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Vocationally Relevant Physical Qualities, Psychophysiological Functions, and Their Variability with Students of Railway Transport Universities

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Abstract — **This paper dwells on the scientifically proven methods and fundamentals of vocational physical education that can be applied to the process of students' personality development throughout their vocational education. The paper presents the results of the research performed with the aim to establish the degree to which instructors' influence by means of Physical Education can affect students' mobility, personality abilities and cultural traits. All of the above can determine how well future professionals can develop their vocational physical condition. One of the characteristic features of creating students' professional physical education at the university level is to meet their social and personal needs in becoming mature specialists, which conditions in-depth profiling of obligatory physical education course through enhancing physical cultivation. The conducted experiment was aimed at improving coherent vocational education and its efficiency, which can promote students' maturity and their physical culture. The paper presents the analysis of correlation between theoretical basics and vocationally important mobility and personality traits with railway professionals; it reasons the educational programme for profiling physical education for students of a particular major.**

Keywords — professional physical education, physical education activity, professional direction, physical traits, pedagogical experiment, level of fitness, psychophysiological qualities.

I. Topicality of the Research

Specific work conditions and higher demands of the occupation determine the requirements for mobility, psychophysiology and social personality skills of the professional. The results of the research are as follows: the major's job profile diagram is designed; the following physical qualities necessary for bridge construction crew-members are defined, such as: overall body endurance, action speed, dorsal spine mobility, body flexibility, balance stand. It is important to identify how well alertness, stamina and emotional strengths are developed in an individual, as well as personal traits of character that are part of leadership abilities, such as collectivism, decisiveness, self-control and self-possession, proactivity, and critical thinking [1, 2].

It becomes more and more topical to research the pedagogical influence targeting the development of a number of personal abilities by means of physical education. Future professionals' human potential is shaped by a set of mobility and personality skills [3–5].

II. Methods and Material

During the experiment conducted there were formed three groups of testees:

– the control group followed the PE curriculum document approved by the Ministry of Education [3, 6, 7];

– the 1st experimental group followed the professionally-designed PE curriculum document for railway universities that was recommended for application several years ago [8];

– the 2nd experimental group followed the PE curriculum document that was designed by the authors of this research [9].

The experimental curriculum document designed by the authors was based on the job profile diagram analysis of working conditions of bridge and transport tunnel constructors to provide overall and targeted impact on a professional's personality. The programme was designed on the basis of effective PE curriculum documents and covers the contents of a university PE curriculum document.

The contents of the experimental curriculum document are designed in accordance with the current job demands and are experimentally proven within the FESTU facilities. It takes into consideration the specificity of vocational guidance

throughout educational stages in bridge construction major learning process.

