

Optimization of psychophysiological indicators of adolescents by means of sport orienteering

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Abstract.

Analysis of scientific and methodological literature testifies about the importance of schooling period for the formation of a fully developed personality, creating the basis for further harmonious development. The availability and effectiveness of using sports orienteering in organizing and conducting practices with senior pupils at the Physical Education lessons, allows to solve the issues typical for a modern school. The aim of the research is to theoretically substantiate, develop and experimentally test the teaching methods of orienteering in high school students in the process of physical education.

On the basis of the conducted studies, it was developed the orienteering teaching methodology which includes the goal and objective of training, motivation of educational activity, thematic planning, control and management of the educational process. It was established a significant ($p < 0.01$) increase in the average statistical results, characterizing cognitive functions in girls and in young men. There was a significant improvement ($p < 0.05$) in indices of well-being, activity, mood in the students of the EG. It was observed positive dynamics of functional indicators and indicators of physical readiness.

Key words: orienteering, teaching methodology, physical education, high school students.

Introduction

At the present stage of the development of the national school in Ukraine, the important strategic task of reforming of the education content is the need to promote the physical and mental health of young people, to take into account the needs of the person-oriented targeting of teaching and educating students, the development of priorities for a healthy lifestyle (Krutsevych, 2000; Bolotin, 2015; Yarmak, 2017; Galan, 2017; Lazareva, 2017; Nakonechnyi, 2017; Pityn, 2017).

Analysis of the data of special literature shows that the period of schooling plays an important role in the formation of a fully developed personality, the creation of basic provisions for further harmonious development (Tymoshenko, 2011; Dutchak, 2012; Arefiev, 2013; Dubohai, 2016; Andrieieva, 2017; Kashuba, 2017).

According to many scientists, sport orienteering opens up ample opportunities for teachers and students (Slonov, 2003; Dotsenko, 2013; Celestino, 2015). Conducted scientific research shows that sports orienteering contributes to physical development, education of strong-willed and moral qualities (Voronov, 2014) development of intellectual abilities, increase intellectual work capacity (David, 2008; Kolomiets, 2008; Galan, 2017), improvement of indicators of functional state and physical health (Korol, 2015); an effective means of conjugate development of the basic physical qualities and motor skills of students (Khimenes, 2016; Galan, 2016). Analysis of studies conducted in various countries of the world confirms the theory of the effectiveness of the introduction of the orienteering tools in the process of physical education of schoolchildren (Midtbø, 2014). At the same time, in the modern educational and methodological literature, the issues related to orienteering teaching at Physical Education lessons are not sufficiently covered.

Materials and Methods

Methods used during the investigation: the method of theoretical analysis, generalization of methodological and scientific literature and analysis of documentary materials, which gave the opportunity to study the methodological and theoretical bases of organization of physical education of upper grades pupils; pedagogical observation of the educational-upbringing process of pupils; pedagogical testing of physical

preparedness; formative and noteworthy pedagogical experiments, with the aim of gaining the necessary for the development and study the effectiveness of methods of education of sport orienteering information, in the process of physical education of the pupils of upper grades.

Anthropometric and physiological methods of investigation were used to obtain information on physical state indicators. To study the psychoemotional state of the students, the "WAM" method was used. Psychophysiological methods of investigation were used to determine a complex visual-motor reaction, the accuracy of perception of size, speed and volume of information processing, and the volume of short-term memory. The Jaguar computer system, the complex of computer psychodiagnostic programme "Personal Psychology", the Windows version of Effect on Studio 2005, and the test, recommended by the European Association of Psychologists, based on the Wexler-Shannon technique, were used to process the experimental results of the study in order to quantify them and quantitative analysis and validity of the conclusions. The study was conducted at the bases of Irpin general education schools No. 17, No. 18, schools of the I-III stages No. 62, School No. 160 of the Darnytskyi district of the city of Kyiv, Kyiv-Pechersk Lyceum No. 171.

Results

In the process of studying the morpho-functional indicators of high school students, it was revealed that the distribution of the average values of anthropometric and physiological indicators of boys and girls was within the age limits. The mean group values of static and dynamic coordination correspond to an unsatisfactory level, a high variability of these indicators is observed.

The indicators of well-being, activity, and mood were in the range of 3.8-4.5, which indicates their low level. The students of the upper grades have low and lower than the average level of physical condition, that confirms the data of the special literature (Krutsevych, 2000; Palchuk 2013; Yarmak, 2017).

