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Qualitative changes in the basic motor and specific throwing abilities under the influence of explosive strength training for students of the university of sports

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Original scientific paper

Abstract
Research was conducted on a sample of (n: 120) students of the I year from the University of Sports and Physical Education. The program of explosive strength lasting three months with a frequency of two trainings per week was applied to the experimental group (subsample of 60 examinees). In addition to the three-month long program, the experimental group had hours of physical education classes of Judo, Anthropomotorics, and Athletics as school subjects, with frequency of two hours per week. Second subsample (n: 60) of examinees belonging to the control group only had the class of physical education according to the Faculty curriculum. The three-month long program of explosive strength led to radical, structural changes regarding the space in specific throwing abilities in the experimental group, while in the control group those changes are of very low intensity. The differences in effects of the experimental program and the class of physical education regarding scoring efficiency in shot put were comparatively determined. A higher level of scoring efficiency in shot put - back technique was determined in the experimental group.

Keywords: **explosive strength, specific throwing abilities, shot put, experimental program, regular class**

Introduction

Reliable and relevant information regarding the subject's state are only possible by applying scientific methods in research. The intention of this work is the analysis of qualitative effects of a modeled explosive strength-based program, as well of the class of physical education in scope of basic motor and specific throwing abilities in care of students of the University of Sports and Physical Education.

Atletic throws belong to group of ballistic motion in which the space catapulting the athletic throwing devices in order to achievethe greatest possible range *(Milanović, Harasin 2003)*.

In the shot put training, accentuation (strength is trained the most in the moves which are dominant in the competing structure), has a significant place in the phase of planning and programming the training it self (*Zaciorski and Kremer 2009)*. In the training cycle, proper distribution and the ratio of general and specific operator, through time periods of one year - training cycle has big significance regarding scoring efficiency.
Research done testify the efficiency specific movements in the training process have on scoring efficiency (*Kyriazis, Terzis, Boudolos, Konstantinos, Georgiadis, 2009*) who studied the performances in shot put – rotational technique, during the preseason and the competing period. The results indicate that the result in shot put – rotational technique, during the competing period, is more dependent on the initial speed and explosive power of lower extremities, than on the absolute muscle strength (1RM from deep squat). Moreover, researchers (*Terzis, G., Spengos, K., Karampatsos, G., Manta, P., Georgiadis, G. (2009).),* on a sample of eight men and eight women, studied the acute effect of deep jumps on throwing performances regarding the shot. The results were measured after the examinees completed five consecutive deep jumps from a 40-cm high bench. Higher results in shot put were achieved from men after completing deep jumps done just before throwing ($8.94\pm$ 1m vs. 9.60 ± 0.9m, $p<$), unlike from the women examinees ($7.56\pm$ 1m vs. 7.67 ± 0.9m, $p<$).
For a quality eccentric-concentric contraction, three significant conditions must be fulfilled (*according to Komi and Gollhofer, 1997*):

- Timeliness of muscle activation just before the eccentric contractions,
- A short-lasting eccentric contraction,
- Actual changes between phases of stretching and shortening,

Plyometric exercises such as jumps, deep jumps, plyometry of upper extremities with medicine balls, and sprinter exercises were mostly represented in the program of explosive strength.

Research of what effect methods of training have on the development of explosive strength in the examinees of the experimental group was achieved in addition to six hours per week in regular classes based on the curriculum for I year undergraduates (Judo, Anthropomotorics, and Athletics – 2 hours of exercises per week), with two additional hours of experimental training, within 26 training hours for the students of the University of Sports and Physical Education in Sarajevo, in duration of 13 weeks.

The examinees of the control group had only their regular classes with six hours per week, which was achieved based on the determined University curriculum of practical exercises (Athletics, Judo, and Anthropomotorics). Initial (before the treatment started) and final measurement (after treatment) of specific motor abilities and results in shot put – back technique were carried out for both groups, in the same time period.

