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Research Insights
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LEVELS OF TRANSFORMATIONAL CHANGES IN MOTOR STATUS OF PRESCHOOL CHILDREN UNDER THE INFLUENCE OF DIFFERENT MODELS OF EXERCISE PROGRAMS

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Abstract. Directed motor activity can affect the anthropological status of children more effectively than unstructured and free activities. The paper examines the impact of two three – month programs on the transformation of the anthropological status of male children aged 6. A statistically significant difference was confirmed in all tested variables (running 20m, backwards polygon, hand tapping, sitting forward lean, long jump, sit up, hand plank) between the initial and final measurements. The outdoor polygon led to greater positive changes in the motor status of preschool children than shaping exercises with elements of games. It is necessary to further investigate the optimal relationship between these two types of directed exercises.

Keywords: motor skills; program orientation; design exercises; games; polygon

Introduction

The specifics of organizational forms of preschool children's activities are based on the needs for movement as one of the fundamental needs of a child. One of the forms in working with preschool children is directed motor activity. The structure of the program of directed motor activities of preschool children shows all the richness and diversity of programs, accessible and adaptable to the needs of children (Jevtić et al. 2011). One of the characteristics of directed motor activity of preschool children is the focus of the program on the optimization of certain dimensions of motor status. This is achieved by applying a specific methodology and methodology for the implementation of individual programs in accordance with their goal and purpose (Visnjic et al. 2004). Directed motor activity can more effectively influence the anthropological status of a child, in comparison to unstructured and free activities. This is evidenced by research conducted to determine the development of gross motor skills over a period of three years in two different preschool institutions.

The results of the study show that the experimental group that had organized motor activity in relation to the control group, which had occasional activities through unstructured free play, achieved much better results on tests assessing their motor status (Borhen, Vlahov 1989). In many preschool institutions, children are rarely included in adequate programs that would sufficiently influence the transformational processes of the motor status (Jevtić et al. 2011). The motor status of children is largely conditioned by the functional mechanisms of the central nervous system that does not reach full maturity, and this is one of the main reasons for insufficiently clear differentiation of motor abilities at this age (Kurelić et al. 1975). General motor skills are gradually improved during the preschool period, but not always in a linear way (Gallahue, Ozmun 1998; Popović, Cvetković and Grujčić 2006; Cvetković, Popović and Jakšić 2007). Research by Kosinac (1999) confirmed the effect of a three-month kinesiology program for preschool children (6 years) on anthropological characteristics and motor skills. The results of this study showed that programmed physical exercise affects the development of motor characteristics of preschool children, while there were no significant transformational changes in anthropometric characteristics. The results showed that after the application of the program boys have better results in coordination, strength, speed and precision, while better results were registered girls in terms of flexibility. Complex sensitivity of motor abilities is evident in children aged 6 years (Bompa 2001). In the seventh year, that sensitivity decreases, and even loses, and in the eighth year, a certain increase is registered, but not to a large extent (Rachev 1984).

Bala (2002) conducted a study of children aged 6 – 7 where he applied a set of 7 composite tests to check motor skills. Based on the obtained results, the existence of a general factor of motor abilities is indicated, which is quantitatively the same in boys and girls of preschool age. Marinković (2013) applied seven tests of motor abilities and five for anthropometric measures in order to determine the connection between coordination with motor abilities and anthropometric characteristics of preschoolers in girls aged 4 to 6 years. The results of this study showed that motor skills in preschool girls are related in a specific way and that coordination has an impact on other motor characteristics. Measuring motor skills in preschool children is a complex process. Based on the research, it has been confirmed that preschool children can hardly respond to stimuli in terms of motor skills, and especially to those that are expressed in a verbal way. Motivation and maturity at that age can be a key link. According to the allegations (Luke and Sinclair 1991), it is necessary to select children according to motivation and maturity at the very beginning. For that reason, the results obtained in some tests can be confusing. The application of various models of physical activity programs in preschoolers stimulates their motor development, and thus cognitive and affective because at that age they are integrated into one whole. The connection between cognitive and motor abilities has been determined, and that connection is mostly manifested in the assessment of

coordination. This speaks of the connection between the performance of motor tasks and cognitive abilities (Kirkendall, Ismail 1976; Planinšec 2002; Planinšec 2006), and it is assumed that such tasks are at a higher level of cognitive functioning, and simple at a lower level, ie. elementary level.

