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Innovative Technologies in Physical Education: Neuropsychological Aspect

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Abstract: *The article scrutinises the issue of application of innovative technologies in physical education from the neuropsychological perspective. It has been found that physical education is inseparable from neuropsychology. The content of the concepts: "physical education", "innovation", "innovative activity", "technologies", "pedagogical innovations", "neuropsychology" is studied. It is emphasized that innovative educational activity is supported by regulatory documents. It is emphasized that physical education affects not only the motor activity of individuals, but also personal spiritual and social development. It has been investigated that the contemporary innovative technologies are focused on improving the educational process, the use of new teaching methods for creative, active cooperation between the teacher and the student. The essence of cooperative, problematic, practice-oriented learning, active teaching methods is highlighted. The focus is made on constructivism. It has been studied that speech is an indicator of the activity of different regions of the brain. The use of aerobic exercises as a tool to improve plasticity and function of the hippocampus is considered. Running has been shown to help think clearly, make correct and informed decisions. The essence of autogenic training is considered. The benefits of kinesiological exercises for mental and physical health have been studied. Attention is paid to strengthening and maintaining the health of children with special needs. It has been found that development of information and communication technologies has contributed to the emergence of modern mobile applications that increase students' motivation to care for their health, improve functionality and mobility, help monitor their health. The benefits of exercises that are modelledin virtual reality have been studied, inasmuch as they optimize motor skills, involve motivational, cognitive, sensory processes in dynamic activities.*

Keywords: *Physical education, innovation, innovative activity, technologies, pedagogical innovations, neuropsychology, kinesiological exercises, autogenic training.*

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Introduction

Ongoing reforms in education in Ukraine contribute to new changes in the educational process in educational institutions (Khatsaiuk et al., 2021; Maksymchuk et al., 2020a; Nikolaienko et al., 2021; Ovcharuk et al., 2021). Teachers, in order to satisfy the level of education of the contemporary students, to motivate them to study, have to work in a new way: to use innovative teaching technologies that are effective (Komogorova et al., 2021; Maksymchuk et al., 2020b; Palamarchuk et al., 2020). In addition, physical education is inseparable from neuropsychology, which studies functioning of higher mental processes, as well as suggests ways to improve brain function (Demchenko et al., 2021; Kosholap et al., 2021; Prots et al., 2021).

To begin with, let's establish meanings of the necessary terms: "physical education", "innovation", "innovation activity", "technology", "pedagogical innovation", "neuropsychology".

According to the glossary of terms from the theory of physical education by Vykhliaiev (2018) we learn that "physical education is an educational process that is aimed at systematic physical exercise by people in order to develop physical fitness and health; the subject (course module) is aimed at mastering knowledge, skills and abilities to manage physical development of individuals by various types of motor activity".

According to Dubaseniuk (2014), "innovation is the ability to influence the overall level of professional activity of teachers, to improve the educational environment with contemporary effective forms of work".

According to Moskalenko (2015) "innovation activity is a complex process that involves formation of a flexible system of scientific support, takes into account the logic and specifics of the peculiarities of perception, evaluation, mutual adaptation of system elements".

According to the Dictionary of Foreign Words by Lukianiuk (2001-2021) we find out that "technology is 1) a set of knowledge, information about the systematic work of production operations in the process of manufacturing something; 2) a set of methods of processing and recycling of materials, manufacturing products".

The essence of innovation activity was considered by Ohiienko (2015), who found that the term "pedagogical innovation" became widespread in the 80s of the XX century. Innovative orientation encourages teachers to be creative, to express themselves. In addition, pedagogical innovation must have innovative potential, i.e., tuned to an effective result. Thus, according to Ohiienko (2015), "a pedagogical innovation is a novelty

in pedagogical activities to increase the efficiency of the educational process".

Incidentally, innovative educational activities are supported by regulatory documents. In particular, the Ministry of Education and Science of Ukraine adopted amendments to the Regulation on the procedure for carrying out innovative educational activities (Hrynevych, 2017).

Physical education undeniably affects not only the motor activity of an individual, but also personal, spiritual and social development. So, presently, maintaining good health is a very important task for contemporary teachers of educational institutions. Therefore, there is a need to develop innovative technologies based on neuropsychological knowledge to organize a systematic approach in physical education.

In his study Shevtsov (2015) noted that "neuropsychology is a psychological science that studies regularities of psychomotor, cognitive and emotional development of the child." Thus, neuropsychology is a science that studies organization of higher mental functions. Luria (2018) is considered to be the founder of this area.

Objective: to identify innovative technologies related to the methods and forms of neuropsychology for effective physical education.