TABLE I. COMPARATIVE ANALYSIS OF STUDENTS' PSYCHOPHYSIOLOGICAL DATA IN THREE GROUPS

№	Indices	Period	Control Group		2nd Experimental		Difference, %	t	P	1st Experimental		2nd Experimental		Difference, %	t	P
			$X \pm m$		$X \pm m$					$X \pm m$		$X \pm m$				
1	Lung Capacity, ml	before	4304	153	4160	165.9	3.35	1.33	>0.05	4236	156.5	4160	166	1.79	0.14	>0.05
		after	4272	133	4749	90.5	-11.17	4.2	<0.05	4460	105.2	4749	90.5	-6.47	2.1	<0.05
2	Back Strength, kg	before	144	4.01	142	3.87	1.39	0.37	>0.05	140	4.37	141.96	3.87	-1.4	0.3	>0.05
		after	142.2	4.33	158	2	-11.11	3.4	<0.05	152	1.9	158.24	1.99	-4.08	2.2	<0.05
3	Dynamometry right hand, kg	before	37.24	1.23	38.1	1.13	-2.36	-0.5	>0.05	37.9	1.2	38.12	1.13	-0.53	-0.1	>0.05
		after	36.4	1.08	43	1.07	-18.2	4.4	<0.05	40.7	1.26	43.04	1.07	-5.8	1.4	>0.05
4	Dynamometry left hand, kg	before	40.36	1.32	37.4	1.13	7.43	1.72	>0.05	37.6	0.85	37.36	0.89	0.64	0.2	>0.05
		after	35.24	1.01	40.3	1.18	-14.3	3.2	<0.05	38.7	1.25	40.28	1.18	-4.03	0.9	>0.05
5	Dorsal Spine Mobility, cm	before	3.4	0.66	3.64	1.4	-7.05	0.6	>0.05	3.27	0.87	3.64	1.4	-11.31	1	>0.05
		after	4.3	0.71	5.16	0.58	15	2.4	<0.05	4.05	0.73	5.16	0.59	-27.4	2.2	<0.05
6	Timed Inspiratory Capacity, sec	before	67.8	4.29	63.2	0.63	6.73	0.91	>0.05	63.2	3.43	63.24	1.07	-0.13	0	>0.05
		after	67.72	3.94	97.2	4.12	-43.5	5.2	<0.05	80.8	4.96	97.2	4.12	-20.3	2.5	<0.05
7	Stange's test, sec	before	32.48	2.41	31.7	2.32	2.34	0.23	>0.05	31.8	2.64	31.72	2.32	0.38	0.03	>0.05
		after	35.36	2.12	53.1	2.04	-50.2	6	<0.05	43.6	2.7	53.12	2.04	-21.8	2.8	<0.05
8	PWC 170, kg/min	before	941.4	18.1	943	17.25	-0.19	0.1	>0.05	934	18.15	943.17	17.2	-0.94	0.4	>0.05
		after	985.8	13.5	1089	14.14	-10.4	5.3	<0.05	1038	15.21	1088.7	14.1	-4.86	2.4	<0.05
9	Cold Test, min	before	3.04	0.23	3.2	0.24	-5.26	0.5	>0.05	3.08	0.25	3.2	0.24	-3.9	0.3	>0.05
		after	3.12	0.22	2.08	0.14	33.3	4	<0.05	3.2	0.24	2.08	0.14	35	3.97	<0.05
10	Eye Sketch, cm	before	2.5	0.5	1.48	0.15	41.1	1.99	>0.05	1.6	0.13	1.47	0.15	7.94	0.63	>0.05
		after	2.2	0.49	0.67	0.08	69.6	3.1	<0.05	1.21	0.17	0.66	0.08	45	2.79	<0.05
11	Reflexometer, sec	before	0.23	0.03	0.23	0.02	3.7	0.25	>0.05	0.24	0.03	0.23	0.15	5.45	0.09	>0.05
		after	0.24	0.03	0.15	0.01	39	3.34	<0.05	0.22	0.03	0.14	0.01	34.2	2.8	<0.05
12	Shuttle Run 4x9 m, sec	before	9.77	0.13	9.76	0.1	0.08	0.05	>0.05	9.68	0.11	9.76	0.11	-0.83	0.5	>0.05
		after	9.75	0.13	9.3	0.06	4.63	3.03	<0.05	9.42	0.07	9.3	0.06	1.27	1.22	>0.05
13	3000-meter Run, min	before	13.7	0.2	14.2	0.1	-3.65	1.01	>0.05	14	0.18	14.2	0.1	-1.43	0.59	>0.05
		after	14.2	0.29	12.8	0.12	9.86	3.07	<0.05	13.5	0.16	12.8	0.13	5.19	2.23	<0.05
14	60-meter Run, sec	before	8.6	0.06	8.66	0.09	-1.74	1.3	>0.05	8.72	0.08	8.66	0.1	0.64	0.43	>0.05
		after	8,36	0.06	8.2	0.07	2.01	1.79	>0.05	8.37	0.06	8.12	0.07	2.1	1.91	>0.05
15	Pull-Ups, times	before	9	0.66	8.76	0.58	2.67	1.53	>0.05	8.8	0.67	8.76	0.59	0.45	0.04	>0.05
		after	11.9	0.49	14.7	0.6	-23.5	2.9	<0.05	12.6	0.55	14.68	0.6	-16.9	2.6	<0.05
16	Mental Determination, points	before	412.9	11.8	414	13.26	-0,35	0.96	>0.05	416	12.3	414.38	13.3	0.44	0.78	>0.05
		after	410	11.4	472	9.76	-14.2	2.46	<0.05	418	12.2	471.75	9.76	-13.3	1.5	<0.05
17	Attention Span, points	before	1.01	0.02	1.05	0.01	-3.66	0.88	>0.05	0.98	0.02	1.05	0.01	-7.92	1.3	>0.05
		after	1.03	0.01	0.84	0.03	17.5	4.24	<0.05	0.98	0.02	0.84	0.04	14.1	1.65	<0.05
18	Attentional Resource Allocation & Refocusing, points	before	32.48	1.43	33.4	1.91	-2.96	0.91	>0.05	36.3	1.7	33.44	1.91	7.83	0.84	>0.05
		after	31.6	1.3	41	0.85	-26.4	3.14	<0.05	35.2	1.7	41.04	0.86	-13.1	1.25	<0.05

