

- Longitudinal study to follow labor market absorption of university graduates and their motives to keep their job.

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CAN THE USE OF POLYGONS BARRIERS CONTRIBUTE TO IMPROVING COORDINATION ABILITY?

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Abstract: *The purpose of this study was to evaluate the effects of the sports activity polygon application on motor coordination of children. The participants (aged: 10.5 ± 0.5 years; body mass: 38.2 ± 7.1 kg; body height: 145.7 ± 6.1 cm) were randomly assigned to the experimental (EG; $n = 35$) and control group (CG; $n = 30$). Motor coordination was assessed by the complex movement task polygon. After initial testing, 10-week sports activity polygon program was implemented. At the end of the treatment the final testing took place. The results of the paired T-test indicated that the EG improved significantly ($p = .000$) in measured motor coordination abilities. The sports activity polygon appears to be an effective way of improving children's coordination performance. Teachers could use this information to plan and improve the process of physical education.*

Key words: *polygon, motor coordination, primary school.*

Introduction

An organized form of physical exercise is a process, which institutionally starts from pre-school and lasts until higher education, although it may even be present during university. For this process to be successful, it has to be implemented continuously and efficiently at all stages, starting from pre-school through primary and secondary school, as well as the university. The quality of physical education in primary school-aged children has an impact on further development of motor skills in children (Piek, Dawson, Smith, & Gasson, 2008). In addition to the quality of teaching, it is necessary to connect sensitive periods and adequate physical exercise programs, and previous children's experience to achieve a better effect of exercise on fine and gross motor skills of students (Ebrahimi, Nasiri, & Salehian, 2013).

One of the often commented but not precisely defined motor skills is coordination. Apart from a large number of studies, there is still not enough data based on which this motor skill can be regarded as thoroughly studied. There are several reasons for this, and one of the most important is probably insufficient data on brain functions during processing coordination of motor actions. Several attempts have been made to classify coordination and determine its position in the area of motor skills (Hošek, 1976; Ismail, 1976). In these studies, more than once, various factors have been singled out that could explain coordination as an ability. Any type of defining of this motor skill is complex and not one definition gives a complete and precise answer to the question of what coordination is. Generally speaking, coordination is a basic framework, which organization of activities depends on, and good organization results in a great success during skill performance (Pettit, 2008; Nagata, Hagio, Tanabe, & Kouzaki, 2012). Fleishman (1964) defines coordination as a form of motor intelligence. This definition is somewhat valid even today and numerous authors find it acceptable. It contains the concept of motor control and movement but at the same time the role of intelligence, i.e. central nervous system, which has proved to be correct. Drabik (1996) states that coordination is an ability to perform simple and complex locomotion, i.e. an ability to perform complex movements, and to learn new movements rapidly, as well as to change one movement into another very fast. Muscle groups, coordinated at a higher level, use less energy during contractions, which results in better performance (Bompa, 1999). All of these statements, show that coordination is one of the essential and dominant motor skills (Marinković, & Pavlović, 2013).

The sports activity polygon, which is used in physical education at schools, is one of the classic organizational and methodical forms. The application of the polygon in physical education requires from a teacher more comprehensive preparation for combining tasks into one meaningful and technically feasible whole, on the other hand, it creates great possibilities for creative work of a physical education teacher. For Findak (1999), the polygon involves successive performance of a certain number of physical exercises during which a student needs to overcome natural or artificial obstacles in the shortest time possible. Marinković, Pavlović, Korovljević, Dimitrić, & Bogdanovski, (2016), states that the polygon is a locomotor activity which involves a combination of running and walking with many other natural and executed movements, which are performed from the beginning to the end of the track. By using methodical and organizational form of the «polygon of agility», which, out of all motor tasks, contains the most natural form of movements, different types of movements and different level of their complexity, the first stage of a class is primarily intended to

try and influence the improvement of students' coordination abilities. Katić, Srhoj and Pazanin (2005), found that the application of the training ground of agility can lead to the improvement of motor skills, and also coordination, with younger school children. Milanović (2007) and Žuvela, Božanić and Miletić (2011), had the same findings, when they proved the development of coordination in students using a specially constructed sports activity polygon. They found that the use of this polygon generally has an impact on the development of motor skills in students.

The aim of this study is to determine the effects of more intensive application of one of the methodical and organizational forms in physical education, «the sports activity polygon», within the existing syllabi for the third and the fourth grade of an elementary school, on the students' coordination.

Method

The study included the total number of 65 respondents aged 10 and 11 (Body High=145,7cm±6,14; Body Weight=38,2kg±7,17), the students of the third and the fourth grade of primary schools in Užice. The entire sample of the respondents was divided randomly into two groups: control and experimental. The experimental group (n=35) of respondents was under the treatment for three months, and it included the implementation of the complex movement task polygon proposed by Pavlović, Marinković, & Bojović (2014). The treatment was conducted during regular physical education classes, twice a week. During this time, the control group (n=30) had a regular physical education class, the content of which was included in the annual syllabus. All subjects attended the physical education classes regularly, without absenteeism, and none of the respondents participated in organized sports activities outside the physical education classes.

The test, which was used to estimate motor performance of coordination in the respondents, was designed and implemented according to the instructions and modifications for the specified age of the respondents. To assess motor ability of coordination, the test of *coordination with a bat (s)*, was used, which proposed Stanković and Stanković (1994).

In the process of obtaining results significant for this study, we started with estimating the difference between the initial and final measurements for control and experimental group respectively. We applied the analysis of a paired samples T test (repeated measures). In this way, the determined values were shown as indicators of how motor ability of coordination responded to the treatment and if there were any changes between the initial and the final measurements in both groups. The entire analysis was performed with the

aim to determine if there was a difference $p \leq 0,02$. The usage of the statistical procedure in this study was enabled by using the statistical package SPSS 20.

