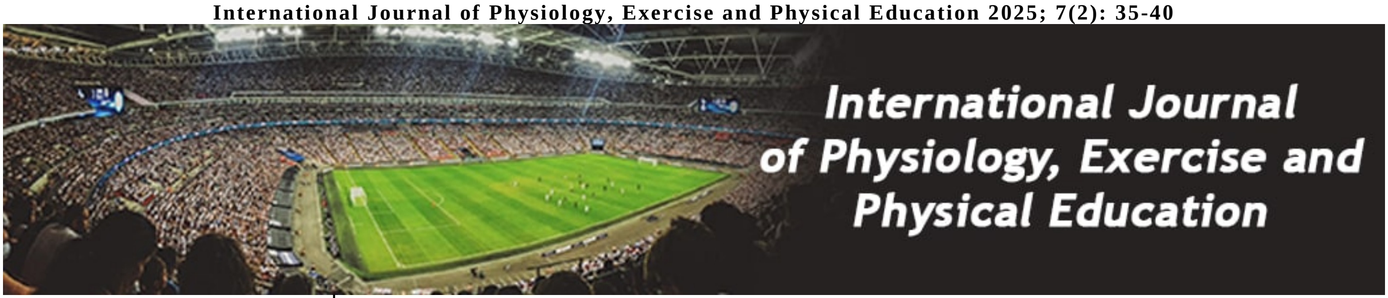

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The effect of structured and random training methods on the development of explosive power, speed-strength ability, and the performance of shot-put for students

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Abstract
The College of Physical Education and Sports Sciences, through its training and instructional curricula, seeks to prepare skilled sports teams and squads in various sports and athletic events, including track and field, which encompasses a range of disciplines, one of which is shot put. Through her experience as an instructor and observer of this event, the researcher noticed a weakness in selecting appropriate training methods for developing both explosive power and speed-strength ability, which in turn negatively affects students' shot-put performance. Since choosing the correct and optimal training method is crucial to achieving the required and high-level results suitable for the students' age group — and failure to do so may prevent them from attaining their potential performance goals — the researcher aimed to investigate the effect of structured and random training methods on the development of explosive power, speed-strength ability, and the performance of shot-put for students.
The objectives of the study were to:

- Identify the effect of both structured and random training methods on the development of explosive power, speed-strength ability, and shot-put performance for students.
- Determine which of the two methods is superior in enhancing these physical capabilities and improving shot-put performance.

The researcher reached the following conclusions:

1. The group that followed the structured training method achieved clear superiority in the post-tests for explosive power, speed-strength ability, and shot-put performance.
2. The group that followed the random training method also showed notable improvement in the post-tests for the same variables.

The structured training method group significantly outperformed the random training method group in the post-tests for explosive power, speed-strength ability, and shot-put performance.

Keywords: Structured and random training methods, explosive power, speed-strength ability, shot-put performance

1. Introduction

The field of sports has witnessed remarkable advancements across all games, whether individual or team sports. This progress did not occur by chance, but rather through the dedicated efforts of specialists in the field, and their continuous search for modern methods and techniques, employing them in a scientifically sound manner to reach the highest levels of technical and skill performance, and achieve competitive results.

Among the sports disciplines that have benefited from this development is track and field, particularly the shot-put event, which requires athletes to possess a high level of individual performance in order to achieve outstanding results. This is especially crucial when athletes have well-developed explosive power and speed-strength ability. In order to improve these qualities, it is necessary to examine the students' capacities in alignment with the event's performance requirements. Moreover, adopting new training methods for learning and developing explosive power and speed-strength ability — and enhancing shot-put performance for students — through varying training positions and forms, allows students to gain the ability to choose the appropriate motor program to solve the motor task most effectively.

The shot-put is one of the distinguished events in track and field, requiring practitioners to possess specific physical capabilities. Similar to other throwing events, the remarkable advances in performance levels achieved by developed countries suggest that it is difficult for athletes and coaches to attain such high levels by relying solely on traditional training methods. Rather, it requires adherence to a multitude of facts and concepts, including: increasing training loads relative to competition, training according to the nature of competitive performance styles, and the widespread use of modern training tools and equipment. This diversity of variables has added significant demands to training processes, making it imperative to integrate these aspects into well-prepared training programs.

The structured training method is considered one of the important approaches in motor learning. It involves repeating the skill in a sequential manner, with varying forms that correspond to the motor skill. On the other hand, the random training method involves alternating between practicing one skill followed by another, then returning to the first, and so on, until the training session ends.