Methods

Sample examinee

Research was conducted on a sample of 120 regular students who attend first year of the University of Sports and Physical Education in Sarajevo, male gender, of age between 20 and 25 years, in second semester of school year 2007/2008. From such a defined population, *two* following *subsamples* are formed:

1. Subsample of 60 examinees who in addition to their motor exercises in classes of practical exercise, within regular classes have an organized training program with two additional hours per week for the development of explosive strength (*experimental group),*
2. Subsample of 60 examinees who are involved only in motor exercises achieved during hours in practical exercises within regular class based on a determined university curriculum (control group).

All examinees passed the shot put – back technique before the start of the experiment. A total of twenty three (23) variables were applied. To assess the state of entities in the area of basic motor-skills a total of fifteen (15) variables were applied, in the area of specific throwing abilities a total of seven (7) and a criterion variable of scoring efficiency in the shot put – back technique.

Sample of measuring instruments

1. Tests of basic motor abilities,
2. Tests of specific motor abilities,
3. Scoring efficiency in the athletic discipline of shot put – back technique.

Measuring instruments for the assessment of basic motor abilities

(1) Segmentary speed:	
1. Foot taping	MTAN
2. Hand taping	MTAR
3. Feet taping the wall	MTAZ
(2) Repetitive strength:	
4. Raising body on the Swedish bench	MDTK
5. Chins	MZGN
6. Squats with a 30% load	MCUO
(3) Explosive strength:	
7. Long jump	MSDM
8. Triple jump	MTRS
9. Five long jump	MTPS
(4) Flexibility:	
10. Deep bend on the bench	MDPK
11. String	MSPA
12. Flex with a rod	MISP
(5) Agility:	
13. Envelope test	MKOT
14. Side steps	MKUS
15. Eight with flexion	MOSS

Applied set of motor variable was taken from *Kurelić, Momirović, Stojanović, Šturm and Viskić-Štalec, 1975.* research

Measuring instruments for the assessment of specific motor abilities

Chest shot put – half squat	SMPP
Overhead backwards shot put – half squat	SMKUN
Forward shot put – half squat	SMKUI
Medicine ball throw from sitting position	SMMES
Clap pushups in 10 seconds	SMSKL
Long jump from half squat	SMDOS
Long jump after the first jump	SMDOSS

Measuring instruments for estimating results in shot put – back technique

1. Shot put – back technique	REZK

By using factorial analysis under the model of congruence, structural changes of basic motor and specific throwing abilities at students were determined. Differences that have arisen through two points in time in criterion variable of scoring efficiency in shot put – back technique, were tested by T tests for independent samples.

Results and discussion

Quality changes in the initial and final measurement of the control group members

Quality changes in the scope of basic motor ability of the control group in the initial and final measurement

In the initial measurement of the control group, a system of fifteen (15) manifested basic motor measures contains about 67% common variance (Table 3). Thus, five latent dimensions were extracted which defined the given space.

The first factor carries the most information because it extracted around 22% common variance of the analyzed measures. It is determined by high projections by measurements of the triple jump (.91 MTRS), long jump (.89 MSDM), and five jump (.88 MTPS).

Considering the presence of explosive strength variables enabled the definition of independent factors, which is how we interpreted it, as a ***factor of explosive strength of lower extremities*** (initial measurement).

In the final measurement (Table 4) of the control group, a system of fifteen (15) manifested basic motor measurements contains around 73% common variance. Thus, six latent dimensions were extracted which defined the given space.

The first factor carries the most information because it extracted around 25% common variance of the analyzed measures. It is determined by high projections by measurements of the long jump (.93 MTRS), and the five long jump (.91 MTPS). An Eigenval value of 3.86 is an indicator of a middle factorial saturation caused by extracted measurements.

As in the initial measurement, the explosive strength variables defined this factor, thus we can name it ***the factor of explosive strength of lower extremities*** (final measurement), and it is under the auspices of energetic regulation (the mechanism of excitation intensity).

The second factor of the initial measurement is defined by flexibility variables and by one variable of segmented movement speed of Deep bend on the bench (.75 MDPK), foot taping (.68 MTAPN), flex with a rod (.67 MISP), and string (.65 MSPA). This factor drained around 17% of common variance of the system with Eigen value. (2.56), which is greater than zero and keeps the rights of its extraction.