This study deals with the problem of directed motor activities where two methods are applied for children aged 6 (a polygon for children in the nature, shaping exercises with music with elements of games). As a result of studying the adequate literature, which treats the problem of directed motor activities, the research problem is defined in the form of a question: Do and to what extent different models of directed activities affect the transformation of motor status of preschool children aged 6? Based on a review of literature sources and theoretical analysis as well as defining the problem, a general hypothesis is defined: The applied models of directed motor activities will positively influence the quantitative changes in the motor status of preschool children aged 6. According to the problem, the goal of the research is defined: Determining the level of the motor status of preschool children aged 6 under the influence of a three-month program of directed motor activities (a polygon for preschoolers in natural conditions, exercise with music with elements of games). In order to realize the set goals of the research, it is necessary to realize the following research tasks:

– Study of sources from the literature on the effects of the application of programs of directed motor activities in preschool children, as well as theoretical analysis of the effects of individual programs on their motor status;

– Determining the mean level and variability of motor characteristics of preschool children in the examined groups (E1, E2, K);

– Determining the degree of homogeneity of groups;

– Determining the significance of the level of transformation processes of the motor status of preschool children from the initial to the final measurement using the Student's t-criteria.

Methods

The sample consisted of 36 boys of preschool age, aged 6. Subjects were clinically healthy and included in regular preschool activities, regularly participated in a program of targeted motor activities (12 weeks, 3 times a week), with parents consenting for children to participate in the experiment. The experimental factor was realized within two models of the program of directed motor activities. The experimental program E1 - a polygon in the open air was made up of appropriate obstacles where the basic forms of movement were applied: walking, running, jumping, stretching, athletic exercises, etc. Experimental program E2 – contained: shaping exercises with music with elements of games. The framework of both programs of directed motor activities consisted of contents aimed at the development of general motor skills, taking into account the individual differences

between children, as well as the uniformity of groups - groups that participated in the experiment (each group consisted of 12 boys, and their results on the initial tests were approximately the same) which can be seen in Table 1.

Table 1. Homogeneity of groups on initial measurement

Initial measurement ANOVA (E1, E2, K)				
	Leven´s test	sig	F test	sig
Running 20 m	0,007	0,993	0,000	1,000
Backwards polygon	0,013	0,988	0,001	0,999
Hand tapping	0,110	0,896	0,014	0,986
Sitting forward lean	0,033	0,968	0,017	0,983
Long jump	0,001	0,999	0,003	0,997
Sit up	0,009	0,991	0,005	0,995
Hand plank	0,112	0,894	0,016	0,984

The significance values of Leven 's test of equality of variances of the tested samples show that the variances of the tested groups are homogeneous. The F-test shows a higher significance of 0.5, which means that there is no statistically significant difference between the examined groups (E1, E2, K) on the initial measurement, so it can be argued that the groups were uniform at the initial measurement. The duration of the applied program models was 3 months (3 hours per week x 35 minutes). Both applied programs were conducted by qualified experts in the field of physical education. In addition to experimental groups E1 and E2, control group K was included in the experiment. Control group K consisted of children who attended preschool and who were not included in one of the specialized programs, but attended activities that were provided by the curriculum of the institution. Measuring of the motor status of preschool children was performed using appropriate motor tests. Testing of the examinees was performed in the morning in a physical education hall with appropriate microclimatic conditions. Instruments were calibrated prior to testing and are standard. During the procedure, the respondents were in appropriate sports equipment. Organization of measurements – All measurements of motor status at the initial and final testing were performed according to the principle of measuring stations (6 subjects at each station). One meter, one recorder and 6 respondents were present at each measuring station. Each motor characteristic was measured by one and the same meter. The team that performed the motor diagnostics consisted of people with many years of experience. The motor diagnostics of the examinees was performed before the beginning of the treatment (initial measurement) and after the treatment (final measurement). In the research, a set of tests for adults was used, which was modified for preschool children (Bala 1996; 1999a; 1999b; Bala, Popović, Stupar 2002a). The set of tests

showed good metric characteristics in both adult and preschool children. Tests to assess motor skills in adults were used to assess the effectiveness of the following mechanisms: structuring movement, synergistic regulation and regulation of tone, regulation of excitation intensity and regulation of excitation duration (Kurelić et al. 1975; Gredelj et al. 1975). The following tests were used to assess the motor status of the subjects, which included 7 variables from the motor status space:

– Backwards polygon (for assessment of body coordination),
– Hand taping (to estimate movement frequency),
– Sitting forward lean (for explosive power assessment),
– Sit upsfor 60 seconds (to assess repetitive power),
– Hand plank(for estimating static force),
– Running 20 m (to estimate running speed).

A complex methodology consisting of the following methods was applied to realize the research tasks and achieve the goals:

– Method of content analysis – theoretical analysis – study of the literature on the transformation processes of the motor status of preschoolers in various program models;

– Experimental method with two experimental groups (a polygon in natural conditions in the open air, shaping exercises with elements of elementary games), as well as one control group K which attended the activities provided by the plan and program of the institution;

– Method of motor diagnostics in order to determine the motor status of preschool children;

– Statistical methods (Descriptive statistics method, Student's t-test to test the significance of the differences between the results on the initial and final measurement, analysis of variance with one factor (ANOVA1) to test the uniformity of groups on the initial measurement.