Optimality of the choice of means and methods of teaching physical exercises for high school students is due to the age-specific features of physical and psychological development.

Based on the structural-system approach, the proposed model of the management of educational and teaching process of the upper grades pupils during orienteering teaching, which is a theoretically and practically created structure reflecting the stages and components of the process of orienteering teaching of high-school students in a schematized and visual form.

The peculiarity of the developed pedagogical model is, properly, the pedagogical system of components of effective management of the process of knowledge, skills and habits formation; the system-block interpretation of the components of the educational process; clearly defined functions of a Physical Education teacher as a subject of management of the process of learning motor skills; the completeness of the educational process is ensured by the presence of direct and inverse links between its participants.

The purpose of the teaching and educational process of high school students in the process of orienteering teaching was to develop the ability of students to orientate themselves on the terrain. During the study, the following tools were used: physical exercises (special running exercises, special jumping exercises, exercises aimed at the developing individual physical qualities), exercises for separate muscle groups; technical-tactical exercises (exercises for the development of memory, thinking, attention, exercises targeted at forming and improving the ability to read the map, exercises aimed at correct orientation of the map, exercises aimed at rational selection of objects (reference points) exercises aimed at determining the distance between objects, exercises aimed at mastering work with the compass, etc.), a variety of quests.

The proposed orienteering teaching methodology includes the following components: goals and objectives of training; motivation of educational activity; thematic planning; means and methods of teaching; forms of organization of academic work.

The results of the studies made it possible to establish that the formation of the motivation of high school students for systematic exercise is effective under certain conditions. First and foremost, groups of methods of upbringing that contributes to a comprehensive positive impact on the consciousness, feelings and will of students should be used to build their confidence in the need of physical exercises (conversation, story, debate, an example of this). The tasks and exercises that are performed during the lesson should be accessible and understandable. Students not only have to perform a certain task, but have a clear understanding of what they are doing and why they need it. These particular measures, with the right and purposeful approach, motivate students to organize consciously their activities and form the experience of regular physical exercises, not only in the classroom, but also in after school hours. In addition, due to the involvement of high school students in the process of organizing and conducting quests and orienteering competitions for secondary and junior school students, it is worth noting the positive impact on the formation of personality traits (responsibility, discipline, assertiveness, etc.), and also stimulates pupils to keep a healthy lifestyle.

In order to assimilate the educational material more effectively and increase the motor density of the training session, the theoretical material of the experimental workouts was organically combined with the content of practical activity. In particular, the study and consolidation of knowledge about the conventional signs and symbols of sports maps was combined with various relay races and access to the terrain. Some theoretical data were submitted in the form of short messages at the beginning of the lesson and, if necessary, in other parts

of the lesson. Technical and tactical methods of working with the map were immediately practiced. This approach made it possible to avoid formalism in the digestion of knowledge and facilitated their rapid assimilation.

So, the methodology was realized in the educational process with the following pedagogical conditions: rational planning of educational material on physical education; implementation of an individual approach; an integrated approach to the diagnosis of individual levels of indicators of physical condition and constant monitoring of the level; identification of students' interest in orienteering and the presence of appropriate psychological and social motivation; availability of trained specialist.

The control group included students who were engaged in the trainings under the standard orienteering teaching method (108 pupils), the experimental group included students who were engaged in the trainings under the methodology we offered (112 students).

The results obtained in the process of the formative experiment testify about the effectiveness of our orienteering teaching methodology. Thus, the students of the experimental group had significantly higher VC indices than in the control group, the increase in this parameter in the young men of the experimental group at the end of the pedagogical experiment was 870.0 ml. (27.6 %, $p < 0.01$), and in men of the control group only 6.9 %. During the pedagogical experiment, the VC increase in the girls of the experimental group was 29.2 %, $p < 0.01$; and in girls of the control group this indicator increased by only 4.3 % (Table 1).