This second extracted factor is interpreted as a latent dimension responsible for the ***flexibility and segmentary speed of lower extremities*** (initial measurement)…

The second factor of the final measurement is defined by agility variables and by one flexibility variable Deep bend on the bench (.76 MDPK), envelope test (.70 MKOT), Eight with flexion (.69 MOS), and side steps (.60 MKUS). This factor drained around 13% of common variance of the system with the Eigen vector value of (1.98).

This second extracted factor is interpreted as a latent dimension responsible for the ***agility and flexibility of lower extremities*** (final measurement).

The third latent dimension of the initial measurement is defined by motor variables: side steps (MKUS =.74) and feet taping the wall (MTAZ .66). Statistically significant projections of the variables explain around 11% of common variance of the system whereby the own value greater than zero (Eigen. =1.66) is maintained. Communalities of the extracted variables are of middle projections about .67 for side steps and .47 for the feet taping the wall variable. The third latent dimension can be defined as a ***factor of agility and segmentary speed of lower extremities.***

The third latent dimension of the final measurement is defined by a motor variable: string (MSPA=.86). Statistically significant projections of the variables explain about 10% of common variances of the system, whereby the own value greater than zero (Eigen. =1.56) is maintained. The communality of the extracted variable is of middle projections around .51. The third latent dimension can be defined as a ***factor of flexibility of lower extremities.***

The initial measurement extracted 67% variability with five main components, while the final measurement extracted 73% variability with six main components (Tables 2 and 3). There was a slight change in the structure of the control group when it comes to motorics, because the contents of a standard class program affected so one coefficient of an explained variability factor increased. In the first factor, there are stronger saturations of the long jump (.94 MSDM), triple jump (.93 MTRS), and five long jump (.91 MTPS). The first and second factor on the final measurement gain on intensity of the projections. There is not a meaningful answer for the changes regarding the third factor.

There were slight structural changes of basic motor abilities in the control group between two time periods, as a consequence of a standard program of the I year of the University of Sports in the second semester of the academic 2007/8 year.

Table 1. and 2. *The communalities of basic motor abilities of the initial and final measurement of the control group*

INITIAL			FINAL		
	Initial	Extraction		Initial	Extraction
mtan	1.00	.73	mtan	1.00	.58
mtar	1.00	.68	mtar	1.00	.49
mtaz	1.00	.47	mtaz	1.00	.81
mdtk	1.00	.76	mdtk	1.00	.80
mzgn	1.00	.42	mzgn	1.00	.53
mcuo	1.00	.77	mcuo	1.00	.72
msdm	1.00	.81	msdm	1.00	.88
mtrs	1.00	.85	mtrs	1.00	.87
mtps	1.00	.79	mtps	1.00	.83
mdpk	1.00	.64	mdpk	1.00	.71
mspa	1.00	.51	mspa	1.00	.84
misp	1.00	.51	misp	1.00	.75
mkot	1.00	.72	mkot	1.00	.67
mkus	1.00	.67	mkus	1.00	.81
moss	1.00	.70	moss	1.00	.71

Table 3. and 4. *A matrix of isolated characterized roots and explained parts of common variance in basic motor abilities of the control group's initial and final measurement*

INITIAL				FINAL			
	Initial Eigenvalues				Initial Eigenvalues		
	Total	% of Variance	Cumulative %		Total	% of Variance	Cumulative %
1	3.44	22.92	22.92	1	3.86	25.76	25.76
2	2.56	17.08	39.10	2	1.99	13.26	39.02
3	1.67	11.11	51.10	3	1.56	10.41	49.44
4	1.32	8.77	59.87	4	1.36	9.06	58.50
5	1.07	7.16	67.03	5	1.20	7.97	66.47
				6	1.03	6.87	73.34

Table 5. and 6. *Structure matrices of basic motor abilities of the control group's initial and final measurement*