Results and Discussion

Table 2. Descriptive statistical indicators of motor status on the initial and final measurement of respondents

			Coef. of var	Stand. dev	Range	min	max	M
Running 20 m(s)	E1	I	0,14	0,84	2,40	5,10	7,50	6,03
		F	0,12	0,63	1,90	4,20	6,10	5,12
	E2	I	0,14	0,85	2,46	5,14	7,60	6,04
		F	0,13	0,74	2,40	5,00	7,40	5,81
	K	I	0,14	0,85	2,40	5,12	7,52	6,04
		F	0,14	0,84	2,37	5,13	7,50	6,04

Backwards polygon (s)	E1	I	0,31	8,19	21,31	17,65	38,96	26,37
		F	0,31	6,18	18,40	12,80	31,20	19,77
	E2	I	0,31	8,13	21,36	17,48	38,84	26,37
		F	0,30	6,88	20,72	15,20	35,92	22,60
	K	I	0,32	8,39	21,62	17,30	38,92	26,52
		F	0,31	8,10	20,79	17,31	38,10	26,29
Hand tapping (rep.)	E1	I	0,26	3,55	11,00	9,00	20,00	13,92
		F	0,17	3,28	10,00	15,00	25,00	19,67
	E2	I	0,28	3,83	11,00	9,00	20,00	13,83
		F	0,24	3,99	12,00	12,00	24,00	16,50
	K	I	0,27	3,87	12,00	8,00	20,00	14,08
		F	0,31	4,31	14,00	7,00	21,00	14,00
Forward lean sitting (rep.)	E1	I	0,20	8,08	22,00	30,00	52,00	41,17
		F	0,20	8,59	24,00	31,00	55,00	43,58
	E2	I	0,20	8,21	23,00	30,00	53,00	41,25
		F	0,20	8,34	24,00	30,00	54,00	42,25
	K	I	0,21	8,52	22,00	30,00	52,00	40,67
		F	0,21	8,51	22,00	30,00	52,00	40,67
Long jump (cm)	E1	I	0,26	24,71	79,00	54,00	133,00	93,92
		F	0,20	22,96	86,00	62,00	148,00	112,75
	E2	I	0,26	24,81	80,00	52,00	132,00	93,83
		F	0,21	22,32	82,00	60,00	142,00	106,00
	K	I	0,26	24,90	78,00	53,00	131,00	94,58
		F	0,26	24,59	78,00	54,00	132,00	95,42
Sit up (rep.)	E1	I	0,65	8,66	27,00	1,00	28,00	13,33
		F	0,51	9,26	29,00	4,00	33,00	18,00
	E2	I	0,64	8,72	27,00	0,00	27,00	13,58
		F	0,59	8,88	28,00	2,00	30,00	15,17
	K	I	0,65	8,89	28,00	1,00	29,00	13,67
		F	0,65	8,92	28,00	1,00	29,00	13,75
Hand plank (s)	E1	I	1,05	10,44	33,70	1,50	35,20	9,91
		F	0,65	9,87	33,90	7,28	41,18	15,08
	E2	I	1,09	10,01	33,51	1,39	34,90	9,20
		F	0,80	9,83	33,00	4,20	37,20	12,32
	K	I	1,07	10,03	33,36	1,74	35,10	9,36
		F	1,06	10,05	33,90	1,70	35,60	9,45

Descriptive statistics (Table 2) indicate the homogeneity of the experimental groups (E1 and E2) and the control group (K) in the following motor variables on the initial and final testing: running at 20m, hand tapping, sitting forward lean, long

