al. (2024), included the following:

1. Ensuring the validity and functionality of the tools and equipment used.
2. Ensure the research team fully understands how to conduct the tests and measurements.
3. Verifying the ease of applying the tests and their suitability for the sample's level.
4. Identifying any potential obstacles and avoiding errors during implementation.
5. Calculating the time required to perform the test (Singer, 2008).

2.5. *Field research procedures*

2.5.1. *Pre-tests*

The pre-tests were conducted at Al-Kashafa Stadium. After a warm-up session, each student was given trial attempts. Then, the actual pre-test was carried out by providing each student with three attempts, all recorded on video, to evaluate technical performance.

The researchers used a video camera placed 6 meters away from the performance area and at a height of 1.60 meters. After the technical performance tests were completed, the videos were shown to three experts, who were given an evaluation form (Appendix 1) to assess the performance. The experts assigned a score out of 10 for each performance phase.

2.6. *Educational exercises using assistive tools*

The experimental group performed the educational exercises using assistive tools. These exercises were included in the central part of the instructional unit and progressed from simple to complex.

The designed exercises focused on strengthening the leg and arm muscles, among other movements. The educational exercises' application period lasted four weeks, with two instructional units per week, for eight units. Each main instructional session lasted 60 minutes, while the total duration of each session was 90 minutes.

The researchers paid attention to the number of repetitions according to the type of exercise. The assistive tools used included small medicine balls, elastic

Table 3. Illustrates the results of the differences between the pre-and post-tests for the experimental group.

Variables	Measurement unit	Pre-test		Post-test		SDD	Calculated T-value	Error Level	Significance
		A	SD	A	SD				
Preparation Phase	Degree	5.459	1.567	6.008	1.532	0.455	5.763	0.001	Significant
Crouch Phase	Degree	4.632	2.098	5.009	2.689	3.729	4.281	0.003	Significant
Glide Phase	Degree	5.002	0.944	5.578	1.744	2.653	5.941	0.002	Significant
Release Phase	Degree	4.589	0.544	5.786	1.991	2.835	6.844	0.001	Significant
Exchange Phase	Degree	5.434	3.687	6.122	22.422	3.421	7.281	0.000	Significant

Statistically significant at a significance level of ≤ 0.05 and a degree of freedom = 9.

ropes, sandbags ranging from 500 g to 2 kg, and low-height wooden boxes.

The use of assistive tools was alternated across the instructional units. Two tools were used in some units, while in others, all tools were integrated depending on the technical phase being taught. The control group performed the standard exercises prepared by the course instructor.

2.6.1. Post-tests

The post-tests were conducted under the same conditions as the pre-tests.

2.6.2. Statistical methods

The SPSS statistical software was used. The statistical tools included:

- Arithmetic mean
- Standard deviation
- Paired-sample t-test
- Independent-sample t-test

3. Results

3.1. Presentation and analysis of differences between pre- and post-tests for the experimental group as shown in Table 3

This means that the results achieved by the experimental group after applying the exercises (post-test) were clearly different from their results before the exercises (pre-test), in a way that is unlikely to be due to chance. This indicates that the exercises used in the research had a positive effect on the group's technical performance in the phases of the shot put.

3.2. Presentation and analysis of the differences between the pre- and post-tests for the control group

The Table 4 shows that there are statistically significant differences between the pre-test and post-test results in the research variables for the control group, and these differences appeared in favor of the post-test in the technical phases of the shot put.

3.3. Presentation and analysis of the differences between the experimental and control groups in the post-test

Table 5 shows statistically and significantly meaningful differences in the means between the experimental and control groups in the post-test results, in favor of the experimental group. These significant differences are attributed to the effectiveness of the exercises applied to the experimental group, which clearly contributed to improving performance and developing the research variables.

4. Results discussion

As shown in Table 5, there were statistically significant differences between the experimental and control groups in the post-tests, in favor of the experimental group across the research variables. The superior performance of the experimental group is

Table 4. Shows the results of the differences between the pre- and post-tests for the control group.

Variables	Measurement unit	Pre-test		Post-test		SDD	Calculated T-value	Error Level	Significance
		A	SD	A	SD				
Preparation Phase	Degree	4.564	1.554	5.003	1.789	0.833	7.733	0.001	Significant
Crouch Phase	Degree	4.005	3.389	4.890	2.634	1.278	5.789 5.673	0.004	Significant
Glide Phase	Degree	4.661	1.144	5.004	1.792	0.633	6.721	0.002	Significant
Release Phase	Degree	4.005	0.667	4.564	1.511	0.222	4.786	0.001	Significant
Exchange Phase	Degree	4.567	2.422	5.022	5.789	0.390	4 2.5903	0.000	Significant

Statistically significant at a significance level of ≤ 0.05 and a degree of freedom = 9.

Table 5. Illustrates the results of the differences between the experimental and control groups in the post-test.