	INITIAL						FINAL					
	Component						Component					
	1	2	3	4	5		1	2	3	4	5	6
mtrs	.91	-.09	-.04	-.06	-.13	msdm	.94	.18	-.08	.12	.10	-.00
msdm	.89	.08	-.04	.06	-.21	mtrs	.93	.11	-.08	.10	.15	-.03
mtps	.88	-.06	-.17	-.07	-.19	mtps	.91	.21	-.07	.22	.12	.04
mdpk	-.15	.75	-.26	.08	.03	mkus	.56	.53	-.49	-.17	.21	.29
mtan	.05	.68	-.43	.43	-.10	mtan	.14	.76	-.12	.08	-.04	.10
misp	.06	.67	.14	-.01	.09	mdpk	.05	.70	.32	.01	-.20	.21
mspa	-.14	.65	.07	.30	.05	mkot	.32	.69	-.14	.27	.32	-.12
moss	.34	.59	-.29	-.26	-.45	moss	.40	.60	-.59	.17	.01	-.06
mkus	.38	-.00	-.74	-.15	-.32	mspa	.06	.21	.86	.08	-.05	.15
mtaz	-.03	.10	-.66	.03	.04	mdtk	.04	.06	-.04	.88	.12	.08
mtar	.04	.10	.03	.81	-.15	mzgn	.38	.14	.06	.65	-.05	.03
mkot	.48	.24	-.43	-.49	-.43	misp	-.06	.25	-.05	.04	-.80	.25
mzgn	.37	.25	-.26	.44	-.08	mcuo	.17	.29	-.17	.12	.73	.32
mdtk	.18	.09	.18	.17	-.78	mtaz	.01	.29	-.07	.38	-.13	.78
mcuo	.04	-.24	-.47	-.11	-.73	mtar	-.03	-.27	.32	-.18	.08	.54

Quality changes in the space of the control group's specific throwing abilities in the initial and final measurement

In the control group's initial measurement, a system of seven (7) manifested specific throwing measurements contains around 71% common variance (Table 9). By that means the two latent dimensions that defined the given space were extracted. In the final measurement (Table 10) of the control group, the system explained, with a negligible increase, regarding the initial measurement 73% common variance, and the two factors were extracted. Essentially, expect for this minor change, there were not significant differences in the space of specific throwing abilities.

Standardized curriculum in the experimental period of thirteen (13) weeks did not cause structural changes on specific throwing space of measurements for the control group examinees.

Table 7. and 8. *The communalities of control group's specific throwing abilities of the initial and final measurement*

INITIAL			FINAL		
	Initial	Extraction		Initial	Extraction
smpp	1.00	.69	smpp	1.00	.76
smkun	1.00	.77	smkun	1.00	.83
smkui	1.00	.81	smkui	1.00	.87
smmes	1.00	.67	smmes	1.00	.60
smskl	1.00	.28	smskl	1.00	.43
smdos	1.00	.88	smdos	1.00	.86
smdoss	1.00	.89	smdoss	1.00	.76

Table 9. and 10. *A matrix of isolated characterized roots and explained parts of common variance in specific throwing abilities of the control group's initial and final measurement*

INITIAL				FINAL			
	Initial Eigenvalues				Initial Eigenvalues		
	Total	% of Variance	Cumulative %		Total	% of Variance	Cumulative %
1	3.72	53.17	53.17	1	3.98	56.91	56.91
2	1.26	18.04	71.21	2	1.13	16.21	73.12

Table 11. and 12. *Structure matrices of specific throwing abilities of the control group's initial and final measurement*

INITIAL			FINAL		
	Component			Component	
	1	2		1	2
smkui	.90	.46	smkui	.93	.42
smkun	.87	.33	smkun	.91	.38
smpp	.82	.50	smpp	.87	.44
smmes	.81	.32	smmes	.77	.45
smdoss	.44	.94	smdos	.51	.92
smdos	.42	.94	smdoss	.52	.86
smskl	.25	.53	smskl	.23	.65

Quality changed in the experimental group's initial and final measurement

Quality changes in the area of basic motor abilities of the experimental group's initial and final measurement

Based on the communality analysis (Table 13 and 14) in the initial and final measurement of the experimental group's basic motor abilities, it can be observed that all the variable significantly contribute to the explanation of the given variability and represent those variance parts of every variable which can be interpreted (explained) through isolated system of latent dimensions. All variables have high and middle-high projections.

