INCREASING THE MUSCULAR POTENTIAL USING THE CIRCUIT METHOD APPLICATIONS WITHIN UNIVERSITY LEVEL PHYSICAL EDUCATION

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Abstract
Within this study we aimed to check and analyze the utility and efficiency of the circuit method in developing muscle strength potential and integrate it in the physical education classes at University level. Therefore we designed several programs that would optimize muscle strength. These programs involve various alternatives that take into account the students' biological, psychological and motor characteristics. Reaching optimum indexes of muscle strength development is a constant objective in physical education and sports, may it be at higher or lower education level. It also ensures young people's robust and healthy development.

Keywords: *students, muscle strength, circuit method*

JEL classification*:* I210, I290, I190

1. Introduction

The student is usually a young man or woman barely out of adolescence, in a period of transition, education and training for labor integration. He or she is free from many of the duties and responsibilities that a grown man has to fulfill on daily basis. Therefore has the opportunity to focus on training in the profession of choice and to focus on his or her social and cultural development.

The student's specific activity is his professional training, the learning process with all its particularities that derive from the specific professional domain. Taking part at classes and seminars, labs and various forms of practical work, study in the library, preparing for exams, all these represent specific components of a student's life. We can say that studentship actually builds a bridge ensuring the transition to labor market and an adult's social life.

The specific tasks that physical education in higher education is called upon to solve confer it, together with other scientific disciplines, an important place in the complete and complex preparation of future specialists.

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1.2 General Framework

Specialized literature has analyzed strength as a motor quality from several points of view: theoretical and methodical, anatomical and physiological, nutritional and medication-related. Therefore, offering a precise definition of strength is difficult, because experts must take into account, on one hand, the multitude of factors that condition it and, on the other hand, the strength's different means of manifesting. It's considered that strength is the motor quality that is noticed and evaluated by its own results, being a motor quality that is perfectible, since the factors influencing it are perfectible as well.

Tudor V. (2007, p. 41) defines „human body's strength describes its capacity to overcome an internal or external resistance through muscular contraction, to withstand an external force or maintain a certain position."

Demeter A. (1981, p. 79) defines the concept of strength as "the ability of the neuron-muscular apparatus to overcome resistance through movement, based on muscle contraction."

Bota A. and Dragnea A. (1999, p. 228) consider strength force as "the ability to achieve the effort of overcoming, of disposal in relation to internal or external resistance by contracting one or several muscular groups".

Summarizing these definitions and points of view, we believe that muscle strength is an important component of motor performance involved in daily activities as well as in achieving valuable results in sports. Strength actually brings its contribution to the achievement of any movement in different proportions, giving shape, direction, motion smoothness and efficiency.

One of the most effective methods for developing strength during physical education classes is the circuit method. This methodical process increases the efficiency of the important body functions, while contributing to a harmonious development of the muscles. The chosen exercises will address to all muscle groups, alternatively, in order to achieve better and speedier recovery. It is recommended that the exercises are simple and known to the subjects. Their order should not lead to successively engagement of muscles from the same segment, and the difficulty of the exercises should increase progressively.

It is required that effort dosage takes into account the biological and motor possibilities of the subjects. Circuit training enhances cardiac rhythm, leading to the strengthening of the muscles and intense burning. During a workout one may burn about 450-550 calories per hour.

Assessment of the circuit training effects on the subjects is done on both objective and subjective basis. One of the most important ones is keeping the heart rate under

supervision. This reflects the body's reaction to a type of effort. Equally important is tracking respiratory rate, which at rest is 16-18 per minute. During exercise, the optimal respiratory rate is 28 to 30, because it maintains an optimum ratio between inhale and exhale. Increasing respiratory rate over 30 per minute is achieved by shortening the expiration, which leads to the accumulation of CO2.

If the teacher is not able to control the values of these physiological indexes during exercise, he may note each subject's reaction to exercise, paying great attention to their symptomatic behavior (skin color, breathing, sweating, coordination of movements etc.).

