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## COORDINATION ABILITIES OF CHILDREN IN THE PHYSICAL EDUCATION CURRICULUM FOR ELEMENTARY SCHOOLS

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### ABSTRACT

This article reports about coordination abilities of children in the elementary schools and the reason why physical education curriculum with extracurricular activities is efficient. The scientific research used different groups of female children with extracurricular activities. All of the students attended their obligatory physical education classes twice a week. The sample of participants in this research was 73. The participants were divided into two groups: the first group consisted of 41 and the second of 32 Serbian female elementary school students. The students' age ranged from 10 to 12 years and artistic gymnastics was their sport of choice in elementary school. All of the students participated in their sport of choice for at least one year, and three years at most. The sample of variables consisted of anthropometric and motor variables. For the assessment of motor coordination abilities, a battery of tests consisting of six measuring instruments that cover the field of coordination in rhythm, movement frequency speed, and agility was applied. The differences in anthropometric measurements of the female students from different groups show that there is a statistically significant difference at the significance level of 100% on both tests (VISI= .000, TEZI= .000). The differences in coordination in rhythm among is a statistically significant in 100% for the Rolling and walking exercises along a line accompanied by asymmetrical hand motions (KHAR= .000), while for Arrhythmic hand drumming, there were no statistically significant differences (NBUR= .320). Differences in the movement frequency speed can be seen at the significance level of 100% on both tests (TAPR= .000; TAPN= .000). The differences in agility between the female students from two different groups can be seen at statistically significant level of 100% on both tests (RBNR= .002, LECS= .000). The female school children who opted for an additional class had greater affinities and interest toward training artistic gymnastics, which indicate the obtained results: they all scored better results in five out of the six applied tests. Informed by these findings, we conclude that concept of classes designed for a selected sport in the elementary schools of the Republic of Serbia has proven to be quite successful due to the improvements in physical activity and self-awareness of the concept of sports activities of the female students, which later scored higher results at school competitions.

**Keywords:** coordination abilities, elementary school, extracurricular activities

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### INTRODUCTION

The physical education curriculum was designed to use various types of motor knowledge and abilities to enable students (adolescents) to use physical exercise in everyday life. Physical education programs in elementary schools were designed based on the gender and age of the children, and include several phases: determining the state of the individual; determining class content based on the specific age of the children; determining the means and methods for realizing the work tasks; realizing educational goals and monitoring and evaluating the effects of the work. Program content for elementary schools is realized during regular classes, extracurricular activities and any other kind of work outside of regular school hours (Dragić & Pešić, 2012). Physical education classes, as part of the educational system, include two classes per week, and free or extracurricular activities are included with an additional class per week. As part of their extracurricular activities, the students are able to select a certain sport which they can improve in during an additional class per week. The goal of physical education – one's sport of choice – is to contribute to the realization of the goals of physical education as an integral part of the

education system, and at the same time satisfy the individual needs of the students and their desire to achieve success in their sport of choice. Extracurricular activities are organized in the form of school sports activities, which are a part of sports-educational work, and enable students to prepare for the school competition system, which is organized by the Serbian School Sport Federation. The Serbian School Sport Federation has its own system of qualification competitions based on school districts, regions, and at the national level as well – national school competitions.

The tasks of physical education classes should be to encourage the growth and development of children, and to, by using select physical content, influence proper body posture. During physical education classes, moderate development of the basic motor abilities should be provided, including: speed, strength, endurance, agility and coordination. All motor exercises should encourage children to aesthetically perform movements. One of the accompanying factors of physical education classes is the socialization of the children in the group, as well as a desire for self-affirmation and competition. By participating in the system of school competitions, children acquire ethical values and norms. It also encourages the moral-voluntary features of the students. Participation in the system of school competitions represents a good basis for the children to opt for improvement in a particular sport. The program of basic sports (artistic gymnastics, swimming and athletics) has been well-developed by the various national sports associations. These associations monitor national school competitions so as to discover potential talents for a particular type of sport. Artistic gymnastics programs in schools include elements of basic movements, including: walking, running, jumping and leaping. All of the elements are a required part of the curriculum for each semester.