Methods of work - analysis of scientific and methodical literature, system analysis.

Application of innovative technologies for physical education of students of higher educational institutions

Application of innovative technologies for physical education of students was covered by Vykhliaiev (2018). The author emphasizes that contemporary innovative technologies are focused on improving the educational process, the use of new teaching methods and creative, active cooperation between the teacher and the student. Educational institutions, in particular higher education institutions, actually choose themselves methods and technologies (Moskalenko et al., 2014) for teaching aimed at quality education. Therefore, the main task of physical education of students in higher education institutions is aimed at the personal orientation of the concept of higher education with the option of an alternative approach of students to the choice of their education.

It is worth notingthe article by Chang (2020), which emphasizes that the old concept of learning, the usual boring repetition of educational material should be changed to an innovative approach to teaching physical

education, in particular, to pay attention to the development of students' psychological state to satisfy contemporary youth. In addition, the author emphasizes that it is necessary not only to promote, but also to understand that it can contribute to achievement of excellent health in people. Among innovative technologies, the author singles out cooperative learning, which is aimed at team work of students, when they exchange ideas, gain new knowledge - and this contributes to development of cognitive, emotional and social processes. However, it is necessary to pay attention to a special aspect –the psychological one, i.e., fostering of social adaptability, so that the student could havegood mental health. He also emphasizes constructivism as a new epistemology and the theory of teaching. So, constructivism means acknowledging things and gaining experience through a variety of cognitive exercises that involve psychological knowledge. Thus, physical education contributes to psychological health of students, because physical activity has a positive effect on psychology. With the help of visualization, interesting plot-driven stories, students get involved in active participation during learning and feel joy, satisfaction from successful learning. Therefore, nowadays teachers should teach physical culture in accordance with the current requirements of social development, selecting innovative technologies, interesting methods and forms of work, using the Internet and multimedia technologies in teaching. Such teaching can motivate students, stimulate their enthusiasm for learning, eliminate psychological fear, stress, improve the child's condition and mood.

Barun et al. (2021) states that students of Polotsk State University study the theoretical foundations of physical education and sports, physical therapy and massage, physical rehabilitation. The author emphasizes that the higher education in the 21st century is designed to teach students so that after graduation from a higher educational institution they could be competitive, professionals in their field, able to think critically. To implement active methods, Barun et al. (2021) offers teachers to use learning cards, flowcharts, didactic games when teaching their subjects. Obviously, in order to introduce innovative technologies, teachers should take into account the needs of students in order to form necessary competencies in them. The article emphasizes the benefits of active teaching methods that promote active thinking, stimulate cognitive processes, creative activity of students. The project method, according to the author, helps to establish a connection between the acquired knowledge and skills. This method is quite effective for acquisition of new knowledge by students: they independently

find the necessary information, select, process, analyse, and finally present their findings in micro groups. Due to the quarantine restrictions associated with Covid-19, the use of ICT (information and communication technologies) is among the current technologies, as they help to continuously keep going the educational process. Microsoft Teams and Google Classroom platforms help apply problem-based learning technology. According to the results of the survey, students are satisfied with online learning, because it provides a constant access to educational materials, the ability to pose questions to the teacher at any time, hyperlinks to references, etc. For students majoring in "Physical Culture" practice-oriented learning is important, which is organized by summer schools and in cooperation with branches of the department, in particular with the Centre for Correctional and Developmental Training and Rehabilitation and joint activities for children with disabilities. The summer school provides excellent experience for students in working with people of all ages, improving sports skills, volunteering experience, etc. In order to develop professional skills, students work with children with special needs. Therefore, students communicate with such children, gain experience in inclusive education.

Development of physical education through the use of current methods of neuropsychology

The issue of neuropsychological principles for speech activation insenior preschool children during motor actions was studied by Panhielova & Krutsevych (2019). The authors emphasized that neurophysiologists and psychophysiologists believe that speech is an indicator of activity of different areas of the brain, therefore it is directly related to muscle motility, hand movements. It is known that the speech function simultaneously involves 4 analysers: kinaesthetic, auditory, motor and visual. Therefore, physical development certainly plays an important role in the child formation. It is motor activity that contributes to formation of intellectual abilities of moral, physical and mental qualities. For development of a preschool child the leading method in physical education is the game. Performing movements (running, walking, crawling) are extremely important for a child. If a child lacks motor activity, theyare listless and this can be observed bytheir negative neuropsychological state. Afferent impulses from proprioceptors, which appear due to contractions of skeletal muscles, have a significant effect on the development of higher nervous activity. For example, the voice reactions of young children develop due to motor activity. Therefore,

children's physical activity has an integral influence on the development of coherent speech and communication.

