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Organizational aspects of an experimental program for physical education with a strengthened course in professional and applied physical training of future electrical engineers in the railway sector

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Purpose: *to develop an optimized program for physical education with a strengthened course in professional and applied physical training (PAPT) for students of railway universities.*

Material & Methods: *analysis and generalization of scientific sources and program-normative documentation on physical education of the higher educational institution of railway transport, survey.*

Results: *the results of the survey of railroad specialists are given. Pilot studies have determined the nature and conditions of professional activity of electrical engineers of railway transport. The experimental program on physical education with the strengthened course of the PAPT of students of railway universities was developed and theoretically justified.*

Conclusion: *structure of the experimental program on physical education with the strengthened course of the PAPT included a theoretical section (8 hours), methodical and practical exercises (6 hours), a practical section (114 hours) and a control section (12 hours). The program focuses on improving professionally important physical and psycho-physiological qualities and functions, psychomotor skills and physical performance. The basis of the practical section was the physical exercises from different sections of the current basic curriculum.*

Keywords: *physical qualities, program, professional activity, electrical engineers of railway transport, students.*

Introduction

The irresistible development of scientific and technological progress, global changes in the political, economic and public spheres radically change the perception of the quality process for the training of the future railroad specialist, which requires fundamentally new approaches to the system of physical education, especially to the process of professional and applied physical training (PAPT). The complication of production, the increase in the volume of information, global computerization and the intensification of labor processes radically transform the working conditions, require from a modern specialist high concentration of attention, increasing the speed of thinking processes, the accuracy of motor actions, the ability to work in conditions of neuro-psychic stress and lack of time. All this causes an urgent need for the reorganization of physical education, especially in the section of professionally and applied physical training, which is a kind of foundation for effective mastery of future professional activity [2; 8].

The training of a reliable specialist first of all should provide for not only perfect mastery of professional knowledge and skills, but also a sufficiently high level of development of physiological mechanisms of movement control, presenting, on the one hand, high demands on the theoretical basis for the basics of vocational training, and on the other – development of the foundations of professionally-applied physical training, with the help of which a high functional readiness of a specialist to professional activity is achieved.

The problem of optimizing the professionally applied physical training of students is devoted to many studies of domestic and foreign researchers [1; 2]. It is not a coincidence, because a modern specialist should differ not only in the quality of professional training, but also have a high level of physical development and functional state of the organism.

In the scientific works of researchers [3; 4] it was noted that the formation of professionally important physical qualities and skills in future specialists, the increase in the resistance of the organism to the adverse effects of the external and industrial environment is most effectively achieved in the process of specially directed use of means and methods of physical education.

Numerous studies prove that the implementation in the technical universities of the traditional program of physical education does not allow to achieve the necessary normative level of general physical fitness and significantly limits the possibilities of improvement of professionally important psychophysiological properties and physical qualities of students of the chosen profession [3; 5; 7].

Analysis of scientific and methodological literature showed that theoretical and practical questions of professionally-applied physical training of students of different professions were studied by many domestic and foreign researchers. However, so far, the concept and formulation of PAPT, its purpose and objectives are treated differently by a scientist, which often leads to inadequate development and substantia-

tion of its content for representatives of specific occupations, in particular, for electric engineers of rail transport.

It is known that an important role in creating the prerequisites for the successful mastery of professional skills is played by physical educations. Students engaged in physical culture and sports, much faster and better formed professionally important skills and techniques that increase the level of efficiency and reduces the incidence, their body adapts faster to new, often unfavorable, production conditions. Thus, the intended effect of specially selected physical exercises helps to improve the quality of professional training of future specialists, allows more efficient to train highly qualified personnel for all industries.

Many researchers [2; 5; 6] dealt with the issues of professional and physical training in the railway sector. However, to date, the problem of PAPT specialists in various specialties of the railway industry remains insufficiently researched.

Results of the research showed that the professional activity of electrical engineers in railway transport is one of the most important, because the safety and smooth operation of trains depend on the reliability and perfect performance of their production operations. Therefore, the physical, psycho-physiological and mental qualities and functions of the future electrical engineers body of rail transport an increased requirement.