Variables	Measurement unit	Experimental group		Control group		Calculated T-value	Error Level	Significance
		AM	STD	AM	SD			
Preparation Phase	Degree	7.211	1.543	6.008	1.439	3.633	0.002	Significant
Curling Phase	Degree	6.342	2.823	5.519	2.723	2.787	0.001	Significant
Glide Phase	Degree	6.007	1.678	5.432	2.645	4.367	0.007	Significant
Release Phase	Degree	6.435	2.721	5.477	4.812	2.189	0.001	Significant
Recovery Phase	Degree	7.898	3.200	6.009	3.767	3.821	0.002	Significant

Statistically significant at a significance level of ≤ 0.05 and a degree of freedom = 18.

attributed to the implementation of instructional exercises utilizing assistive tools, as well as the structured progression within the educational units—from simple to complex movements—which positively influenced the technical execution of the shot-put skill among the students.

This finding is supported by the study of Amara and Easa (2024), which stated: "The use of assistive tools, including resistance bands, to guide the movement of the arms played an effective role by providing external resistance that targeted the specific muscle groups involved in the shot-put movement" (p. 430).

It is also consistent with the study of Schiffer (2010), which found that "jumping exercises using low-height wooden boxes positively impacted the whole motor sequence of the leg glide during the shot put" (p. 88).

This is further supported by the findings of Issa et al. (2024), who stated that "the role of arm movements lies in the coordination and integration of movements during the glide and transition phases, as well as in the final pushing position" (p. 360).

Similarly, the study by Hay and Miller (2009) emphasized that "this physical component must be reinforced, as it represents a critical and essential aspect of the integrated motor performance in shot put athletes" (p. 68).

This highlights the fact that the glide and final push phases are among the fundamental movements performed by shot put athletes throughout the stages of training. This is confirmed by the findings of Kata'a and Yahya (2022), who emphasized "the importance of coordinating and integrating motor performance across movement phases" (p. 120).

Similarly, Sage (2006) pointed out that "the development of performance depends on leg muscle strength and the athlete's ability to execute an appropriate movement path" (p. 114).

Additionally, structured learning—through performing the skill in accordance with simple instructional steps followed by a gradual increase in speed and strength of the shot put movement—was also supported by Singer (2008), who stated that "the primary goal of instructional exercises is to acquire, master, and progressively develop new skills, as learning is the process through which motor skills and knowledge are gained as a result of experience or practice" (p. 187).

5. Conclusions

The researchers concluded that instructional exercises using assistive tools contributed effectively to improving the technical performance of the shot-put event.

The use of assistive tools had a positive impact on the technical execution of the shot put among female students.

6. Recommendations

- Employ assistive tools in teaching the shot-put event to female students.
- Generalize the use of instructional assistive tools in track and field lessons.
- Develop similar instructional programs for other throwing events.

Author's declaration

The authors formally declare that the content of this paper is the original work of themselves.

Conflicts of interest

None.

We confirm that all tables and figures in this article are ours and written by the researchers themselves.

Author's contributions

All contributions of this study were done by the researchers.

Aseel Jalil Kata'a: Preparation of research stages and field procedures. Diana Ghanem Yahya: Preparation of tests. Hadi Ahmed Khudhur: Discussion of results and conclusions. Hind Walid Kalaf: Research formatting and typing. Asst. Prof. Dr. Dhiffaf Al-Shwillay in revision. Asst. Lect. Noor Riyadh Rahim in translating.

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Data availability

The data that support the findings of this study are available on request from the corresponding author.

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7. Appendix 1: Technical Performance Evaluation Form – Shot Put Event (Female Students)

Technical Stages	Preparation – 10 marks		Curling Phase -10 marks		Glide Phase – 10 marks		Release Phase– 10 marks		Recovery Phase – 10 marks	
Test	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
1										
2										
3										
4										
5										
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19										
20										

Sample of the instructional unit used week one

Selected Sample of an Instructional Unit for the Shot Put Event
Learning Objective: Holding and carrying the shot put
Number of Students: 10 female students

Main Section	Total time (minute)	Activity	Used Weight	Number of Repetitions per Student in the Turn	Number of Repetitions per Student in the Group
Instructional Part	10 min	Explanation and Demonstration of the Shot Put Activity by the Teacher			
Practical Part	20 min	Alternating the transfer of the shot between the hands to make circular motions around the body, along with weight-awareness exercises using small balls and then sandbags of different weights.	1 kg	5	10
		Standing position, holding the shot with fingers in front of the chest – palms facing down – letting the shot fall then catching it before it touches the ground.	1 kg	5	10
		Throwing motion practice using resistance bands.	2 kg	5	10
		Performing the skill inside the legal shot-put circle.	2 kg	5	10
		•Linking all stages using equipment before the performance, and then performing the full shot-put movement without equipment (glide, stance, throwing position, and Exchange) inside the legal throwing circle.	2 kg	5	10