In its formulization, the experimental curriculum document followed such methodological requirements as profiling of conventional physical activities with achieving applied fitness for contemporary professional activity conditions; modernization of the mandatory PE process in accordance with the specificity of vocational physical education, which involves teaching applied swimming and developing vocationally relevant personality traits and qualities; implementing teaching methods to impact students' personalities by means of vocational physical activities.

The trend data presented in Table I show the efficiency of the targeted professionally-specified physical education process for railway university students. The data reflect, first, how well the set of professionally important qualities and skills is developed with students, and, second, how well their personal physical condition is [10, 11].

The results obtained through the research prove that the starting level of profiling psycho-physical fitness with the testees of the 2nd experimental and the other two groups in the experiment was identical, which is a crucial condition for the validity of the experiment conducted.

The data analysis shows a positive and statistically proven trend data with the testees of the experimental curriculum document designed by the authors of the article. For instance, the comparison of the results with the 2nd experimental group and the 1st experimental and the control ones reveals improvement in: overall body endurance by 5,2 % and 5 % respectively; arm strength endurance by 16,9 % and 5,8 % respectively; static physical force by 4 % and 6,8 % respectively. The dorsal spine mobility results show a substantial difference with the 1st experimental group by 27,4 % and with the control one by 5,8 %; the level of agility improvement is lower by 1,27 % for the 1st experimental and by 3,38 % for the control groups if compared with the 2nd experimental group.

Such results can be explained by the fact that the qualities under analysis and their improvement were neglected since they are of low importance for the professional sphere of bridge constructors.

Comparative analysis of the functional performance proved true-to-fact improvement with the students of the 2nd experimental group and the control one by 11 %; the PWC170 value increased by 4,6 % и 10,4 % in the two groups respectively; the Timed Inspiratory Capacity value increased by 20,3 % and 43,5 % respectively; Stange's test value increased by 21,8 % and 50,2 % respectively.

The significant difference in the indices of the respiratory system activities proves the efficacy of the means (mainly swimming) employed within the designed curriculum document.

Of a particular interest are the testees' thermotaxis indices. The resulting difference between 2nd and 1st experimental groups is 35 % ($p< 0,05$), whereas the difference between 2nd and the control groups is 33,3 % ($p< 0,05$), which leads to the conclusion that those who followed the experimental programme have developed stronger body resistance to adverse environmental factors. Such ability is crucial for bridge constructors who experience significant variety of outdoors temperatures.

