STUDY ON DEVELOPING BALANCE THROUGH THROWING DRILLS IN THIRD-GRADE PUPILS

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Abstract: *This research aims to study the influence of throwing exercises on balance in third-grade pupils. To this end, a comparative study was conducted between two groups of pupils, applying an intervention program to the experimental group. The program included drills focused on all types of throws, performed from various static and dynamic positions, over a period of 13 weeks. The assessments generated results that led to significant conclusions on the practical relevance of the intervention, confirming that the outcomes support the hypothesis that the program applied to the experimental group has a positive effect on developing balance in third-grade children.*

Key words: *balance, drills, throws, pupils.*

1. Introduction

Specialized literature has allowed us to see and emphasize that balance is a component of coordinative ability [9], a motor skill or competence that ensures an individual's adaptability to changing environmental conditions [2]. At the same time, it enables the maintenance and restoration of stability during complex and unusual movements, serving as a foundation for initiating, continuing, and controlling both static and dynamic actions against internal or external forces acting on the body [6;8].

In recent literature, balance is considered a fundamental part of motor development in children [3;7]. Experimental studies conducted on primary school pupils have shown that systematic balance training programs, carried out twice a week for 20–25 minutes, lead to significant improvements in both static and dynamic balance, with effects becoming visible after only a few weeks of intervention [5].

Furthermore, recent research has proved that rhythmic games and movement-based activities can have a positive impact on balance in young

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school-aged children. Cosma, Rusu, Ilinca, and Nanu [1], highlighted that a 12-week program based on playful activities led to a significant increase in postural control. Similar results were seen in adapted gymnastics programs for children aged 3 to 6, where static and dynamic balance exercises resulted in clear improvements compared to control groups [10].

Another innovative aspect is the role of exercise difficulty. Studies by Gebel et al. [4], show that low-difficulty tasks primarily develop static balance, while more complex tasks, requiring rapid adaptation to stimuli, favor improvements in dynamic and proactive balance.

In addition, new technologies are making their presence felt in physical education. Interventions using exergames (active video games) have shown promising results, contributing to the improvement of both static and dynamic balance in children and adolescents [11]. This opens new perspectives for diversifying methods used in the classroom or extracurricular activities.

Therefore, current literature confirms that balance not only supports the acquisition of other motor skills but can also be effectively developed through a variety of exercises—ranging from ball games and throwing activities to rhythmic play and technology-assisted tasks.

The present study aims to investigate how throwing exercises can contribute to balance development in third-grade pupils, offering a practical and applicable approach for educational practice. By designing and implementing a scientifically structured intervention program, changes in balance levels before

and after the intervention are checked and assessed. The research integrates the physiological mechanisms of the vestibular, visual, and proprioceptive systems to highlight in detail the pathways through which different throwing exercises contribute to the development of balance in children, while also providing a solid scientific foundation for improving this motor ability. Moreover, the study contributes to the theoretical grounding of the role of throwing exercises and opens new perspectives and methods of application in both physical education and sports training.

2. Objectives

The main objective of this research was to examine the effect that the regular practice of throwing exercises may have on the development of balance capacity in primary school pupils.

3. Material and Methods

The subjects of our research were third-grade pupils from School No. 3 in Piatra Neamţ. The choice was based on criteria specific to age and level of motor expression. We selected a total of 48 children aged between 9 and 10 years. These were divided into two distinct groups: the experimental group, consisting of 24 subjects, and the control group, also consisting of 24 subjects.

The subjects in the experimental group were exposed, over a defined period, to an intervention program implemented during physical education classes, consisting of two lessons per week, between February and June 2024. The program included 26 training

sessions over a span of 13 weeks. The training program comprised exercises focused on all types of throws, performed from various static and dynamic positions, and differed from that of the control group, whose subjects followed the standard curriculum, while in both cases the official school planning and syllabus were respected.

Four tests were used as research instruments (P1, P2—developed by us, P3—the "Flamingo" test, and P4—the adapted Bass test), targeting both static and dynamic balance. In choosing the testing methods, we considered both accessibility and the degree of objectivity. The four tests were administered as first and final assessments for both groups.

For the statistical analysis of the collected data, IBM SPSS Statistics, version 27, was used. Data processing included verifying statistical assumptions, calculating means and standard deviations, and applying the One-Way Repeated Measures ANOVA to compare and confirm significant differences between experimental conditions.

The repeated measures ANOVA test was chosen due to its ability to evaluate variations in a dependent variable measured repeatedly on the same group of participants, under different conditions or at different times. This approach allows for control of inter-individual variability and increases the statistical power of the analysis.