In the initial measurement of the experimental group, a system of fifteen (15) manifested basic motor measurements contains about 68% common variance (Table 15). By that means five latent dimensions which defined the given space were extracted.

The first latent dimension is defined by the participation and extraction of explosive strength variables which with their coefficient sizes and positions on the coordinate system enabled an independent extraction. The main carrier of this extracted factor is the five long jump variable (.91 MTPS), long jump (.86 MSDM), and triple jump (.86 MTRS). Eigenval value of 4.39 is an indicator of a middle factor saturation caused by the extracted measurements.

Considering the presence of explosive strength variables enabled the definition of independent factors, which is how we interpreted it, as a ***factor of explosive strength of lower extremities*** (initial measurement).

In the final measurement of the experimental group, a system of fifteen (15) manifested basic motor measurements contains about 66% common variance. Thus, five latent dimensions which defined the given space were extracted.

The first latent dimension was defined by the participation and extraction of explosive strength variables which with their coefficient sizes and positions in the coordinate system enabled an independent extraction. The main carrier of this extracted factor is the triple jump variable (.87 MTRS), five jump (.85 MTPS), and long jump (.77 MSDM). Eigenval value of 4.39 is an indicator of a middle factor saturation caused by the extracted measurements. This factor drained around 29% of the total motor system.

Considering the presence of explosive strength variables enabled the definition of independent factors, which is how we interpreted it, as a ***factor of explosive strength of lower extremities*** (final measurement).

The first factor in the initial measurement was dominant in terms of motorics; however under the influence of the experimental program, it lost on its intensity. There were structural changes, and that fact mostly explains the structure of the first factor.

In the initial measurement, 68% of the variability was extracted from five main components, while in the final measurements 66% variability was extracted with the same number of five main components (Table 15 and 16). There was a slight change in the structure of the experimental group when it comes to motorics, because the contents of the plyometric program affected in a way which changed the intensity of the bonds. In the first factor, there is a stronger saturation in the measurement of five jump (.91 MTPS), long jump (.86 MSDM), and triple jump (.86 MTRS). There is not a meaningful answer for the changes regarding the third factor. The first and second factors explain 51% of the variability in the initial measurement, while 48% of the variability is explained in the final measurement. The contents of the plyometric program for the basic motor abilities caused slight structural changes within the experimental group.

Table 13. and 14. *The communalities of the experimental group's basic motor abilities in the initial and final measurement*

INITIAL			FINAL		
	Initial	Extraction		Initial	Extraction
mtan	1.00	.64	mtan	1.00	.52
mtar	1.00	.74	mtar	1.00	.76
mtaz	1.00	.56	mtaz	1.00	.29
mdtk	1.00	.45	mdtk	1.00	.41
mzgn	1.00	.75	mzgn	1.00	.72
mcuo	1.00	.65	mcuo	1.00	.68
msdm	1.00	.81	msdm	1.00	.74
mtrs	1.00	.80	mtrs	1.00	.78
misp	1.00	.65	mtps	1.00	.85
mkot	1.00	.70	mdpk	1.00	.75
mkus	1.00	.62	mspa	1.00	.67
moss	1.00	.71	misp	1.00	.57
mdpk	1.00	.63	mkot	1.00	.85
mspa	1.00	.66	mkus	1.00	.57
mtps	1.00	.86	moss	1.00	.76

Table 15. and 16. *A matrix of isolated characterized roots and explained parts of common variance in basic motor abilities of the experimental group's initial and final measurement*

INITIAL				FINAL			
	Initial Eigenvalues				Initial Eigenvalues		
	Total	% of Variance	Cumulative %		Total	% of Variance	Cumulative %
1	4.39	29.26	29.26	1	4.36	29.08	29.08
2	2.12	14.15	43.41	2	1.78	11.84	40.92
3	1.38	9.21	52.62	3	1.52	10.14	51.05
4	1.27	8.44	61.06	4	1.22	8.14	59.20
5	1.06	7.10	68.16	5	1.04	6.91	66.11