Strength plays a vital role in enhancing overall athletic performance, especially in track and field events like shot put, which heavily relies on strength attributes, particularly explosive power and speed-strength ability, given their crucial influence in developing the muscles of the legs and arms — the primary contributors to performance in this event. The importance of this research lies in utilizing both structured and random training methods to develop explosive power, speed-strength ability, and shot-put performance for students, thereby contributing to achieving notable results.

1.1 Research Problem

The College of Physical Education and Sports Sciences, through its training and instructional programs, aims to prepare experienced sports teams and squads in various games and athletic events, including track and field, which consists of a range of disciplines, one of which is shot put.

Through her experience as an instructor and observer of this event, the researcher noticed a weakness in selecting appropriate training methods to develop both explosive power and speed-strength ability, which consequently negatively impacts students' shot-put performance. Selecting the correct and optimal training method is essential to achieving high-level, age-appropriate results, and failure to do so may prevent students from effectively realizing their performance potential. Therefore, the researcher sought to identify the effect of both structured and random training methods on the development of explosive power, speed-strength ability, and shot-put performance for students.

1.2 Research Objectives

- To identify the effect of structured and random training methods on the development of explosive power, speed-strength ability, and shot-put performance for students.
- To determine which of the two methods is superior in enhancing these physical qualities and improving shot-put performance for students.

1.3 Research Hypotheses

- Both structured and random training methods will have a positive effect on the development of explosive power, speed-strength ability, and shot-put performance for students.
- The structured training method will have a superior effect on the development of these physical abilities and on shot-put performance for students.

1.4 Research Fields

1.4.1 Human Field

First-year students in the College of Physical Education and Sports Sciences — University of Babylon, academic year 2024–2025.

1.4.2 Temporal Field

From November 2, 2024 to March 3, 2025.

1.4.3 Spatial Field

The outdoor field at the College of Physical Education and Sports Sciences — University of Babylon.

2. Research Methodology and Field Procedures

2.1 Research Method

The researcher employed the experimental method using a design of two equivalent experimental groups with pre- and post-tests.

2.2 Research Population and Sample

The research population consisted of first-year students in the College of Physical Education and Sports Sciences – University of Babylon, for the academic year 2024–2025, totaling 62 students.

A sample of 30 students was randomly selected from this population using a simple random sampling method. The researcher then divided them into two equal experimental groups:

- 15 students in the first experimental group.
- 15 students in the second experimental group.

3.3 Tools and Equipment Used in the Research

3.3.1 Data Collection Tools

- Questionnaire
- Personal interviews
- Tests and measurements
- Observation

3.3.2 Equipment Used in the Research

- Medicine balls weighing 2, 3, and 4 kg (American-made)
- Two electronic stopwatches (China-made)
- 75-meter canvas measuring tape
- Chalk
- Plastic whistle
- Sensitive electronic scale (German-made)
- Wooden platforms with varying heights from 20 cm to 80 cm
- 12 wooden hurdles with incremental heights (30 cm to 80 cm)
- Two iron poles, each with a height of 2–3 meters
- Sony digital video camera (Japanese-made) with a speed of 64 frames per second
- Reflective anatomical markers for identifying anatomical points

2.4 Field Procedures of the Research

2.4.1 Selection of Explosive Power and Speed-Strength Ability Tests for Students

To fulfill the research procedures and achieve its objectives, it was necessary to select standardized and scientifically validated tests for measuring the variables related to the phenomenon under study. Accordingly, the researcher reviewed various scientific sources and references and prepared a survey form for expert opinion, which was presented to a panel of 9 experts and specialists in testing, measurement, and sports training.

After collecting and analyzing the survey forms, and verifying their validity using the Chi-square test (χ^2), tests that achieved a validity rate of 88.89% were approved for use in the research, as shown in Table (1).

Table 1: Number of Agreeing and Disagreeing Experts, Percentage, Calculated and Tabulated Chi-Square (χ^2) Values for the Selected Tests

No.	Test	No. of Agreeing Experts	%	No. of Disagreeing Experts	%	χ^2 Calculated	χ^2 Tabulated	Statistical Significance
1	Throwing a 3 kg medicine ball with both hands from sitting position	6	66.67	3	33.34	1	3.84	Not Significant
2	Throwing a 3 kg medicine ball with one hand from standing position	9	100	0	0	9	3.84	Significant
3	Standing Long Jump	8	88.89	1	11.12	5.46	3.84	Significant
4	Vertical Jump from Standing Position	7	77.78	2	22.23	2.78	3.84	Not Significant
5	Front Leaning Rest (Push-ups) within 15 seconds	8	88.89	1	11.12	5.46	3.84	Significant
6	Front Leaning Rest (Push-ups) within 20 seconds	6	66.67	3	33.34	1	3.84	Not Significant
7	Three Consecutive Standing Jumps Forward	3	33.34	6	66.67	1	3.84	Not Significant
8	Single-Leg Hopping Maximum Distance in 10 Seconds (for both legs)	9	100	0	0	9	3.84	Significant