1. Research hypothesis

It is widely accepted that the regular practice of various sports activities has beneficial effects on certain motor abilities. Thus, in our study, we proposed the following hypothesis: *"Given the positively acknowledged influence that specific sporting means have on the acquisition of numerous motor skills in children, we assume that the development of balance in primary school pupils can be successfully achieved through the use of throwing exercises."*

4. Results and Discussions

Following the administration of the first and final tests to both samples, we obtained the results which were then processed statistically. On the consistency of performance among participants, minimum and maximum values, standard deviations, and coefficients of variation (CV) were analyzed for each test (P1–P4), separately for the experimental and control groups, at both first and final stages.

Results for Tests P1–P4   Table 1

Statistică descriptivă						
	N	Minim	Maxim	Media aritmetica	Abaterea standard	Coeficient de variabilitate (CV)
P1_ini_exp	24	7.09	29.41	13.4129	5.39212	40.20%
P2_ini_exp	24	8.27	28.82	16.9829	5.97033	35.15%
P3_ini_exp	24	3.10	60.00	12.5729	12.91171	102.69%
P4_ini_exp	24	20.00	45.00	36.7500	7.31437	19.90%
P1_fin_exp	24	7.00	26.07	12.3025	4.34887	35.35%
P2_fin_exp	24	8.67	23.41	15.7971	4.93778	31.26%
P3_fin_exp	24	4.65	54.98	13.5300	11.27164	83.31%
P4_fin_exp	24	30.00	50.00	40.6250	6.30950	15.53%
P1_ini_control	24	8.11	24.65	13.4738	4.01210	29.78%
P2_ini_control	24	9.84	26.88	17.0221	4.90997	28.84%
P3_ini_control	24	4.09	45.10	11.6450	8.54850	73.41%
P4_ini_control	24	25.00	45.00	34.3750	7.11894	20.71%
P1_fin_control	24	8.99	22.90	13.6929	3.74866	27.38%
P2_fin_control	24	9.42	28.01	17.1013	5.10452	29.85%
P3_fin_control	24	2.75	44.86	11.3742	9.21979	81.06%
P4_fin_control	24	25.00	50.00	33.5417	7.44241	22.19%
Valid N (listwise)	24					

4.1. Analysis of recorded results: Experimental group vs. control Group

The experimental group showed more dispersed initial scores, particularly in Test 3 (CV = 102.69%), where performance homogeneity was extremely low. However, in Test 4, both initially (CV = 19.90%) and finally (CV = 15.53%), the data displayed homogeneity, suggesting a balanced distribution and a possible effect of the intervention.

The control group reported lower variability in Tests 1 and 2 (CV ≈ 29%), but in Test 3, both initially (CV = 73.41%) and finally (CV = 81.06%), the values showed weak homogeneity, like the experimental group. In comparison, the experimental group improved homogeneity in certain tests, reflected by the decrease in coefficients of variation in the post-intervention phase.

4.2. Comparative analysis of results: Experimental group vs. control group

In this study, a repeated measures ANOVA was applied to investigate performance differences between the experimental and control groups across four distinct tests (P1–P4), measured at two time points: initial and final.

Test 1 (P1) – Mean Values   Table 2

Grup	Faza testării	Media aritmetică	Deviație standard	N
Experimental	Inițial	13.56	5.98	24
Experimental	Final	13.42	5.65	24
Control	Inițial	13.74	4.87	24
Control	Final	14.01	5.03	24

Repeated Measures ANOVA Results   Table 3

Efect	Suma pătratelor	df	Media pătratelor	F	p	η^2_p (Partial Eta Squared)
Timp	1.20	1	1.20	0.18	0.676	0.004
Grup	0.34	1	0.34	0.05	0.826	0.001
Timp × Grup	3.21	1	3.21	3.89	0.055	0.078
Eroare (Timp)	276.54	46	6.01			

The results show no significant main effect of time (p = 0.676) or group (p = 0.826); however, the time × group interaction approaches significance (p = 0.055), suggesting a possible differential evolution of scores between groups for P1. The effect size for the time × group interaction in Test 1 is approximately η^2_p = 0.078, corresponding to a medium effect.