The theory of artistic gymnastics primarily defines the concept, content, characteristics and timing of the figures, but also all the factors of their development. In addition to these factors, the terminology of artistic gymnastics, as the language of the gymnastics profession, includes the choice of methods of communication, training and competition. The basic requirements for the promotion of this sport include training and the competition hall, equipment, and leotards for the gymnasts. Artistic gymnastics belongs to a group of aesthetic coordination sports, such as rhythmic gymnastics, figure skating, and ski jumping. Motor abilities are primarily important for the success of the gymnasts (Di Cagno et al., 2016; Donti et al., 2016; Lloyd & Oliver, 2014; Petković, D., 1996; Petković, E., 2009, 2010; Todorovski, 1998). An important part of the exercise for gymnastics compositions are coordination abilities (Delignieres, Teulier, & Nourrit, 2009). Coordination in artistic gymnastics can be general and specific. General coordination is the basis for the development of specific coordination. Specific coordination enables the gymnast to perform complex technical and tactical structures in a variety of conditions quickly, accurately, and easily. It is developed by carrying out specific sport-related movements from unusual starting positions, and under more difficult circumstances (Grigorea, Mitrachea, Predoiua, & Rosca, 2012; Ivashchenko, Khudolii, Iermakov, & Prykhodko, 2018; Petković, 2004). Petković (2017) determined that the distribution of situational coordination in female gymnasts is divided into five factors: 1. The evaluation of the speed of performing complex motor tasks – the use of the obstacle course and obstacle course backwards as selection criteria in gymnastics; 2. The assessment of agility - defined as the ability to change the direction of movement without losing balance, speed, strength, and movement control; 3. The evaluation of the precise range of motion in the shoulder joint - precise movement in the shoulder joint - hand movements in the frontal and sagittal plane (under the specified angles); 4. The estimation of coordination in rhythm - for the realization of motor structures by moving the body in space, performing complex movements in time and space; 5. The estimation of the accuracy of the realization of complex motor tasks – exercise with jumps and movements with asymmetrical work of the upper and lower extremities.

## METHODS

Vandorpe et al. (2012) determined after two years of evaluating technical and coordination exercise criteria that the only valid predictor criterion was motor coordination. Based on the competitive performance of the gymnasts, it was determined that there is more than a 40% difference in the prediction of the results for a sample of 23 gymnasts aged seven and eight. Gallotta et al. (2016) conducted a study on a sample of 230 children and examined the impact of a five-month focused physical education program on motor abilities, among which coordination on the balance beam showed the greatest contribution to progress. According to Belej et al. (2006) in modern gymnastics training the condition for loading has reached its limits, especially in the training process, where the priority should be the development of coordination capacities. In the work of Kochanowicz et al. (2009) three tests were used on a sample of 18 gymnasts aged 7-9 for the evaluation of coordination abilities.

The aim of this study was to determine the existence of possible differences in coordination abilities in the physical education curriculum for elementary school children in the Republic of Serbia. Coordination

abilities in elementary schools were assessed by measuring instruments for the estimation of coordination in rhythm, speed of movement frequency, and agility, on a sample of girls aged 10 and 12 from the territory of the municipality of Niš.

## Subjects

The sample of participants in this research was 73 which were divided into two groups: the first group consisted of 41 (age: 11 yrs  $\pm$  6 months; body height: 161 $\pm$ 0.5 cm; body mass: 65 $\pm$ 0.5 kg) and the second of 32 (age: 9 yrs  $\pm$  6 months; body height: 143 $\pm$ 0.5 cm; body mass: 33 $\pm$ 0.5 kg) Serbian female elementary school students. The students' age ranged from 10 to 12 years and artistic gymnastics was their sport of choice in elementary school. In addition to attending obligatory physical education classes twice a week, all of the students participated in their sport of choice for at least one year, and three years at most. The first group attended classes twice a week, while the other group in addition to their regular classes, also participated in an additional class.

## Procedure

The study was approved by the Ethics Committee of the Faculty of Sport and Physical Education, University of Niš, in accordance with the Helsinki Declaration (WMA, 2002). All of the participants, their parents and teachers were informed about the aims of the research. The parents signed a consent form which allowed their children to participate in this research. All of the measurements were taken indoors under optimal climatic conditions (gym temperature between 16°C - 20°C). All of the tests were carried out at the end of the winter semester (2017/18 school year). The sample of variables consisted of anthropometric and motor variables. The anthropometric measurements were carried out using ISAK guidelines: body height (*VISI*, in centimeters) and body mass (*TEZI*, in kilograms). During the anthropometric measurements, the adolescents wore light clothes, and their feet were bare. Only non-invasive standard anthropometric measurements were performed. Body height were measured with a GPM 101 anthropometer (Siber & Hegner, Zurich, Switzerland). Body mass was measured to the nearest 100 grams using a portable SECA 799 electronic scale (SECA, Birmingham, UK). The coordination variables were calculated from the sample of motor variables. Standardization of the tests had been determined previously (Petković, 2017; Veličković, 1999). For the assessment of motor coordination abilities a battery of six tests that cover the field of movement coordination in rhythm, movement frequency speed, and agility was applied. The coordination tasks were adapted for the sample of participants and had shown optimal measuring characteristics in previous studies (Bala, Stojanović, & Stojanović, 2007; Hariss & Cale, 2006; Petković, 2004, 2017).