Table 17. and 18. *Structure matrices of basic motor abilities of the experimental group's initial and final measurement.*

INITIAL						FINAL					
	Component						Component				
	1	2	3	4	5		1	2	3	4	5
mtps	.91	.28	.14	.30	-.18	mtrs	.87	.04	.22	-.15	.13
msdm	.86	.35	.03	.25	-.11	mtps	.85	.00	.42	-.21	.27
mtrs	.86	.22	-.00	.27	-.27	msdm	.77	-.02	.47	-.26	.05
mspa	.61	-.07	.50	.06	.12	mspa	.68	.41	.08	.23	-.02
mtaz	.48	.23	.44	.33	-.43	mkus	.66	.19	-.16	-.12	.17
mzgn	.41	.80	.10	.12	-.13	mtaz	.48	.14	.32	-.05	.05
mcuo	.17	.79	.25	.16	.00	mdpk	.30	.81	.25	-.13	.00
moss	-.04	.59	.58	.42	.10	misp	-.04	.71	-.08	-.11	.25
mdpk	.04	.35	.74	.20	.05	mzgn	.23	.16	.83	-.02	.17
misp	.11	.03	.73	-.22	-.09	mcuo	.37	.21	.77	-.10	-.03
mtan	-.10	.27	.55	.45	-.38	mdtk	.05	-.14	.59	-.14	.18
mkus	.31	-.06	.13	.71	-.15	mkot	.34	.12	.12	-.87	.02
mdtk	.12	.19	-.11	.63	-.15	moss	.06	.51	.24	-.67	.40
mkot	.27	.43	.17	.61	.39	mtar	.28	.07	.25	.24	.75
mtar	.24	.09	.04	.18	-.84	mtan	.10	.23	.05	-.35	.66

Factorial analysis of specific throwing abilities of the experimental group in the initial and final measurement

Based on the communality analysis (Table 19 and 20) in the intial and final measurement of the specific throwing abilities of the experimental group, all variables can be observed expect push ups with claps within 10 seconds (SMSKL .21) in initial and (SMSKL .16) in the final, which significantly contribute to the exaplanation of the given variability. All variables have high and middle-high projections.

Based on the differences in the communality values, which had only one value greater than 0.70 in the initial measurement, which is shot put Chest shot put – half squat (.72 SMPP), and five communality value's measurements higher than .70 in the final measurements: Forward shot put – half squat (.83 SMKUI), Long jump from half squat (.78 SMDOS), Overhead backwards shot put – half squat (.77 SMKUN), Chest shot put – half squat (.75 SMPP), and Long jump after the first jump (.70 SMDOSS), from which it can be observed that root changes occured in the experimental group's members which were applied to the plyometric program. Forward shot put – half squat gained the most strength due to its change from the initial and final measurement, from .59 to .83.

In the initial measurement of the experimental group, a system of seven (7) manifested specific throwing mesurements contains about 56% of common variance (Table 21). Thus, one latent dimension which defined the given space was extracted. In the final measurement (Table 22) the experimental group explained this system much better with 63% of common variance and one extracted variable.

Based on the changes in the communality values, the percentagally explained variances in the initial and final measurement and the changes in the structure matrices, it can be observed that the plyometric program which lasted for thirteen (13) weeks and conducted on an experimental group of students, caused radical qualitative changes in the specific throwing abilities in the final measurement in regard to the initial measurement.

Table 19. and 20. *The communalities of the experimental group's specific throwing abilities in the initial and final measurement.*

INITIAL			FINAL		
	Initial	Extraction		Initial	Extraction
smpp	1.00	.72	smpp	1.00	.75
smkun	1.00	.68	smkun	1.00	.77
smkui	1.00	.59	smkui	1.00	.83
smmes	1.00	.39	smmes	1.00	.47
smskl	1.00	.21	smskl	1.00	.16
smdos	1.00	.68	smdos	1.00	.78
smdoss	1.00	.67	smdoss	1.00	.70

Table 21. and 22. *A matrix of isolated characterized roots and explained parts of common variance in specific throwing abilities of the experimental group's initial and final measurement*