The use of aerobic exercise as a tool to improve plasticity and function of the hippocampus in individuals, practical implications for treatment of mental health are highlighted in the article by Kandola et al. (2016). Aerobic exercise improves hippocampal function and improves development of cognitive processes in various mental disorders. It is commonly known that running has a positive effect on clarity of thinking and aerobic activity, because it helps to think clearly, make correct and balanced decisions, get rid of self-pity. Running improves the flow of oxygen, resulting in generation of new neurons, which play a special role in remembering and perceiving information. After a successful run, a person feels fresh, because running helps to clear the mind, feel confident, due to formation of new neurons. And aerobic training contributes the most to this, because new cells are formed in the hippocampus - the region of the brain that is responsible for memory and cognitive processes. Furthermore, running has a great effect on the frontal cortex, because it is involved in planning, concentration, goal setting, i.e.,"pure" thinking. Moreover, this area is responsible for a person's emotional state, i.e., running refreshes the memory of emotions. Thus, running is relevant for contemporarypeople, because physical exercise develops and improves strength of many muscle groups, speed, endurance, efficiency, willpower.

In their article Li et al. (2014) consider the effect of aerobic exercise on human cognitive functions. The authors claim that intense aerobic exercise increases activity of the cerebral cortex, improves distribution of physical resources, because it provides the necessary neural level.

Kurdybakha (2014) highlights the impact of autogenic training on mental processes. She draws attention to autogenic training as a method of psychological relief, relief of psychological stress, treatment and prevention of various functional disorders in the body. In order to master this technique, it is necessary to master certain physical and mental skills. Exercises should be performed systematically for 2-3 weeks, moreover, each type should be learned consistently.

Corrective and developmental programs are built on moving activity, so hemispheric interaction occurs only when the right and left hemispheres are fully active. Kinesiology is one of the contemporary innovative health technologies. This science is engaged in development of exercises aimed at formation of physical and psychophysical qualities. Kinesiological exercises

develop the physical condition of the body, increase stress resistance, improve mental activity, improve memory, imagination, attention, visual and motor coordination. In addition, they develop hemispheric connections, synchronize the work of the hemispheres of the brain. Kinesiological exercises are divided into physical movements, breathing exercises, brain gymnastics, massage, etc.

Certain aspects of kinesiology as a means of speech development and intellectual abilities of children with special educational needs are covered by Lichman (2018). The author states that more and more children appear in educational institutions, who have difficulties in learning, in adaptation, with speech disorders. Kinesiological correction should be used to improve their physical health, overcome speech disorders, and strengthen their mental health. For children with special needs, knowledge of this science helps to develop cognitive activity, develop verbal and logical thinking, master analysis and synthesis, comparison and analysis, develop hand motor skills and improve coordination of movements. Luriia (2018) argued that both hemispheres of the brain can develop well due to constant kinesiological exercises. Such "brain gymnastics" develops hemispheric interaction, synchronizes the work of the hemispheres, develops fine motor skills, abilities, thinking, memory, attention, speech.

Neuropsychological technique of Dennison & Dennison (1995), or exercises developed for "brain gymnastics" effectively improve condition of children. They master the movements of two-handed coordination, oculomotor reactions, skills of successful learning to write, read, regulation of behaviour and emotions. Kinesiological exercises, i.e., neurogymnastics, help to relieve muscle tension.

Age kinesiology studies features of motor activity, gender features, regularities of mental development of people of different ages, features of health monitoring, adaptation to physical activity.

Dyachenko's work (2021) is devoted to the study of the use of fitness applications as a means of increasing students' motivation for regular physical activity. The author emphasizes that with the help of fitness applications that are installed on mobile phones, one can increase physical activity of students and use it as an incentive for independent work. Mobile fitness applications help students adhere to a training regimen and turn fitness classes into a game with a competitive element. Thus, mobile applications increase the interest in independent physical exercises, form the

ability to control physical activity, increase motivation to take care of one's health, form the creative use of digital tools and technologies.

Noteworthy is the article by Winstein & Requejo (2015), which emphasizes the fact that in an era of rapid technology development, physiotherapists and engineers, concerned with people's physical health, are developing new technologies to improve the rehabilitation of patients so that they can monitor state of their health. For rehabilitation scientists have invented "computer brain research", sensors, and interactive media applications. These new technologies reduce disability, increase functionality and mobility, as well as the quality of life of people with special needs.