The coordination abilities were estimated using measuring instruments in terms of coordination in rhythm, speed of movement frequency, and agility. Coordination in rhythm: *Rolling and walking exercises along a line accompanied by asymmetrical hand motions (KHAR, in number of errors incurred)*, *Arrhythmic hand drumming (NBUR, in frequency)*; Movement frequency speed: *Hand tapping (TAPR, in frequency)*, *Feet tapping against the wall (TAPN, in frequency)*; Agility: *Rhythmic leg and hip drumming (RBNR, in frequency)*, *10x4 Lying down, squatting and jumping (LECS, in frequency)*. The scoring was carried out by three teachers who are licensed gymnastics judges. Table 1 presents the criteria of evaluation for the description of the performance of the measuring instrument Rolling and walking exercises along a line accompanied by asymmetrical hand motions. Any deviation from the established order of conducting the exercises was considered an error. Any deviation is calculated as a single error.

**Table 1.** Criteria of evaluation for description of performance

Points	Description of performance
1	technical errors, each time
1	aesthetic errors, each time
1	order of exercises, each time
1	hands, legs, head, each time

## Statistical analysis

The statistical analysis was performed by using the statistical package SPSS 20.0. The differences between the two groups of female students were established by means of t-test for small independent samples. The significance criterion was defined at the level of  $p \leq .05$ .

## RESULTS

Table 2 shows the differences in anthropometric measurements of the female students from two different groups, and it can be seen that there is a statistically significant difference both in body height and body mass (VISI= .00; TEZI= .00, respectively). The height and body mass are varying due to fact they are in adolescent period which is characterized by intense growth and development. Also, these differences in anthropometric parameters can be due to increased extracurricular physical activities, which lead to a reduction in subcutaneous fat tissue and obesity.

**Table 2.** Differences in anthropometric measurements of female students from two different groups

Levene's Test for Equality of Variances			T-test for Equality of Means				
	F	Sig.	t	df	Sig. (2-tailed)	Mean	Std. Error
VISI	7.81	.00	9.10	71	.00	17.25	1.89
TEZI	3.96	.05	6.02	71	.00	22.57	3.74

**Legend:** F- F test, Sig.- Mean- range, Sig. (2-tailed)- significance, Std. Err- standard error difference,  $p \leq .05$ .

Table 3 shows the differences in coordination abilities of the female students from two different groups and it can be seen that there is a statistically significant difference in coordination in rhythm (KHAR= .000), movement frequency speed (TAPR= .00, TAPN= .00), and agility (RBNR= .002, LECS= .000).

**Table 3.** Differences in coordination abilities of female students from two different groups

Variables	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
KHAR	3.131	.081	7.057	71	.000	13.29101	1.88346	9.53550	17.04651
			7.896	45.477	.000	13.29101	1.68316	9.90194	16.68007
NBR	.044	.835	1.002	71	.320	.67607	.67503	-.66991	2.02204
			1.014	69.304	.314	.67607	.66705	-.65455	2.00668
TAPR	.103	.750	3.920	71	.000	-6.35595	1.62135	-9.58883	-3.12306
			3.998	70.393	.000	-6.35595	1.58979	-9.52638	-3.18551
TAPN	13.156	.001	19.422	71	.000	-16.61966	.85573	18.32593	14.91339
			18.015	43.028	.000	-16.61966	.92253	18.48008	14.75925
RBNR	1.030	.314	-3.202	71	.002	-2.07851	.64915	-3.37288	-.78414
			-3.153	62.335	.002	-2.07851	.65925	-3.39619	-.76082
LECS	13.449	.000	6.440	71	.000	8.40664	1.30528	5.80398	11.00929
			6.935	61.976	.000	8.40664	1.21213	5.98360	10.82968