3-5 Pilot Study
The researcher conducted the pilot study on November 15, 2024, on a sample of 10 students from the first-year students of the College of Physical Education – University of Babylon. After five days, the same procedures were repeated on the same individuals on November 20, 2024. This pilot study was carried out to ensure the following:

1. The safety and proper functioning of the equipment and tools.
2. The appropriateness of the time allocated for the tests.
3. Identification and avoidance of potential errors during test administration.
4. Establishing the scientific bases for the selected tests.

2.6 Scientific Bases of the Tests
2.6.1 Test Validity
Validity is one of the essential indicators that must be present in any measurement tool used to assess specific sports traits or phenomena. Test validity is defined as "the extent to which a test measures what it is intended to measure" (Bahi, 1999) [10].

Accordingly, the researcher adopted content validity, by presenting the tests to a panel of experts and specialists in the fields of testing, measurement, and sports training using a dedicated questionnaire, to determine their agreement on the suitability of these tests for the sample and the targeted variables.

2.6.2 Test Reliability
Test reliability refers to "the degree of accuracy with which a test measures the phenomenon under study" (Farhat, 2001) [6].

To calculate the reliability coefficient, the researcher employed the test–retest method, administering the same tests twice to the same individuals, and then calculating the Pearson correlation coefficients between the results of the first and second tests. After obtaining the correlation values, the researcher determined the significance of the correlations using the t-test formula. The details of these values are shown in Table (2).

2.6.3 Test Objectivity
Objectivity is defined as "the extent to which different judges agree when evaluating the same test" (Ibrahem, 1999) [8]. To determine the objectivity of the tests, the researcher relied on the scores given by multiple judges for the test results. The Pearson correlation coefficient was calculated between the scores of the first and second judges. It was found that all tests demonstrated a high level of objectivity. The results are presented in Table (2).

Table 2: Scientific Bases of the Selected Tests (Reliability and Objectivity)

No.	Test	Reliability Coefficient (r)	Calculated t-value	Objectivity Coefficient (r)	Calculated t-value	Statistical Significance
1	Standing Long Jump	0.93	14.82	0.92	13.65	Significant
2	Throwing a 3 kg Medicine Ball with One Hand from Standing Position	0.86	9.69	0.89	11.44	Significant
3	Front Leaning Rest (Push-ups) within 15 seconds	0.92	13.65	0.89	11.44	Significant
4	Trunk Flexion and Extension from Prone Position within 10 seconds	0.92	13.65	0.91	12.68	Significant
5	Single-Leg Hopping Maximum Distance in 10 Seconds (Right Leg)	0.84	8.96	0.86	9.69	Significant
6	Single-Leg Hopping Maximum Distance in 10 Seconds (Left Leg)	0.86	9.69	0.89	11.44	Significant

2.7 Pre-Tests
The researcher conducted the pre-tests on the research sample for both groups (the first experimental group and the second experimental group) on November 28, 2024, at 9:30 a.m., on the outdoor field of the College of Physical Education – University of Babylon. The tests were administered by the course instructor.

2.7.1 Homogeneity and Equivalence of the Research Sample: The researcher tested the homogeneity of the research sample and the equivalence of the two groups (the first and second experimental groups) in the performance variable (achievement).

The calculated F-values for all variables were found to be lower than the tabulated F-value at the degrees of freedom (14, 14) and the significance level of (0.05), which is 1.90. This indicates the homogeneity of the participants within both groups. The details are shown in Table (3).

Table 3: Homogeneity of the Sample in the Research Variables

Variables	1st Experimental Group			2nd Experimental Group			Calculated F-value	Statistical Significance*
	Mean ($\bar{X}$)	SD	Variance (SD^2)	Mean ($\bar{X}$)	SD	Variance (SD^2)		
Achievement	8.06	0.69	0.47	7.97	0.93	0.86	1.82	Not Significant
Standing Long Jump	1.98	0.10	0.01	2.00	0.12	0.01	1.00	Not Significant
Throwing a 3 kg Medicine Ball with One Hand from Standing Position	8.17	0.61	0.37	8.41	0.78	0.60	1.62	Not Significant
Front Leaning Rest (Push-ups) within 15 seconds	16.46	2.11	4.45	16.10	1.93	3.72	1.19	Not Significant
Single-Leg Hopping Maximum Distance in 10 Seconds (Right Leg)	39.28	3.05	9.31	39.52	3.14	9.86	1.06	Not Significant
Single-Leg Hopping Maximum Distance in 10 Seconds (Left Leg)	37.76	4.14	17.13	37.64	3.76	14.13	1.21	Not Significant

(*) The tabulated F-value at degrees of freedom (14, 14) and significance level (0.05) is (1.90).