For the employee of the railway industry, professional and applied physical training is of fundamental importance, because in the course of training by specially selected physical exercises reserve capacities of an organism, improve the adaptive processes of the organism to unfavorable conditions of production activity and negative environmental conditions. The active performance of physical exercises improves the interaction of the processes of excitation and inhibition in the central nervous system, improves the regulation of vegetative function, the composition of blood, the work of the heart, the movement of blood through the vessels, the blood supply of the brain, improves gas exchange in the lungs and energy supply of muscular activity, which is necessary for a large amount of mental and physical work of a worker in the railway industry. As a consequence, specialists improve performance indicators [5; 6; 7].

The purpose of the research

To develop an optimized program for physical education with a strengthened course in professional and applied physical training (PAPT) for students of railway universities.

Material and Methods of the research

Research methods: analysis and generalization of scientific sources, program-normative documentation on the physical education of high schools of the railway transport, questioning.

Results of the research and their discussion

The development of the experimental program on physical education was carried out on the basis of the contents of the basic curriculum on physical education for higher education institutions, taking into account the specifics of the professional activities of specialists in the engineering profile of the railway industry, the nature of the work that they perform, physical, psycho-physiological and mental loads, exposure to environmental hazards, occupational diseases, requirements for professionally important qualities, level of health, physical development, physical and vocational skills of future specialists. A special feature of the experimental program on physical education is the expanded section of professional and applied physical training.

The problem of optimization of professionally-applied physical training for future specialists of various specialties is devoted to a considerable number of scientific works, but virtually unexplored features of preparation with the orientation on the work process of electrical engineers of railway transport, not developed organizational and methodological foundations of the construction of technology of professional and applied physical training are not developed taking into account the structure and functioning of the universities of railway transport. Such training of railway transport engineers is practically not carried out either during study at the university, or during the further production activity. The main reason for this is the lack of research to date regarding the specifics of the professional activities of railway engineers, a list of professionally important physical and psycho-physiological qualities, technology of their development. Therefore, the issue of the development and implementation of the advanced training of the PPFP is important and relevant.

Purpose of the experimental program is to optimize the professionally applied focus of the physical education process for university students in the railway profile.

To determine the nature and working conditions of electrical engineers in railway transport, pilot studies were conducted. The obtained results allowed to determine typical production operations, labor actions, characteristic working posture and working movements, motor activity, physical and mental stress during the working shift and the level of their fluctuations; labor errors; professionally important motor skills, skills and psycho-physiological functions; physical and mental qualities and abilities; important business, strong-willed and other personal qualities; sanitary and hygienic working conditions; influence of climatic and meteorological changes in the environment; occupational diseases, harmful production and other.

Analysis of the survey data made it possible to determine that the electrical engineers of the railway transport with a generalized object of the activity of automation systems and computer-integrated technologies in railway transport, which include the systems of railway automation and telemechanics, information transmission systems in railway transport (master of integrated automation and telemechanics; master on repair of devices and equipment; master on maintenance service of automation systems on a railway transportation; master of maintenance of communication systems in railway transport, master on repair of means of measurement and automation; operator (dispatcher) of computer-integrated technology (CIT) specialist in automated control systems and others), carry out production and technological, organizational and management, design and research activities in the field of the creation of rail automation and telemechanics systems, information transmission systems, design and research works in the field of automation, information processing and manage-

ment in railway transport. In the work of the above-mentioned specialists, the following types of professional activity prevail, such as design and development, installation, regulation of systems and equipment, organization and implementation of maintenance, operation and repair of railway automatic devices, in turn, determines the professionally important qualities of the personality of specialists in the railway industry.

It is determined that electrical engineers of railway transport inherently have a long stay in the forced monotonous working posture – sitting, standing, with a long standing static physical loads (design work, installation and adjustment of equipment, operator activity), as well as dynamic physical loads, a large number of movements during working changes, the action of extreme factors that make up specific production conditions (maintenance of automatic devices and systems, elimination of emergencies consequences). Such working conditions often cause a number of occupational diseases of the peripheral nervous system, vision, hearing, and emotional-nervous tension, mental stress in conditions of prolonged hypodynamia leads to a decrease in efficiency and productivity.

The analysis of data on the study of the specific features of the professional activities of electrical engineers in railway transport makes it possible to assert that their activities are of a multifunctional character, and professional duties include a large volume of various works. Works can be carried out both on the street, near the railway tracks, and indoors, when carrying out the watch at the floor devices. Such working conditions require from the railroad specialists a sufficiently high development of general and strength endurance, the ability to withstand many hours of physical and mental stress and maintain a high level of efficiency during the working shift. In general, the working posture “in motion” (74%) prevails and standing-bending (65,6%), during the working shift, specialists overcome large distances on foot, sometimes from 10 to 15 km, the greatest load is experienced by the muscles of the legs and back. The implementation of production operations is mainly provided by small and medium-sized localized actions with hands and fingers.