The data analysis to characterize vocationally relevant psychophysiological qualities for bridge construction workers reveals the positive dynamics with the students in the 2nd experimental group. These students demonstrated a more improved level of mental determination if compared with the testees of the 1st experimental group by 13,3 % and with those of the control group by14 %; the attention span level improved by 14 % and 17,4 % respectively. Attentional resource allocation and refocusing ability was assessed by means of the Schulte tables. The data obtained through the experiment proved the designed programme to be more beneficial for shaping the above-mentioned quality with the testees of the 2nd experimental group. For instance, by the end of the experiment the trend data of this quality improved by 13 % in the 1st experimental and by 26,3 % in the control groups. The indices of motor reaction that defines the lability of the nervous system are definitely improved, too.

One of the most vocationally important ability for bridge constructors is their ability to visually assess distance, i.e. eye sketch; this quality was greatly enhanced with the students who followed the designed programme. The difference with the testees of the 1st experimental group is by 45 %, that of the control group by 69,6 %.

III. Research Results and Their Discussion

As can be seen from the above, a targeted influence on students' physiological and psychological traits, which are vocationally relevant for the bridge construction major, has improved the process of shaping the testees' motorial capacity by means of the professionally-designed PE curriculum document. The overall healthcare effect with the testees of the 2nd experimental group seems to be logical. In particular, before the experiment the amount of sick days with the students in the 2nd experimental group was 4.4 days per person, in the 1st experimental group it was 3,9 days per person, in the control one it was 3,7 days per person. By the end of the experiment this amount decreased to 2,8 days per person in the 2nd experimental group, whereas in the 1st experimental group it increased to 4,2 days per person, and in the control group increased to 5,0 days per person.

The experimental PE programme proved its positive impact on enhancing the students' body defenses and preventive care of the vocational medical issues of bridge construction majors.

The main factor of such improvement in the students' professionally-profiling physical fitness was the set of applied physical activities which was realized through a significant amount of special physical exercises, both conventional and unconventional. Those means of the profiling physical education system aimed at shaping vocationally relevant traits, qualities and functions of the testees.

At the basis of the research there was a suggestion that a system of physical activities focused specifically on shaping the youth personality throughout learning process could help them get prepared for their future career.

There was employed the analysis of personality integral indicators which reveals how well vocationally relevant traits, qualities and personal characteristics are developed.

The results obtained through the research show that the integral indicator of socially-relevant qualities is 11,3 % ($p<0,05$) higher in the 2nd experimental group than in the control group and is 9,3 % ($p<0,05$) higher than in the 1st experimental group (Table 2).

It is remarkable that such characteristics as attitude towards oneself, people and society, physical activity are better shaped with the students of the 2nd experimental group.

For instance, the students in the 2nd experimental group exhibited a higher level of their preparedness for labour by 11,6 % ($p<0,05$), their attitude towards people by 24,9 % ($p<0,05$), and towards physical activity by 14 % ($p<0,05$).

The 1st experimental group exhibited a profound difference with the regard towards people by 20,9 % ($p<0,05$), towards

physical activity by 12,8 % ($p<0,05$), towards labour by 10 % ($p<0,05$) (Table 2).

The comparison of the academic performance results in the major subjects shows that the students of the 2nd experimental group achieved a qualitatively higher level of vocationally relevant knowledge by the 4th year of studying.

TABLE II. COMPARATIVE ANALYSIS OF PERSONAL ATTITUDE INDICES OF STUDENTS IN THE GROUPS (BEFORE AND AFTER THE EXPERIMENT)