Table 1 Link between different symptoms and fatigue level

Symptoms	**Level of fatigue**		
	WEAK	**MIDDLE**	**ACCENTUATED**
Skin color	Slightly rosy	Accentuated rosy	Pale with cyanotic lips
Breathing	Regular	Frequent but regular	Very fast, irregular
Movement co-ordination	Good	Small mistakes	Elementary coordination failures
Subjective feeling of fatigue	Absent	Incipient fatigue	Headache, accentuated fatigue, nausea

It is advisable to follow a certain progression of the difficulty degree of the exercises making up the circuit, according to the subjects' level of training and their training experience, depending on the level of training and experience of the subjects. At first one should choose exercises that use one's own body weight. Then it's time for exercises with light objects (dumbbells, medicine ball etc.), followed by exercises involving different devices (trellis, gymnastics bench etc.)

2. Material and methods

2.1 Research Aim

Our study aims to optimize the physical education and sport process in the university by designing and implementing effective programs for developing muscle strength, using the circuit method and taking into account morph-functional and motor particularities of the students.

2.2 Research objectives

- Studying profile literature
- Elaborating programs aimed at optimizing the muscular strength values by using the circuit method

- Checking and adjusting the difficulty and complexity of the systems used in circuits according to the psycho-behavioral and bio-motor particularities of the subjects
- Achieving the experiment in order to optimize the student's muscular strength level by implementing the programs we've developed to that purpose; performing the necessary tests.

2.3 Research Hypothesis

We assume that the implementation of muscle strength development programs in the physical education and sports classes at university level, using the circuit method, will effect in increasing the muscular strength of the students.

2.4 Research Methods

The research methods we used were: bibliographic study method, observation method, experimental and statistical and mathematical method.
In order to evaluate the students' muscle strength potential we've used the following tasks:

- Testing explosive muscle strength of inferior limbs using long jump and high jump without momentum;
- Testing explosive muscle strength of superior limbs by traction and push ups;
- Testing abdominal muscle strength by trunk lifting from the laidback position;
- Testing back muscle strength by trunk extensions.

2.5 Subjects and location and didactic strategy

The subjects of our study were college freshmen from University Politehnica Bucharest, aged 19-20 years, the experiment and specific tests were done at the Politehnica sports base.

The experiment was conducted over nine weeks, as follows:

- 24-26 February 2014 - initial testing;
- March 3 -10 May – applying the program designed to optimize muscle strength;
- 12 to 14 May 2014 final –Testing.

The experimental plan was oriented towards: determining the initial index of muscle strength; providing with training strategies through experimenting the 3 circuits; determining the final muscle strength index as well as noticing the differences that appeared between initial and final testing, after having applied the designed program.

Table 2 Steps needed to apply the muscle strength optimization program

Timetable	Weeks	Aim	Content	Exercise type
3-21.March 2014	3 weeks	Increasing general and segment muscle strength index	Circuit 1	Isotonic exercises
24.March - 11April	3 weeks	Increasing general and segment muscle strength index	Circuit 2	Isotonic exercises with/at apparatus
14 April - 10 May	3 weeks	Increasing general and segment muscle strength index	Circuit 3	Isotonic exercises with medicine ball

Circuit no.1: Aim: increasing general strength and segments strength
- 6 stations
- 30 seconds of workout in week 1
- 40 seconds of workout, weeks 2 and 3
- 45 seconds break between stations
- Repeat the circuit:
- 3 times in week 1, 4 times in weeks 2and 3
- Break between circuits – 2-3 minutes
- Pulse 130-150 per minute

Circuit no.2: Aim: increasing general strength and segments strength
- 6 stations
- 45 seconds of workout in weeks 4 and 5
- 60 seconds, week 6
- 45 seconds break weeks 4 and 5, 60 seconds of break week 6
- Repeat the circuit 4 times in weeks 4, 5 and 6
- Break between circuits – 2-3 minutes
- Pulse 130-150 per minute

Circuit no.3: Aim: increasing general strength and segments strength
- 8 stations
- 60 seconds of workout in weeks 7, 8 and 9
- 45 seconds break
- Repeat the circuit 4 times in weeks 7, 8 and 9
- Break between circuits – 2-3 minutes
- Pulse 140-150 per minute

2.6 Results

We present below the initial and final results of the experimental group based on the determined statistical indicators: arithmetic mean (AVG), medium number

(MED), the maxim (max) and minim (min) values, standard deviation (ST.DEV), the variation coefficient (Cv), effect size (Eff.size) and Paired "T" test calculated as "t". (Epuran M., pp. 51-57)