In the professional work of electrical engineers in railway transport, manual labor sometimes mixed. The motor actions are precise, localized; rapid movements of hands and fingers during the implementation of production operations; manipulation of small parts, objects, tools in a strictly regulated period of time,; actions with the maximum power of effort requiring power sometimes in extreme or emergency situations that require high concentration, focus, dexterity and speed of fingers, coordination of motor actions and movements with the process of perception of endurance and strength; long-term various dynamic motor actions of severe or moderate severity and intensity with a load on the locomotor system, which require total endurance.

Negative features of professional work of electrical engineers include: performance of production duties under any meteorological conditions; high tension of the visual and auditory analyzers; long-term static working posture, standing, bent, sitting with a slope, which causes tension in the muscles of the neck, shoulder girdle, lumbar spine, stagnation in the pelvic organs and lower limbs; neuro-emotional tension, work in conditions of time deficit.

Due to the survey UkrSURT students and professionals of the railway industry were identified professionally important physical and physiological qualities and properties of Electrical Engineers of Railway Transport, the influence of harmful factors of production, composed professiogram.

Based on the data obtained, a program for physical education with a strengthened PAPT course for students, future electrical engineers for railway transports.

The contents of the main sections of the curriculum on physical education of UkrSURT and the technology of their teaching have been revised, and a new approach has been proposed in teaching the teaching material without increasing the total number of hours. The theoretical section on the first and second year was extended to 8 hours and is aimed at the formation of a world outlook system of scientific and practical knowledge necessary for the implementation of the professionally applied physical training of future railway transport specialists, their positive attitude towards physical education and PAPT. Practical exercises in the amount of 6 hours provided for the creative reproduction by students of the basic methods and methods of forming the educational, professional, household skills necessary for effective employment of the PAPT during and after graduation. The practical section was aimed at ensuring a high level of physical, psycho-physiological and psychological preparedness of students, the formation and development of professional and applied skills and skills required in future professional activities. The control section used for testing and evaluating the effectiveness of the process objective physical and professionally-applied physical preparation.

Experimental program is based on the substantive part of the current program on physical education for higher education institutions. The main emphasis was placed on the introduction of a strengthened course of PAPT in the physical education process, but did not imply any drastic changes in the program material and the use of additional study hours.

The practical section of the program provided 240 hours for two years of training (120 hours each). Program of the practical section is aimed at using a large amount of PAPT material in accordance with the conditions of professional activity of future electrical engineers of railway transport.

Basis of the practical section was the physical exercises from the sections of the current basic curriculum on physical education for higher educational institutions of Ukraine III–IV level of accreditation: general physical training, athletics, football, volleyball, basketball, gymnastics, as well as sports (athletic gymnastics, gymnastics), outdoor games, PAPT, which fully contribute to the formation of professionally important qualities of future railway engineers. A complex of exercises with dumbbells was widely used. Obligatory components of the program were: individual types of athletics, athletics relay races, sports games, corrective gymnastics for the eyes, respiratory gymnastics, psychological self-regulation, psycho-muscle training. Preliminary, general developing, specially-preparatory, applied physical exercises were used. Funds that were used in the work with the experimental group, were aimed at the development of general and strength endurance, strength, coordination of movements, dexterity, static and dynamic endurance of the muscles of the shoulder girdle, neck, back, upper and lower limb strength, joint mobility, and attention and memory development.

Selection of PAPT funds was carried out taking into account professionally important physical, psycho-physiological and motor qualities, with an accentuated development of muscle groups bearing the main stress in the process of professional activity.

The conditions of the sports base UkrSURT and the temperature of the autumn-winter season in the east of Ukraine make it possible to conduct practical exercises with groups of SPT, to which the students of the groups studied belonged, in the open air, using the natural factors of the environment and the healing forces of nature. Such conditions are most closely related to the real, accompanying future professional activities of railroad engineers. The content and methods of conducting classes were constantly updated and complicated, physical activity increased gradually.

To increase the level of livelihoods, stress resistance, functional reserves of the organism and the general endurance of students of the experimental group, preference was given to exercises and sports of aerobic character. Providing the body with the necessary aerobic loads was due to running and sports games.