INITIAL				FINAL			
	Initial Eigenvalues				Initial Eigenvalues		
	Total	% of Variance	Cumulative %		Total	% of Variance	Cumulative %
1	3.95	56.38	56.38	1	4.47	63.81	63.81

The differences between the initial and final measurement of scores in shot put in terms of the control group

Table 23. *The significance of the differencecs between arithmetic sorroundings in shot put – back technique in terms of the control group*

					Std.Dv.			
	Mean	**Std.Dv.**	**N**	**Diff.**	**Diff.**	**t**	**df**	**p**
REZKI	738,03	119,38						
REZKF	767,50	118,71	60	-29,46	50,77	-4,49	59	**,000**

Table 23. presents T-test results in shot put – back technique between the initial and final measurement in terms of the control group's examinees. It points out that with the analysis of the T-value coefficient (-4.49) and its significance (p=.000) it can be concluded that there is a statistically significant difference (p=.005) in the shot put test, in terms of the final measurement and the initial measurement. Considering the negative sign of the value (t), the values of the results in the final measurements gained slightly more value (better interpreted), and that indicates that there is a higher value of the results of the arithmetic sorrundings of the final in regard to the initial measurement of 29cm.

The differences between the initial and final measurements in shot put scores for the experimental group

Table 24. *The significance of the differencecs between arithmetic sorroundings in shot put – back technique in terms of the experimental group*

					Std.Dv.			
	Mean	**Std.Dv.**	**N**	**Diff.**	**Diff.**	**t**	**df**	**p**
REZKI	791,03	97,36						
REZKF	837,28	103,06	60	-46,25	49,60	-7,22	59	,000

Table 24. presents T-test results in shot put – back technique between the initial and final measurement in terms of the experimental group's examinees. It points out that with the analysis of the T-value coefficient (-7.22) and its significance (p=.000) it can be concluded that there is a statistically significant difference (p=.005) in the shot put test, in terms of the final measurement and the initial measurement. Considering the negative sign of the value (t), the values of the results in the final measurements gained slightly more value, and that indicates that there is a progress of the results of the arithmetic sorrundings of the final in regard to the initial measurement of 46c m.

Conclusion

The results of the factorial analysis (under the model of congruence), in the final compared to the initial measurement in the experimental group of examinees indicate, that under the influence of transformational processes, and the application of explosive strength modelated training in the space of basic motor abilities, it leads to slight differences in the space of specific throwing abilities which led to radical structural changes.

The results of the factorial analysis (under the model of congruence), in the final compared to the initial measurement in the control group of examinees indicate, that under the influence of a standard model of practical class in the space of basic motor abilities, there were slight changes and in the space of specific throwing abilities were no structural changes.

Progress in intensity the early stages is therefore not a result of increased muscle(hypertrophy), but the ability of central nervous system to activates or stimulates the muscles (Bompa, 1993, Sale, 1986).

Based on these results, it is obvious that the Program of explosive strength caused a higher level of changes compared to the control group which only performed regular class of physical education. Radical structural changes occured mostly in the area of specific throwing abilities.

In the shot put training, accentuation (strength is trained the most regarding the moves which are dominantin the competitive structure), has a significant place in the planning and programming phase of the training (*Zaciorski i Kremer 2009*).

Specialized strength training secures the athlete's great chance of improving his/her athletic achievements, and reduces the risk of getting injured *(Foran 2010)*.

In addition to determining the effects of the author's program and his adaptive potential in the development of basic and specific throwing ability, his effect on the scoring efficiency in the shot put discipline was determined. Thus, it should be clear that a higher level of achievement was not the primary goal. Range of improvement only measures the efficiency of the offered program content. The score improvement in the shot put of 46 cm, which was statistically more significant in the experimental group than within the control group that received a results shift from 29 cm, which is a 17 cm difference, could only be underestimated by people who do not understand this type of experiment. For those who understand this program, the improvement of 46 cm is a very significant jump, especially taking into account that the experiment lasted only for three months and with training frequency of two hours a week. Continued use of the content of this program throughout an one-year macrocycle, with higher weekly frequency, would certainly give results with even more significant effects.

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