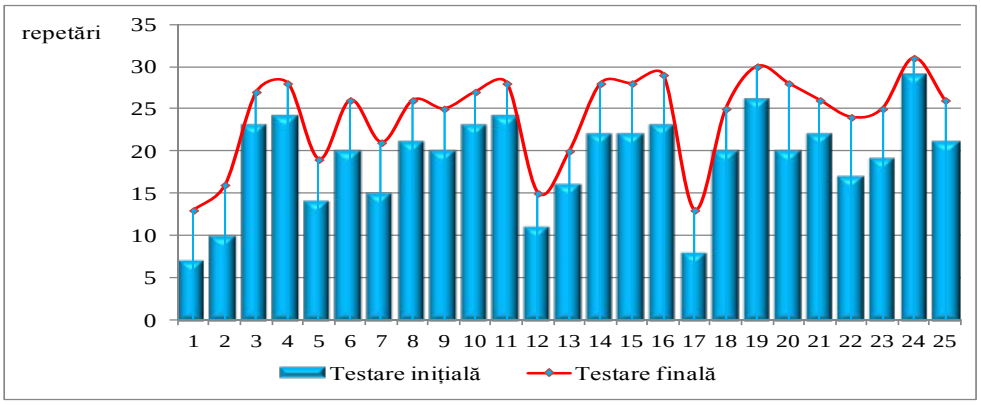
Analysis of the results obtained at the end of the experiment, after statistical calculations (see table no. 3, 4, 5, 6, 7, 8) indicates the following:

Table 3 The push-ups results

TEST.	STATISTICAL INDICATORS							
	AVG	MED	ST.DEV	Max.	Min.	AMP	Cv	Eff. size
Initial	19.08	20.00	5.59	29.00	7.00	22.00	29.30%	4.05
Final	24.16	26.00	5.26	31.00	13.00	18.00	21.76%	

Table 4 PAIRED T TEST

DIFFERENCE	DIFFERENCE INDICATORS			Critical t	Calculated t	P
	Average	Medium	Standard deviation			
Final testing – Initial testing	5.08	5.00	1.26	2.064	20.229	0.000



Graphic 1 The Push-ups results

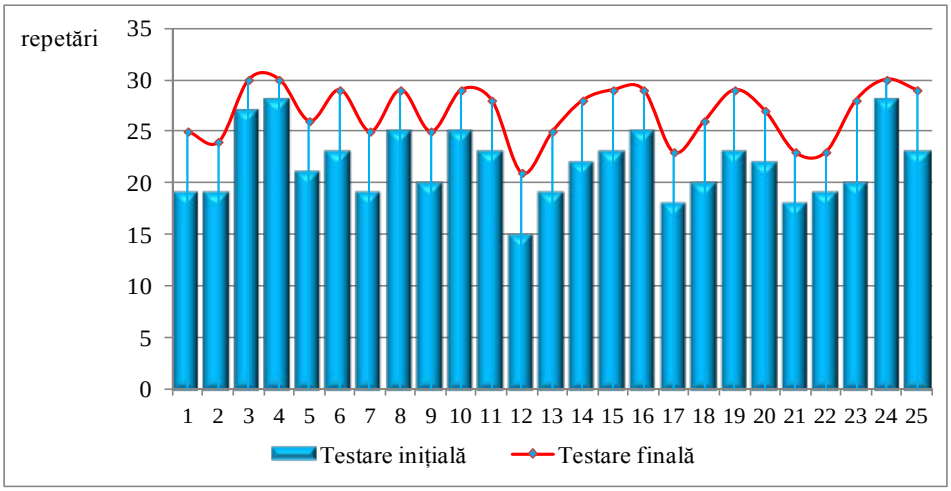
At the final testing, the medium number of push-ups increased by 5.08 repeats, from an average value of 19.08 at the initial testing to a value of 24.16 at the final one. The dispersion of the results lowered by 4 repeats but it still remained at a relatively homogenous structure. The size of the effect (4.05) indicates a dig to very big difference between the average values of the 2 tests. Having applied the t test we see that the difference between the average values reached the threshold of statistical significance, $p = 0.0001 < 0.05$. Graphic representation can be seen above in graphic 1.