jump. The dynamics of the results in the test for the assessment of coordination of preschool children (back polygon) shows that the set is on the border of homogeneity (V = 30%), i.e. the tested variable can be described as insufficiently homogeneous. The tested variables: torso lift (repetitive force) and hand plank(repetitive force), describe the experimental groups (E1 and E2), as well as the control group (K) on the initial and final measurement as extremely inhomogeneous groups, i.e. large variations of the tested properties, repetitive strengths and repetitive forces are present. The obtained results of variations of the examined characteristics represent the result of non - differentiation of various properties of the motor status of preschool children. Insight into the results of the mean values on the speed test – running at 20 m shows approximate values in the experimental groups E1 – outdoor polygon (increment -0.91s) and E2 – shaping exercises with elements of elementary games (increment -0.23s), while in control group K no improvement in results was registered. Based on the mean values of the results on the test of running speed at 20m, we can see that there was an improvement in motor ability in speed in the experimental groups E1 and E2, which is in line with the recommendations of some authors (Malina, Bauchard, Bar-Or 2004). period preschool children should work on the development of speed. By inspecting the mean values on the coordination test – backward polygon, the final measurement registered an improvement in coordination abilities in the experimental group E1, where an increase of -6.6s was recorded, and in the experimental group E2, an increase in results was also recorded, but to a lesser extent -3.77s, while in the control group K a minimal increment of results of -0.23s was registered. It is indisputable that there was an intensive development of coordination skills after treatment in the experimental groups E1 and E2, and the period of preschool age is a developmental period in which coordination skills should be developed (Malina, Bochard, Bar-Or 2004). The dynamics of the results of the mean values on the test of segmental velocity estimation - taping by hand at the final measurement shows an increase in the experimental group E1 of 5.75, and in the experimental group E2 an increase of 2.67 was also recorded, while in the control group K minimal and amounts to 0.8. Inspection of the mean values of the test for the assessment of mobility - inclination in the sitting position in the final test during the final testing registers an increase in the results in the experimental group E1 of 2.41 cm, and in E2 an increase of 1.00 cm was also recorded. Control group K did not optimize mobility results. The average measured value on the long jump test after the applied treatment recorded the largest increase in the experimental group E1 of 18.83 cm, and in the experimental group E2 an increase of 12.17 cm was registered, while in the control group K the increment of results is the smallest and amounts to 0.84 cm. The obtained results of the mean values on the repetitive strength test after the experimental treatment show an increase (E1 increase of 4.67; E2 increase of 1.59; K increase of 0.08). The dynamics of the indicators of the mean values on the test hand plank at the final

measurement show a significant increase in the experimental group E1 of 5.19s, E2 of 3.12s, and in the control group K the increase is minimal and amounts to 0.09s. Table 3 shows the quantitative changes in the motor variables of the experimental groups and the control group between the initial and final measurements, i.e. the results of t-test of dependent variables and the level of significance of p motor indicators of the examinees are presented.

Table 3. Comparative statistical indicators of motor status on the initial and final measurement of respondents

	E1		E2		K	
	t	sig	t	sig	t	sig
Running 20 m	10.736	0.000	2.691	0.021	-0,383	0.709
Backwards polygon	9.307	0.000	6.773	0.000	1.176	0.265
Hand tapping	-32.045	0.000	-10.407	0.000	0.290	0.777
Sitting forward lean	-8.403	0.000	-4.690	0.001	0.000	1.000
Long jump	-9.438	0.000	-7.330	0.000	-2.590	0.025
Sit up	-15.065	0.000	-8.204	0.000	-0.364	0.723
Hand plank	-6.881	0.000	-20.441	0.000	-0.987	0.345

The obtained results of the Student's t-criteria in the experimental groups E1 and E2 show a statistically significant difference in the level of significance $p < 0.05$ in all analyzed motor variables. In control group K, a significant statistical difference was found between the initial and final measurements only for the long jump variable ($t = 2,590$, $p = 0,025$). This long jump result in control group K was most likely influenced by the motivation of the children to participate in the test, which is in line with previous research (Luke and Sinclair, 1991). By projecting the obtained results (Tables 2 and 3), and primarily on the basis of the value of the t-test, i.e. based on statistical significance, it is observed that there are statistically significant differences in the motor space of all tested variables in experimental groups E1 and E2. Insight into the mean values of the tested variables shows that the best results were achieved by the experimental group E1 (outdoor polygon), and then by the experimental group E2 (shaping exercises with elements of elementary games). Exercises in nature give a better effect due to the ambient factor, longer continuous multistructural movement, constant use of the whole-body during movement, as well as due to the social factor represented in the joint solution of motor tasks (Višnjić et al., 2004). Although outdoor polygons give better results than shaping exercises with elements of elementary games, this does not mean that other forms of exercise should be excluded because they are complementary and

ideally complementary in terms of unity of motor characteristics with cognitive and conative factors. It is indisputable that the experimental treatment of directed motor activities caused positive changes in the transformational processes of the motor status of the experimental groups.

Conclusion

Based on the results of the study, the following conclusions can be drawn:

– Application of experimental programs of directed motor activities (outdoor polygon, shaping exercises with elements of elementary games) are a good instrument in order to optimize the motor status of children aged 6;

– The results of descriptive statistics indicate positive transformational changes in motor status in all tested variables, and the dynamics of the coefficient of variation (V%) in most variables at the initial and final measurement describe the groups as homogeneous;

– A significant difference in the results of all testing of variables between the initial and final measurement of the experimental groups using the Student's t-test was confirmed;

– Exercising on an outdoor polygon led to greater positive transformational changes in the motstatus of preschool children than shaping exercises with elements of elementary games.

– Although outdoor polygons give better results than shaping exercises with elements of elementary games, this does not mean that other forms of exercise should be excluded because they are complementary and ideally complementary in terms of unity of motor characteristics with cognitive and conative factors.

– Future research should focus on solving the problem of the optimal relationship between these two types of targeted exercise in preschool children.

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