Results

The conducted survey emphasizes the value of motor skill assessment tests during the initial and final measurements to determine the effects of the treatment in both groups of the respondents.

Table 1. Paired samples t-Test between experimental and control sub-sample in the initial and final measuring.

Sex	Group	Measurement	AM	SD	t	Sig.
Boys	Control	Initial (s)	7.84	1.981	.409	.687
		Final (s)	7.83	2.006		
	Experimental	Initial (s)	8.59	1.666	4.155	.000
		Final (s)	8.03	1.630		
Girls	Control	Initial (s)	8.79	2.804	2.081	.046
		Final (s)	8.74	2.844		
	Experimental	Initial (s)	8.48	2.753	4.561	.000
		Final (s)	8.06	2.851		

Legend: N- number of subjects; AM-arithmetic mean, SD-standard deviation, t-T test value; Sig.- statistically significant difference ($p \leq 0.02$).

In table 1 we can see the effects of the treatment and the relations between the two groups. It is evident that the experimental group made statistically significant improvement in the motor ability of coordination. On the other hand, the control group which did not undergo the experimental treatment, did not have any significant progress in the measured variables, although the results of the measurement showed improvement. Having considered the average values between the initial and final measurements, it has been recorded to what extent have both groups made progress. It should also be noted that there was no deterioration in either of the two groups.

Discussion

The conducted three-month treatment, the application of the complex movement task polygon as a teaching method, has contributed significantly the improvement of motor ability of coordination in the primary school-aged

students of both sexes. The subjects in the experimental group showed better performance on coordination assessment tests compared to the subjects in the control group. The treatment effect is more visible in the boys than in the girls. The reason for this is the fact that boys, in this period of their lives, due to a rich motor life achieved through running, climbing and jumping and a greater desire to win as well as a larger motive for achievements, have better results on the tests of coordination and running speed compared to girls (Fairclough, Boddy, Ridgers, Stratton, & Cumming, 2011; Seabra, et al., 2013). Better-developed motor skills in boys come from intense movement in pre-school and primary school. Demands and characteristics of natural features of the movements, which are usually the subject of interest in small children at this age, can also be considered as causes for the development of coordination. Due to the treatment, the experimental group develops coordination through numerous types of jumping, crawling, climbing, running, etc., unlike the control group that mainly practice individual polygon elements in smaller space, with fewer but more precise movements. The contribution to these findings is also possible because of the sensitive period as one of the coordination development mechanisms. The fact is that the children at the age of 7-11, develop the capacity to improve coordination (Vandrope, et al., 2012). Taking into account that the conducted treatment is completely focused on coordination, the mechanism of its development and improvement is more efficient. Stimulating the muscle apparatus and the central and peripheral nervous system through the overall exercise structure, the following is improved: execution of movements with greater efficiency, synergy of movements and the ability to be agile and change the direction of movements (Schieber, & Santello, 2004).

The subjects in the control group underwent the treatment which consisted of individual polygon elements, but was still different from the treatment of the experimental group. Such treatment was conducted during the regular physical education classes, through teaching lessons. This helped to improve coordination; however, not to a significant level. Regular attendance of both groups of respondents certainly contributed the improvement of results on the coordination tests (Yasumitsu, & Nogawa, 2013), but the application of a specific treatment (complex movement task polygon), makes a significant effect on coordination. Earlier studies which have dealt with the problem of the application of the polygon as well as complex movement tasks have obtained similar findings (Žuvela, Božanić, & Miletić, 2011).

Regarding the overall problem of implementing physical education in the lower grades of an elementary school, especially in terms of the development of motor skills, and coordination as well, this study, and all the

future researches, should complete the picture on how necessary it is to introduce specially designed programs. This would mean the intensive use of complex movement task polygon within the physical education curriculum, primarily aimed at development of motor abilities in both male and female primary school-aged students.

It is known that the period the student spends in the lower grades (from the age of 7 to 11) is very important for the development of a child, who at this age easily acquires motor skills. Taking into consideration that coordination is closely related to CNS (Carson, 2006; Reeves, Pathak, Popovich, & Vijayanagar, 2013; Pelemiš, Pelemiš, Mitrović, & Džinović, 2014) the majority of authors insist that improving this ability should start from early childhood as the neuro-muscular system is in its developmental phase at the time. The most suitable period for the development of coordination is considered to be the period between the age of 9-12 for boys and 8-11 for girls (Balyi, & Hamilton 2004). Based on the data obtained in their study, Kukolj, Ugarković and Matavulj (1998) conclude that the development of motor efficiency up to the age of 12-13 should be encouraged through complex coordination activities, whereas the phases of the complementary development of different motor skills should be achieved through a change of dynamic characteristics in movements of different complexity. Džinović-Kojić, Pelemiš, & Mitrović (2012), among other findings of an extensive study, point out the fact that the sensitive period for the coordination development is between the age of 7 and 11. Therefore, it is of great importance to dedicate special attention to coordination in the primary school-aged children with a view to developing and improving (Augste, Jaitner, & Storr, 2012; Favazza, et al., 2013). The level of coordination determines further development of the majority of other motor skills, except for flexibility (Haehl, Vardaxis, & Ulrich, 2000). The children who showed better results on coordination tests also showed better results on other tests for other motor skills (Marinković, 2012; Andreeva, & Akimov, 2011; Wilson, Miles, Vine, & Vickers, 2013).

Conclusion

We can conclude that this approach in working with primary school-aged children, which is, apart from other things, suitable for developing motivation and positive attitudes towards physical education. Modern, planned and programmed approach to the learning process of physical education in primary school-aged children contributes the development of the entire personality of a child as an integral human being (Ismail, & Gruber, 1971).

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