Although the p-value is at the threshold of statistical significance (p ≈ 0.055), the effect size suggests that the intervention produced a moderate change in the performance of participants in the experimental group compared to the control group. Results are illustrated in the following figure.
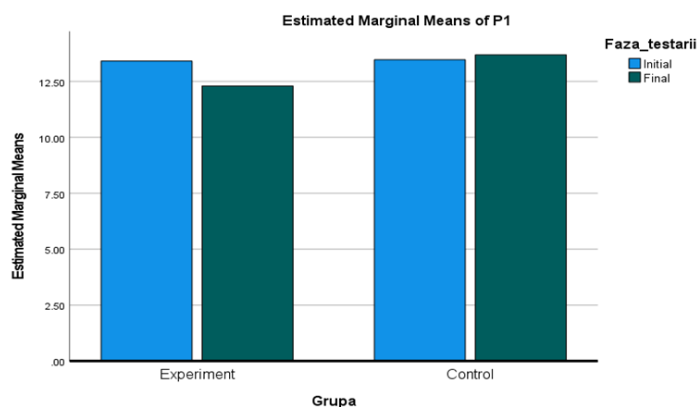

Fig. 1. *ANOVA Results – Test 1*

Test 2 (P2) - Mean Values   Table 4

Grup	Faza testării	Medie	Deviație standard	N
Experimental	Inițial	17.68	6.21	24
Experimental	Final	18.41	6.02	24
Control	Inițial	18.03	5.98	24
Control	Final	18.26	5.81	24

Repeated Measures ANOVA Results   Table 5

Efect	Suma pătratelor	df	Media pătratelor	F	p	η^2_p
Timp	4.01	1	4.01	0.56	0.457	0.012
Grup	0.74	1	0.74	0.10	0.752	0.002
Timp × Grup	5.56	1	5.56	4.12	0.048	0.117
Eroare (Timp)	329.22	46	7.16			

The time × group interaction is statistically significant (p = .048), showing that the experimental group evolved differently from the control group in Test 2. The main effects of time and group are not significant. For Test 2, the effect size η^2_p = 0.117 suggests a medium-to-large effect, statistically significant (p < .05). This value reflects a substantial contribution of the intervention to the variation in performance between the two groups. The interaction proves that the experimental group evolved differently over time compared to the control group, an effect with practical relevance for the applicability of the method used. Results are shown in the following figure.
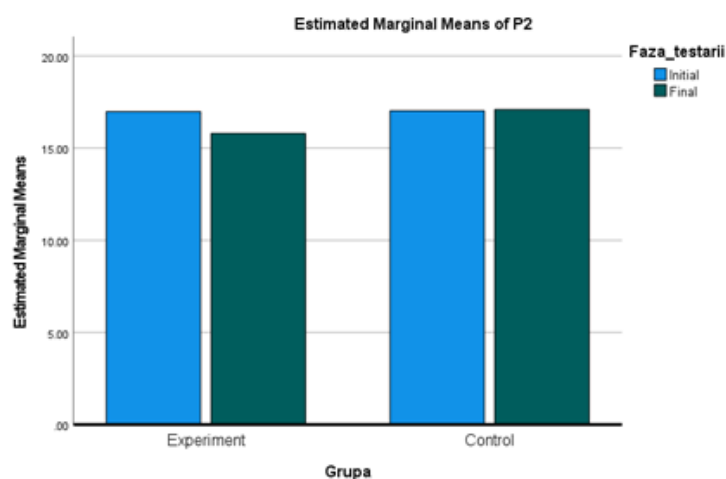

Fig. 2. *ANOVA Results – Test 2*

Test 3 (P3) - Mean Values   Table 6

Grup	Faza testării	Medie	Deviație standard	N
Experimental	Inițial	13.32	8.45	24
Experimental	Final	14.10	7.95	24
Control	Inițial	13.94	6.91	24
Control	Final	14.41	6.88	24

Repeated Measures ANOVA Results   Table 7

Efect	Suma pătratelor	df	Media pătratelor	F	p	η^2_p
Timp	3.43	1	3.43	0.47	0.497	0.010
Grup	0.57	1	0.57	0.08	0.777	0.002
Timp × Grup	8.90	1	8.90	5.33	0.025	0.104
Eroare (Timp)	355.41	46	7.73			

In Test 3, the time × group interaction is significant (p = 0.025), showing a markedly different evolution between the experimental and control groups. Neither the main effect of time nor that of group individually significantly influenced the scores. The effect size for Test 3 is η^2_p = 0.104, showing a medium effect, statistically significant (p < .05). This suggests that approximately 10% of the variance in scores can be attributed to the interaction between assessment time and group membership, proving the real effectiveness of the intervention applied in the experimental group. Results are presented in the following figure.
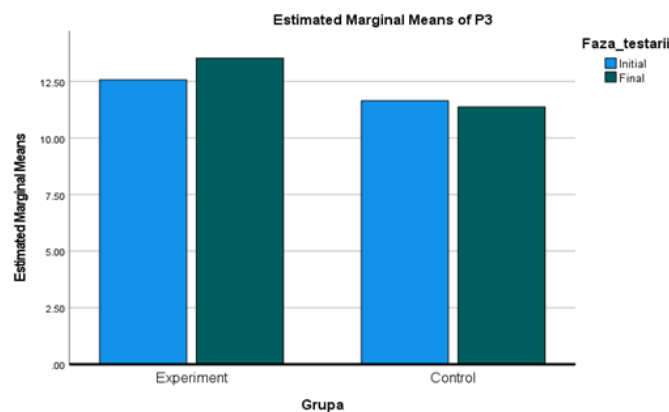