To establish the equivalence between the two groups, the researcher employed the independent samples t-test, as shown in Table (4).

Table 4: Equivalence of the Sample in the Research Variables

Variables	1st Experimental Group		2nd Experimental Group		Calculated t-value	Statistical Significance*
	Mean ($\bar{X}$)	SD	Mean ($\bar{X}$)	SD		
Achievement	8.06	0.69	7.97	0.93	0.39	Not Significant
Standing Long Jump	1.98	0.10	2.00	0.12	0.66	Not Significant
Throwing a 3 kg Medicine Ball with One Hand from Standing Position	8.17	0.61	8.41	0.78	1.26	Not Significant
Front Leaning Rest (Push-ups) within 15 seconds	16.46	2.11	16.10	1.93	0.63	Not Significant
Single-Leg Hopping Maximum Distance in 10 Seconds (Right Leg)	39.28	3.05	39.52	3.14	0.28	Not Significant
Single-Leg Hopping Maximum Distance in 10 Seconds (Left Leg)	37.76	4.14	37.64	3.76	0.10	Not Significant

(*) The tabulated t-value at degrees of freedom (28) and significance level (0.05) is (2.01).

When comparing the calculated t-values for the research variables with the tabulated value (2.01) at degrees of freedom (28) and a significance level of (0.05), it is clear that all calculated values were less than the tabulated value. This indicates the equivalence of the two experimental groups in all research variables.

2.8 Implementation of the Organized and Random Methods

- The implementation period lasted for 6 weeks.
- The number of training sessions per week was 2 sessions.
- The total number of training sessions was 12 sessions.
- The duration of each training session was 90 minutes.
- After reviewing numerous related sources and studies, the researcher prepared the training units as well as the data recording forms for test scores.
- The first experimental group implemented the training units using the organized method.
- The second experimental group implemented the training units using the random method.
- The program started on December 1, 2024, and ended on January 16, 2025.

2.8.1 Post-Tests for the Research Sample

The researcher conducted the post-tests on January 18, 2025. These tests were conducted under conditions and circumstances closely similar to those of the pre-tests.

2.9 Statistical Tools

1. Arithmetic Mean
2. Mode
3. Skewness Coefficient
4. Chi-square Test
5. Simple Correlation Coefficient (Pearson)
6. Rank Correlation Coefficient (Spearman)
7. Independent Samples t-Test
8. Paired Samples t-Test
9. Coefficient of Variation
10. t-test Formula

3. Presentation, Analysis, and Discussion of Results

3.1 Presentation and Analysis of Pre- and Post-Test Results for the First Experimental Group (Organized Method)

Table 4: Shows the means, standard deviations, and calculated t-values for the pre- and post-tests of the first experimental group (organized method):

No.	Statistical Measures	Pre-Test	Post-Test	Calculated t-value	Significance Level
Test	Mean (M)	SD	Mean (M)	SD	
1	Achievement	7.97	0.93	10.30	0.27
2	Standing Long Jump	2.00	0.12	2.56	0.13
3	Throwing 3 kg Medicine Ball (One-Handed, Standing)	8.41	0.78	11.69	0.40
4	Front Leaning Rest (Push-ups) in 15 seconds	16.10	1.93	26.90	3.06
5	Hopping Max Distance in 10 seconds (Right Leg)	39.52	3.14	49.68	2.49
6	Hopping Max Distance in 10 seconds (Left Leg)	37.64	3.76	48.88	3.90

From the above table, it is clear that there are noticeable differences between the means and standard deviations of the pre- and post-tests for the first experimental group. The researcher used the paired samples t-test to verify these differences, and all differences were statistically significant at the 0.05 level.