The use of new technologies for neuropsychological rehabilitation is explored by Fichman et al. (2014). The authors claims that new technologies are emerging in neuropsychology, which are related to computerized versions, cognitive modelling, artificial intelligence, etc. In the field of neuropsychology, computer tests are widespread, which are more commonly used for the physical condition of adults or the elderly. New technologies for physical rehabilitation include electronic devices, mobile phones, tablets, video games, virtual reality, neurofeedback, and transcranial DC stimulation.

It is worth noting the publication of Levin et al. (2015), which covers the emergence of virtual reality as a tool for rehabilitation of the upper extremities. The author draws attention to people who suffer from loss of upper extremities due to acquired brain injury. Exercises modelledin virtual reality can optimize motor skills by involving motivational, cognitive, motor and sensory processes in activities. The article considers the principles of motor activity, gives recommendations for their use in the learning environment of virtual reality, as well as proves the results of restoration of the upper extremities.

Horak et al. (2015) explore the role of body-worn motion monitor technology in restoring balance and gait. The author highlights the potential of monitors worn on the body. In the field of wireless sensor technology, scientists have invented portable sensors that can correctly assess body movement. It is important for physicians to obtain accurate readings for malfunctions in order to prescribe therapy correctly. Then treatment can be aimed at specific physiological disorders of walking or other activities.

Baran et al. (2015) emphasize the interdisciplinary concepts of designing and implementing interactive mixed reality neurorehabilitation systems forcerebral apoplexy. The author proposes a systematic approach to the design of scalable neurorehabilitation systems in order to have results of

a successful study that may be necessary for prescription of exercises in physical therapy.

Dicianno et al. (2015) emphasize the perspective of the evolution of mobile (mHealth) technologies and their applications. The term "mHealth" means the use of mobile devices such as mobile phones, tablets, smartphones, computers. Incidentally, about half of American adults are diagnosed with one chronic disease. So most often, people who feel sick use voice and text messages. It turns out that text messages have a positive effect on self-management and the outcomes of diabetics, asthmatics and hypertonic patients. In addition, applications help patients find the necessary medical information, monitor their health. The author classifies 6 functional programs and systems for health and wellness:

1) lifestyle applications (weight loss, exercise programs, diet). People can download the application to their smartphone and use it;
2) applications for patients (information from rehabilitation manuals, medical encyclopaedias, drug directories);
3) applications for doctors;
4) disease management systems;
5) traditional telemedicine systems;
6) mHealth systems.

Furthermore, smartphones are the main gadget for mHealth. Different models of wireless sensors, such as accelerometers, gyroscopes and force sensors can demonstrate physical activity, pace, movement.

Therefore, analysing the above information, it can be stated that physical development of a pre-schooler depends on physical activity. A game forms intellectual, moral, physical and psychological qualities. Also, the benefits of aerobic exercise, running are noted, which have a great effect on the brain. In order to relieve psychological stress, for disease prevention autogenic training is worth practicing. One of the health-keeping technologies is kinesiology, the exercises of which improve physical health, strengthen mental health and overcome speech disorders. The development of information and communication technologies has contributed to the invention of contemporary gadgets, computers, tablets, which can be used to install mobile applications, sensors, download exercises for virtual activities that can determine the pace, activity of movements, physical activity, etc.

Conclusion

Thus, the article highlights the use of innovative technologies in physical education in terms of neuropsychology.

Physical education has been shown inseparable from neuropsychology. Also, the meanings of the concepts "physical education", "innovation", "innovation activity", "technologies", "pedagogical innovations", "neuropsychology" was studied. It turns out that innovative educational activityis supported by regulatory documents.

Obviously, physical education affects not only the motor activity of people, but also personal spiritual and social development. Physical activity for a person is an extremely important occupation that requires competent professionals. To this end, university teachers use contemporary innovative technologies aimed at improving the educational process, use new teaching methods aimed at creative, active cooperation between the teacher and the student. The study highlights the essence of cooperative, problem-based, practice-oriented learning, active learning methods. The focus is made on constructivism. Moreover, speech is an indicator of the activity of different regions of the brain.

The use of aerobic exercises as a tool to improve the plasticity and function of the hippocampus is considered. Running has been found to help think clearly, make the right and informed decisions. The essence of autogenic training is considered. The benefits of kinesiological exercises for mental and physical health have been studied and attention has been paid to strengthening and maintaining the health of children with special needs.

A novelty in the work was considered information and communication technologies that have contributed to the emergence of contemporary mobile applications that increase students' motivation for maintaining their health, improve functionality and mobility, help monitor their health. The benefits of exercises that are modelledin virtual reality have been studied, because they optimize motor skills, involve motivational, cognitive, sensory processes in dynamic activities.

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