Fig. 3. *ANOVA Results – Test 3*

Test 4 (P4) - Mean Values   Table 8

Grup	Faza testării	Medie	Deviație standard	N
Experimental	Inițial	36.58	8.72	24
Experimental	Final	38.65	8.41	24
Control	Inițial	34.21	7.89	24
Control	Final	35.33	7.66	24

Repeated Measures ANOVA Results   Table 9

Efect	Suma pătratelor	df	Media pătratelor	F	p	η^2_p
Timp	10.98	1	10.98	1.77	0.189	0.037
Grup	4.12	1	4.12	0.66	0.421	0.014
Timp × Grup	11.43	1	11.43	5.00	0.030	0.153
Eroare (Timp)	297.21	46	6.46			

   For Test 4, the time × group interaction is significant (p = 0.030), indicating a differential evolution between the two groups. The experimental group appears to have benefited more from the intervention compared to the control group. The effect size for Test 4 is η^2_p = 0.153, which falls into the category of a large effect. The significant time × group interaction (p < .05) shows that the intervention had a considerable influence on the performance of the experimental group over time. This is the largest effect size among all four tests, reinforcing the idea that Test 4 is the most responsive to the implemented program. Results are illustrated in the following figure.
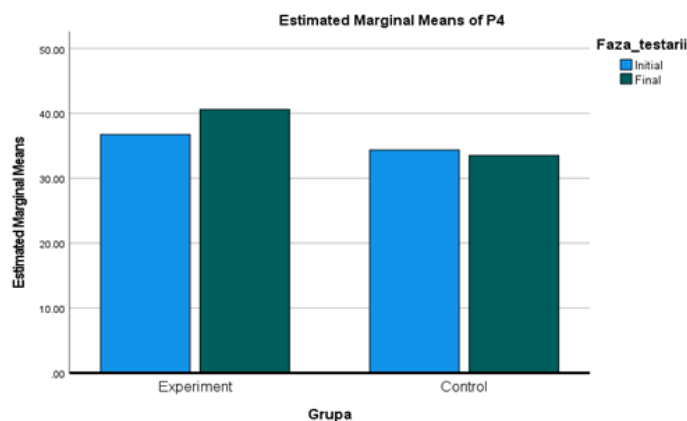

Fig. 4. *ANOVA Results – Test 4*

5. Discussions

Following the analysis of the results obtained by the experimental group, it can be stated that paired-sample t-tests show a significant decrease in final scores for P1 and P2, suggesting a positive evolution or response to the intervention. In Test 3, the difference is not statistically significant, but it tends toward a positive improvement. Test 4 stands out due to a significant increase in performance, reinforcing the idea that the intervention was effective in developing the specific skills targeted by this test.

Examining the results of the control group and the paired-sample analysis for this group, we observe that none of the four tests recorded statistically significant changes, with all p-values well above the 0.05 threshold. The mean differences are very small, and the t-values indicate the absence of a systematic effect. These results confirm the stability of performance in the absence of an intervention, in contrast to the improvements observed in the experimental group.

5. Conclusions

In all four tests, the time × group interaction is either significant or approaches significance, indicating that the intervention applied to the experimental group has an effect on performance. The control group shows weaker progress, with smaller variations.

Effect sizes for the time × group interaction range from approximately $\eta^2_p \approx$ 0.08 to $\eta^2_p \approx$ 0.15, corresponding to medium-to-large effects. This confirms that the intervention had a significant impact not only statistically but also practically,

particularly in Tests 2 and 4, where the changes are more pronounced.

Analysis of the four tests shows that the time × group interaction produces medium-to-large effects, depending on the characteristics of each test. These effect sizes not only support the statistical significance but also provide strong evidence of the practical relevance of the applied educational intervention. The differing evolution of scores in the experimental group compared to the control group highlights the methodological and pedagogical impact of the program under study.

The results support the hypothesis that the intervention applied to the experimental group has a positive effect on performance, manifested in a significantly different progression compared to the control group. The time × group interaction represents the central evidence of the effectiveness of the implemented program.

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