Table 1. Morpho-functional indicators of high school students before and after pedagogical experiment (n = 220)

Indicators	EG before experiment		EG after experiment		$\pm\Delta$, %	CG before experiment		CG after experiment		$\pm\Delta$, %
	\bar{x}	S	\bar{x}	S		\bar{x}	S	\bar{x}	S	
Young men (EG-57, CG-53)										
BL, cm	179.9	6.65	181.2	6.26	0.7	177.4	5.01	178.3	5.10	0.5
BW, kg	67.8	12.84	68.9	8.13	1.6	65.9	11.34	67.9	10.43	3.0
HR, beats /min-1	87.6	12.33	78.3*	4.63	-9.7	85.2	12.33	83.4	10.04	-2.1
SBP, mmHg.	118.9	13.26	120.2	8.63	1.1	117.9	9.81	119.3	5.13	1.2
DBP, mmHg	71.2	6.33	73.5	5.87	3.2	69.5	10.12	71.5	8.43	2.9
VC, l	2.9	0.31	3.7**	0.24	27.6	2.9	0.41	3.1*	0.37	6.9
Shtange test, sec	46.5	10.34	48.3	8.96	3.9	47.5	9.95	48.1	9.37	1.3
Genchi test, sec	21.8	3.11	23.6	2.62	8.3	23.8	3.36	23.9	3.97	0.4
Girls (EG-55, CG-55)										
BL, cm	164.0	4.05	165.1	4.07	0.7	164.2	3.71	165.0	4.5	0.5
BW, kg	58.2	8.33	59.3	8.12	1.9	57.8	5.84	59.1	5.71	2.2
HR, beats /min-1	85.7	8.41	78.9*	5.25	-7.9	87.9	10.15	86.5	16.60	-1.6
SBP, mmHg.	117.8	13.59	114.5	7.16	-2.8	115.7	12.56	117.1	8.87	1.2
DBP, mmHg	74.8	12.80	75.3	5.34	0.7	71.2	11.16	71.0	7.11	0.3
VC, l	2.4	0.38	3.1**	0.63	29.2	2.3	0.34	2.4	0.33	4.3
Shtange test, sec	41.6	7.34	44.7*	5.97	6.9	41.9	7.12	42.7	6.69	1.9
Genchi test, sec	23.0	2.44	24.3	3.84	5.7	22.3	2.77	22.9	2.49	2.7

Note: $\pm\Delta$, % - the difference between the indicators before and after the pedagogical experiment.

Notes: * - changes in the indicator are statistically significant at the level of $p < 0.05$; ** < 0.01 .

It was found that after the formative experiment in the students of the experimental group, the average statistical results were significantly higher: of the Romberg test ($p < 0.05$); of the Yarotskyi test; in the "Running 1,500 m race" test ($p < 0.01$), "Running 100 m" ($p < 0.05$); the young men of the experimental group also had a significant improvement in the results from the "shuttle running 4x9 m" ($p < 0.05$). In addition, it was established statistically significant ($p < 0.01$) improvement of the indicators of the short-term memory capacity (STMC) in young men of the experimental group, and in girls – the indicators of the information processing speed (IPS) (Table 2).

Table 2. The indicators of the psychophysiological state of the high school students before and after pedagogical experiment (n = 220)

Indicators	EG before experiment		EG after experiment		$\pm\Delta, \%$	CG before experiment		CG after experiment		$\pm\Delta, \%$
	\bar{x}	S	\bar{x}	S		\bar{x}	S	\bar{x}	S	
Young men (EG-57, CG-53)										
Accuracy of size perception, %	54.2	12.8	71.6**	9.55	17.4	53.7	14.5	58.5	13.12	4.8
Speed of CVMR, м с	493.8	47.0	389.3**	117.2	-21.2	481.4	50.3	461.7	84.6	-4.1
STMC, %	27.9	10.9	45.7**	12.1	17.8	25.0	11.3	32.7	12.9	7.7
VPI, bit	347.4	56.2	406.7**	56.1	17.1	325.8	29.76	341.4	30.2	4.8
IPS, bit·sec ⁻¹	16.1	1.3	14.8	0.6	-8.1	16.3	0.87	15.7	0.82	-3.7
Girls (EG-55, CG-55)										
Accuracy of size perception, %	48.8	9.4	73.7**	12.0	26.9	48.6	9.8	50.2	9.2	3.3
Speed of CVMR, м с	516.5	53.5	403.6**	47.1	-21.9	522.6	68.2	507.9	67.7	-2.8
STMC, %	30.4	7.2	50.5	11.0	20.1	29.2	6.4	32.1	6.9	2.9
VPI, bit	389.1	27.6	434.6**	47.5	11.7	384.2	22.6	401.1	34.5	4.4
IPS, bit·sec ⁻¹	15.4	0.91	14.2*	0.81	-7.8	15.5	1.2	15.3	0.9	-1.3

Note: $\pm \Delta, \%$ - the difference between the indicators before and after the pedagogical experiment.