When planning the aerobic exercise is required to take into account the level of health and physical preparedness of students. The normalization of the intensity of aerobic exercise was carried out according to the heart rate. Based on preliminary testing, for each student of the experimental group, the individual recommended heart rate was calculated, which ranged from 60-80% of the maximum permissible age of heart rate. For subjects who had a low level of physical fitness, an aerobic exercise of 25–35 minutes duration with an intensity of 60-70% of the maximum heart rate. For students average fitness level – the duration of aerobic exercise was 25 minutes, the intensity of 70–75% of maximum heart rate, and students with a level of physical readiness above the average – the duration was 15–20 minutes with an intensity of 75–80% of the maximum heart rate.

To form, develop and improve the speed and accuracy of the movements of arms, hands and fingers, exercises were chosen that help to increase dexterity, mobility, working capacity of hands and fingers, remove fatigue, increase the strength of fingers and brushes, prevent occupational diseases of the joints.

The content of the exercises in athletic gymnastics was directed mainly to the development of strength, power, static and dynamic endurance of the basic muscle groups of hands, trunk, legs, raising the level of moral and strong-willed qualities and psycho-emotional stability, educating self-confidence and one's own strengths.

In specially designed complexes with dumbbells, the exercises were selected in such a way as to cover all the major muscle groups and were arranged in order of consistently increasing physical activity. Students were offered four basic sets of exercises with dumbbells. For self-study offered a shortened set of exercises with dumbbells.

The section of the program "Psychological self-regulation, psychomusical training" was aimed at the development of psychological stability, the formation of skills, necessary for the mobilization of physical and volitional qualities of future specialists in emergency actions in cases, in situations of neuro-emotional tension, time limit, during fatigue and overstrain. In this section, exercises of respiratory gymnastics were widely used; methods of psychological self-regulation, psycho musical training and relaxation were assimilated. The main goal of this section is to teach students how to optimally use the means and methods of psychological self-regulation in the production process, life and way of life, promote highly effective performance of professional duties, increase professional longevity, prevent stress.

To increase the effectiveness of the development of physical qualities in the classroom, the method of circular training with the sequential execution of a set of specially selected physical exercises was used, and game and competitive methods. During the training by the method of circular training, preference was given to exercises for the development of general and strength endurance, strength, speed and accuracy of movements, speed and flexibility. To perform each exercise a certain place was allocated, which was conditionally called "station". In the circular training included 8 "stations", each of which the student performed one exercise and, proceeding from the tasks of the lesson, passed the circle 1-3 times.

To educate confidence, self-control, the ability to quickly navigate in difficult circumstances and quickly assess the unexpected situation, unusual conditions were created, additional complications were introduced, and disorientate emotional factors were added.

In order to improve the functions of attention, mobile and sports games and gaming tasks were widely used to solve conflict situations in a state of fatigue, with time limits, under the influence of disorientate factors.

During the sessions, conversations were held with students on the applied orientation of physical education, prevention of occupational diseases, and so on.

Important for the students in the experimental group were transcripts requirements by which determined not only by the level of physical, but also the professional-applied physical readiness of the future railroad engineers.

The control section of the experimental program, for both I and II courses, consisted of 12 hours and provided for assessing theoretical and methodological knowledge on the basics of theory, methodology and organization of physical education in the form of written test tasks during the crediting session and determining the level of general physical and professionally-applied physical preparedness according to the results of testing.

Conclusions

1. Analysis of literature sources and normative documentation makes it possible to assert that the questions of the professionally applied physical training of future electrical engineers of railway transport have not been developed sufficiently.

2. Pilot studies have made it possible to determine the nature and working conditions of electrical engineers in railway transport, the types of their professional activities, working posture, physical activity, physical and mental stress, occupational diseases, sanitary and hygienic working conditions,

professionally important physical and psychophysiological qualities and functions.

3. Experimental program on physical education with the strengthened course of the PAPT was developed and theoretically justified, the structure of which provided for a theoretical section of 8 hours, methodical and practical classes – 6 hours, practical section – 114 hours and control – 12 hours. The program is focused on the improvement of professionally important physical and psycho-physiological qualities and functions, psychomotor abilities and physical ability to work. Basis of the practical section was the physical exercises from different sections of the current basic curriculum.

Further research is planned to devote to the study of other organizational and methodological aspects of physical education classes, namely, occupations of professionally-applied physical training for university students of the railway profile.

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