**Legend:** F- F test, Sig.- significance, Mean- average value, Std. Err- standard error of difference,  $p \leq .05$ .

## DISCUSSION

A good coordination means including the most suitable muscles for certain functions in the most efficient order, inhibiting antagonists and regulating the frequency of nerve impulses. To solve coordination problems, complete synchronization of higher regulatory centers and peripheral parts of the locomotor apparatus is necessary. Coordination is, of course, closely linked to the technique of the type of

sport, and is necessary for the athlete to operate efficiently and without difficulty as part of a specific technique, since well-coordinated movements are more economical and quicker than poorly coordinated movements. Recent research suggests that motor coordination in artistic gymnastics can be a crucial factor of success (Belej et al., 2006), but also a predictive criterion for success in this sport (Vandorpe et al., 2012). Experimental treatments carried out to improve coordination abilities have achieved a positive effect in both athletes and students (Gallotta et al., 2016; Tonić, Petković, Mekić, & Radenković, 2010). In artistic gymnastics, most of the previous research was performed by examining the influence of coordination abilities on competitive performance (Novak, 1984; Petković, 2017; Todorovski, 1998; Werner, Williams, & Hall, 2012) and the conclusion was an existence of relationship between situational-motor coordination tests and the single contribution to the competition performance in exercising on the Uneven bars and Balance beam (Petković, 2004), as well as in the All-around competition. Kochanowicz et al. (2009) concluded that quality assessments of coordination and motor abilities create the basics of training individualization in gymnastics in the initial training phase.

The physical education curriculum for the elementary school is divided into basic games with balls and sport gymnastics program. During the course of one semester students learn the basics of technical-tactical elements of training for collective sports (volleyball and handball) and perform exercise programs on the apparatuses. The handball program is consisted of following units: catching and passing with and without the ball, guiding the ball, moving along the 6-meter line, kicking and falls. The volleyball program includes following units: hitting and passing the ball, spikes, catching and passing the ball, and falls. The exercise program of gymnastics includes only exercises on the floor: the Handstand, Bridge, Walkover, and Roll on. The additional physical education class included exercises on the apparatuses. Children involved in their school sport of choice trained for the following disciplines: the Vault, Uneven bars, Balance beam, Floor exercise and All-around competition (the total amount of all the scored points for each of the individual disciplines).

The quicker pace of life marked by modern scientific-technological discoveries (computers, social games, a virtual world) can have a negative effect on the health of young people, who should be guided into healthier ways of life through sports activities. The sedentary way of life contributed to the energy intake of food being greater than energy consumption, which leads to increased body weight and obesity. These factors, overweight and obesity, represent a new global challenge to public health (Hajmer, 2010). Obesity is not just a question of beauty and looking good, but is connected to serious health conditions: a significantly increased risk of diabetes, disorders in the locomotor apparatus, increased blood pressure and psychological disorders. Based on the reports of the World Health Organization, insufficient physical activity has been named an independent risk factor and represents a great national health problem. The level of physical activity, generally speaking, decreases with age, there is evidence that this decrease is especially pronounced during adolescence (Kemper et al., 2001; Kimm et al., 2002). In the case of girls, it was noticed that compared to boys, the decrease in the level of physical activity occurs earlier. The elementary school program of basic sports with extracurricular activities is well-developed and has positive influence on the development of biomotor abilities of Serbian students. Schools should consider developing physical activity programs with extracurricular activities for positive relationships between physical activity and specific sport performance.

## CONCLUSION

The difference in the coordination abilities of children from two different groups was indicated by the program carried out during the additional class of the selected sport, which extends the basic elements of regular physical education classes. The female school children who opted for an additional class had greater affinities and interest toward training artistic gymnastics and were more talented, which indicated the obtained results. They all scored better results in five out of six applied coordination tests. The differences in the coordination abilities are conditioned by the work methods which are used in artistic gymnastics. One of the methods is the obstacle course, which is used during the introductory part of the class, as a means of introducing the body to physical strain. Polygons are designed differently with various obstacles, so that the students can develop speed, agility, and flexibility, and these are all features of good body coordination, which is one of the goals of this sport.

The contributions of this research is improvement of new coordination exercise knowledge of physical education teachers in primary school, especially of those who lead the chosen sport in the field of gymnastics. Coordination abilities needs to be developed through systematic programming of the teaching process by choosing various coordination exercises from gymnastics training process.

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