№	Indices	Period	Control		2nd Experimental		Difference, %	W	P	1st Experimental		2nd Experimental		Difference, %	W	P
			$X \pm m$		$X \pm m$					$X \pm m$		$X \pm m$				
А	Towards labor	before	60	1.5	60.2	1.7	-0	0.9	>0.05	59	1.5	60.2	1.7	-2.5	0.9	>0.05
		after	59.3	1.5	66.2	2	-12	1	<0.05	60	1.6	66.2	2	-10	1.7	<0.05
Б	Towards a task	after	62.4	1.7	62.2	1.7	0.4	0.6	>0.05	61	1.4	62.2	1.7	-1.9	0.8	>0.05
		after	60	1.4	64.2	1.1	-7	0.7	>0.05	62	1.6	64.2	1.1	-3.5	1.1	<0.05
В	Towards oneself	before	61.7	1.4	62.4	1.6	-1	0.6	>0.05	61	1.5	62.4	1.6	-2.1	0.6	>0.05
		after	61.2	1.1	63.4	0.9	-3.5	0.9	>0.05	62	1.3	63.4	0.9	-2.6	0.8	>0.05
Г	Towards others	before	60.6	1.3	60	1.6	1.1	0.6	>0.05	60	1.5	60	1.6	-0.6	0.7	>0.05
		after	58.6	1.4	73.2	1.6	-25	1.9	<0.05	61	1.3	73.2	1.6	-21	1.8	<0.05
Д	Towards the world	before	60.9	1.5	64	3.1	-5	0.8	>0.05	63	3	64	3.1	-1.6	0.9	>0.05
		after	61	1.3	65.4	0.9	-7	1.3	<0.05	62	1.3	65.4	0.9	-5.9	1.6	<0.05
Е	Towards PE	before	60.9	2.8	62.2	2.7	-2	0.9	>0.05	58	1.8	62.2	3.1	-6.7	0.6	>0,05
		after	63.4	2.5	72.3	1.5	-14	1.4	<0.05	64	2.1	72.3	1.5	-13	1.4	<0.05
Total		before	367	8.5	371	9.6	-1	0.7	>0.05	362	8.4	371	9.6	-2.5	0.9	>0.05
		after	364	6.7	405	3.5	-11	4.4	<0.05	370	6.9	405	3.5	-9.3	2.4	<0.05

Moreover, there was established a direct correlation between the integral indicator of the students' personality values who followed the experimental programme with the average number of the major level of proficiency ($r = 0,758$).

IV. CONCLUSIONS AND RECOMMENDATIONS

The carried out research leads to the following main conclusions and recommendations on arranging the system of physical education. Such an approach will promote more efficient and well-rounded vocational education for students and provide their personality development and physical education culture in their professional sphere.

1. While designing the system of physical education for students, it is advisable:

– to profile the obligatory physical education according to the requirements of the vocational education, specialist's occupational activities, qualification profile;

– to develop professionally-specified physical education contents on the basis of education modeling in professional physical education, including teaching, upbringing, developing, while monitoring the quality of theoretical, methodological, and practical material learning;

– to select physical activities that aim at creating the system of knowledge and values, applied physical qualities and motorial skills and abilities, personality traits and characteristics, which define the readiness to fulfill a particular occupational activity, in accordance with to the job profile diagram и sport profile diagram;

– to monitor students' motivation and values in order to improve their self- and physical development;

– to utilize a variety of sporting and mass participation events, work-related physical recreation and rehabilitation activities; to implement them in both theoretical courses and job training.

2. While planning the academic year training course, it is necessary to provide its focus on the essential components of professionally-designed physical education activity:

– to shape theoretical knowledge on vocational profiling of professionally-profiling physical education, healthy lifestyle and various forms of self-development;

– to target the value of doing professionally-specified physical activities through appreciating their role and meaning for oneself;

– to employ the considerable amount of specific physical exercises within conventional and non-conventional means of professionally-specified physical education for better shaping of vocationally relevant physical conditions and psychophysical level of future professionals;

– to target shaping of personality traits, characteristics and qualities that are characteristic of a true professional.

3. While designing the structure and contents of physical education classes, to fulfill the major educational tasks

concerning professionally-specified physical education it is important:

– to use means of day-to-day control to monitor the learning process and achievements through extra assignments and home work;

– to provide personalized tasks and self-tuition in accordance with students' personal needs, fitness level and values;

– to implement the theoretical component of professionally-specified physical education importance coordinated with motor performance;

– to utilize means of psychophysical and psycho-emotional training (e.g. auto training), intensive development of vocationally relevant abilities and skills (e.g. applied swimming);

– to provide coordinated shaping of applied abilities and skills and vocationally relevant physical and personal traits.

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