Table 5 Trunk extensions from laid back position

TESTING	STATISTICAL INDICATORS							
	AVG	MED	ST.DEV	Max.	Min.	AMP	Cv	Eff. size
Initial	21.76	22.00	3.33	28.00	15.00	13.00	15.3%	3.68
Final	26.80	28.00	2.65	30.00	21.00	9.00	9.9%	

Table 6 PAIRED T TEST

DIFFERENCE	DIFFERENCE INDICATORS			Critical t	Calculated t	P
	Average	Medium	Standard deviation			
Final testing - Initial testing	5.04	5.00	1.37	2.064	18.412	0.000



Graphic 2 Trunk extensions laid front position

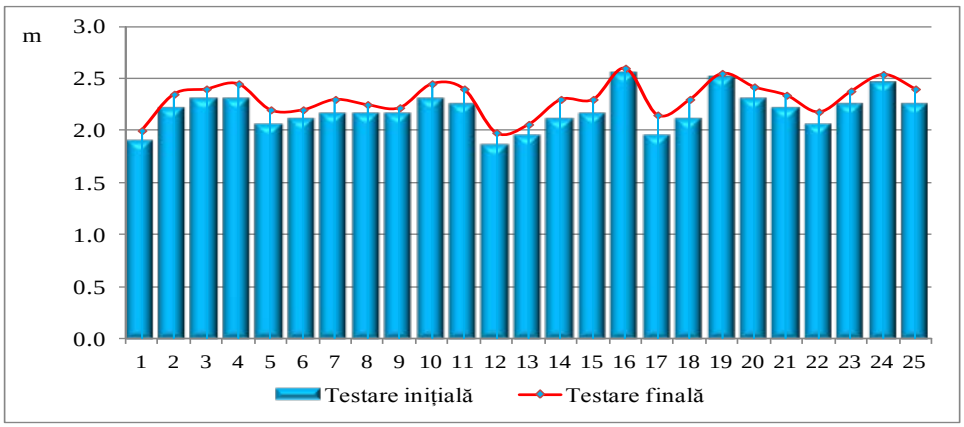
At the final testing, the average number of executions increased by 5.04 repeats, from an average value of 21.76 at the initial testing to 26.80 repeats at the final testing. The dispersion of the result modified its structure from relative homogenous at the initial test to homogenous at the final test, amplitude decreasing by 4 repeats. The size of the effect (3.68) indicates a big to very big difference between the average values of the 2 tests. The t test shows that the difference between the average values reached the threshold of statistical significance, $p = 0.0001 < 0.05$. Graphic representation can be seen above in graphic 2.

Table7 Long jump without momentum

TESTING	STATISTICAL INDICATORS							
	AVG	MED	ST.DEV	Max.	Min.	AMP	Cv	Eff. size
Initial	2.18	2.15	0.18	2.55	1.85	0.70	8.0%	3.15
Final	2.31	2.30	0.16	2.60	1.98	0.62	7.0%	

Table 8 PAIRED T TEST

DIFFERENCE	DIFFERENCE INDICATORS			Critical t	Calculated t	P
	Average	Medium	Standard deviation			
Final testing - Initial testing	0.13	0.13	0.04	2.064	15.762	0.000



Graphic 3 Standing long jump

The average value increased by 0.13 m at the final testing, from an average of 2.18 m to an average of 2.31 m. The dispersion of the results remained at a homogenous structure. Amplitude decreased by 0.08 m. The size of the effect (3.15) shows that the difference between the two average values is big to very big. The t test shows that the difference between the average values reached the threshold of statistical significance, $p = 0.0001 < 0.05$. Graphic representation can be seen above in graphic 3.

Conclusions

We have analyzed the results of the current research on the effects that muscle strength optimization programs had on the students' muscle strength potential. Here is what we found:

- **Push-ups.** At the final testing, the average number of executions increased by 5.08 repeats, from an average of 19.08 at the initial testing to 24.16 at the final one. The size of the effect, 4.0, indicates a large to very large difference between the average values. The t test shows that the difference between the average values reached the threshold of statistical significance, $p = 0.0001 < 0.05$.
- **Trunk extensions from laid back position.** At the final testing, the average number of executions increased by 5.04 repeats, from an average value of 21.76 at the initial testing to 26.80 repeats at the final testing. The size of the effect (3.68) indicates a big to very big difference between the average values of the 2 tests. The t test shows that the difference between the average values reached the threshold of statistical significance, $p = 0.0001 < 0.05$.
- **Standing long jump.** The average value increased by 0.13 m at the final testing, from an average of 2.18 m to an average of 2.31 m. The size of the effect (3.15) shows that the difference between the two average values is big to very big. The t test shows that the difference between the average values reached the threshold of statistical significance, $p = 0.0001 < 0.05$.

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