3.2 Presentation and Analysis of Pre- and Post-Test Results for the Second Experimental Group (Random Method)

Table 5: Shows the means, standard deviations, and calculated t-values for the pre- and post-tests of the second experimental group (random method):

No.	**Statistical Measures**	**Pre-Test**	**Post-Test**	**Calculated t-value**	**Significance Level**
Test	Mean (M)	**SD**	**Mean (M)**	**SD**	
1	Achievement	8.06	0.69	8.89	0.72
2	Standing Long Jump	1.98	0.10	2.12	0.10
3	Throwing 3 kg Medicine Ball (One-Handed, Standing)	8.17	0.61	9.05	1.03
4	Front Leaning Rest (Push-ups) in 15 seconds	16.46	2.11	20.20	2.57
5	Hopping Max Distance in 10 seconds (Right Leg)	39.28	3.05	44.64	3.45
6	Hopping Max Distance in 10 seconds (Left Leg)	37.76	4.14	42.16	4.07

The above table demonstrates significant differences between pre- and post-test means and standard deviations for the second experimental group. The paired samples t-test showed all differences were significant at the 0.05 level.

3.3 Presentation and Analysis of Post-Test Results of Selected Motor Abilities Between the Two Experimental Groups (Organized and Random Methods)

Table 6: shows the means, standard deviations, and calculated t-values for the post-tests between the first experimental group (organized method) and the second experimental group (random method):

No.	**Statistical Measures**	**Group 1 (Organized)**	**Group 2 (Random)**	**Calculated t-value**	**Significance Level**
Test	Mean (M)	SD	Mean (M)	SD	
1	Achievement	10.30	0.27	8.89	0.72
2	Standing Long Jump	2.56	0.13	2.12	0.10
3	Throwing 3 kg Medicine Ball (One-Handed, Standing)	11.69	0.40	9.05	1.03
4	Front Leaning Rest (Push-ups) in 15 seconds	26.90	3.06	20.20	2.57
5	Hopping Max Distance in 10 seconds (Right Leg)	49.68	2.49	44.64	3.45
6	Hopping Max Distance in 10 seconds (Left Leg)	48.88	3.90	42.16	4.07

The above table indicates significant differences in the post-tests between the two experimental groups across all variables. The independent samples t-test revealed significance at the 0.05 level, indicating the superiority of the organized method.

4. Discussion

The results and analyses presented above demonstrate statistically significant differences between the pre- and post-tests of explosive power, speed characteristics, and shot-put performance for both experimental groups—the first (organized method) and the second (random method)—favoring the post-tests.

The researcher attributes these differences to the effects of both training methods and the structured training units designed by the researcher, in addition to the students' consistency and regularity in training, which played a clear role in improving the studied variables. Possessing this ability helps students elevate their performance levels, particularly during movements requiring body balance maintenance or position changes during execution (Al-Bdery, 2011) [5].

The researcher also attributes the observed improvements to the effects of both organized and random training methods, the skill exercises embedded in the training units, and the students' perseverance and repeated practice of the shot-put event. Continuity plays an essential role in helping students reach a high level of technical performance, accuracy, integration, and consolidation of high-level motor skill execution (Mahmoud, 1994) [1].

Moreover, the significant differences between the two experimental groups in the post-tests favoring the organized method group can be explained by the nature of the organized training method, which focuses on mastering the skill in detail with all its physical, motor, and psychological requirements. The development of explosive and speed-related abilities contributed to improved shot-put performance, as students possessing a higher level of specific muscular capabilities tend to improve their performance.

Additionally, the organized training method's characteristics enhance students' motivation and enthusiasm since this method suits the age group and stage of motor learning. It allows learners uninterrupted time to focus on performing each task, enabling them to acquire, refine, or correct one skill before moving on to the next. In other words, the organized training is a sequential and structured chain of repetitive training aimed at practicing the same motor task (Ali, 2006) [2].

Furthermore, this method provides an integrated process for motor skill learning by creating a clear and predictable environment around the learner. This reduces confusion and promotes independence, self-confidence, and minimal anxiety during performance. The researcher emphasizes that high anxiety and excitement increase interference in sensory signals from the central nervous system to muscle groups, causing tremors and spasms. Optimal brain signals occur at moderate arousal levels (Khaiyon, 2008) [13].

5. Conclusions
1. The group trained using the organized training method showed a clear superiority in the post-tests of explosive power, speed characteristics, and shot-put performance among the students.
2. The group trained using the random training method also showed clear superiority in the post-tests of explosive power, speed characteristics, and shot-put performance among the students.
3. The group trained with the organized training method clearly outperformed the group trained with the random training method in the post-tests of explosive power, speed characteristics, and shot-put performance.

6. Recommendations
1. Emphasize to educators and trainers the importance of training methods, particularly the organized training method.
2. Give due attention to developing students' specific muscular abilities related to shot-put during learning, training, and competitions.
3. Stress the necessity of employing effective training methods to develop shot-put performance and other sports activities.
4. Conduct similar studies on other sports activities utilizing the same training methods.

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