Notes: * - changes in the indicator are statistically significant at the level of * $p < 0,05$; ** $p < 0.01$.

It is established that the inclusion of orienteering in the educational process of the general education school allows to solve a number of issues that are urgent for the modern national school: increasing the physical qualities development level; purposeful improvement of psycho-physiological indicators (memory, attention, thinking); improvement of the psychoemotional state; formation and maintenance of proper physical health of students.

Discussion

It was confirmed the available in the literature data on the fact that orienteering in its content is a combination of intense physical work alongside with intense intellectual load (Blanchard, 2009).

We found that at the initial stage of training, the development of cognitive processes is the key element in the technical and tactical training of orienteers. The study confirmed data (Sirakovska, 2011) that the most significant in the technical and tactical training of orienteers are the cognitive processes and the style of perception and processing of information.

The conducted study proved (Galan, 2016) that in the course of the activity, an orienteer repeatedly remembers the site of the map in order to control his way through the terrain and some areas of terrain to feel and control his location on the map constantly. According to (Hancocks, 1997), the process of memorizing conventional symbols of the map and reproducing of the real terrain shapes continues from start to finish. According to (Midtbø, 2014), the development of the "memory map" allows you to pass the distance more quickly. Orienteers constantly use short-term (operational) and long-term memory. Often the action of both types of memory occurs simultaneously. The study (Galan, 2016) confirmed that the enormous importance in the psychological preparation of orienteers has redirecting attention. In the practice of orienteering, it is constantly present: switching attention from reading the map to the terrain and vice versa, from the scrupulous map reading (accurate orienteering) to the high-speed version and vice versa.

Our studies confirmed the statistically significant ($p < 0.01$) improvement in the speed of a complex visual-motor reaction, the volume of the processed information in the course of practicing orienteering under the developed methodology.

As Cheskykhyna (2006) notes, due to the orienteering exercises, the efficiency of work of the cardiovascular and respiratory systems is increased. Our studies have confirmed a statistically significant ($p < 0.01$) improvement in the indicators of the heart rate and VC in the process of practicing orienteering.

Further development was given to the issue of improving the organization of physical education classes for students. We have supplemented the research of a number of authors (Shevtsiv, 2007; Vashchuk, 2009; Sainchuk, 2012; Galan, 2016) on the motivational-value targeting of high school students to physical culture. It was revealed a low level of latitude, stability and force of motivation of high school students to physical education lessons at school.

The conducted studies (Goncharova, 2015), which were devoted to the implementation of means of

tourism and orienteering in the process of physical education of junior schoolchildren.

The studies substantiated the methods (Dotsenko, 2013) of the formation of special skills in the educational process of adolescents involved in orienteering, the peculiarities of which are : strengthened focus on variability of mastering skills and abilities in various pedagogical conditions, the use of the game method, the combination of hours for the development of physical traits and mastering of special skills and abilities; the application of innovative multimedia and technical means of education, control and safety of children. (Slonov, 2003) defined the available means of formation of skills of orienteering in the process of physical education of pupils of 7-8 grades of general education schools. The structure and content of the program (Korol, 2015) on physical education with priority use of means of orienteering for students of technical specialties is scientifically grounded. However, in the specialized literature scientific data on the justification of the program and the introduction of means for orienteering in the physical education of students in the upper grades are limited. Therefore, we developed "Orienteering", the structure and content of the variable module of the basic program on physical education for senior students. Orienteering, as a variable component, unlike many other sports, opens wide opportunities for the activities of teachers and students. The availability and effectiveness of using orienteering in organizing and conducting trainings with high school students in physical education classes allows to solve the problems special to a modern school.

Conclusions

Analysis of scientific and methodological literature testifies about the important role played by the period of schooling for the formation of a fully developed personality, the creation of basic provisions for further harmonious development. However, as studies have noted, there is an alarming trend in the deterioration of the health status of children, the number of children with disabilities in the health status increases every year. According to the researchers, the solution to these problems is related to the need to improve the modern system of physical education. At the same time, it was revealed that the orienteering as a variable component, unlike many other sports, opens wide opportunities for the activity of teachers and pupils.

The results of the experimental and theoretical experiments that were carried out, certain that the proposed provisions are lawful, showed the effectiveness of the tasks solving and gave grounds to for formulation of these conclusions.

The results obtained in the course of the formative experiment testify about the positive impact of physical education lessons with elements of orienteering on indicators of physical fitness and somatic health of high school students.

Computing Interests

The authors declare that they have no competing interests.

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