BRAIN. Broad Research in Artificial Intelligence and Neuroscience
ISSN: 2068-0473 | e-ISSN: 2067-3957
Covered in: Web of Science (WOS); PubMed.gov; IndexCopernicus; The Linguist List; Google Academic; Ulrichs; getCITED; Genamics JournalSeek; J-Gate; SHERPA/RoMEO; Dayang Journal System; Public Knowledge Project; BIUM; NewJour; ArticleReach Direct; Link+; CSB; CiteSeerX; Socolar; KVK; WorldCat; CrossRef; Ideas RePeC; Econpapers; Socionet.

2021, Volume 12, Issue 4, pages: 543-564 | https://doi.org/10.18662/brain/12.4/264

Training Future Physical Education Teachers for Physical and Sports Activities: Neuropedagogical Approach

Serhii KARASIEVYCH[1],
Borys MAKSYMCHUK[2],
Vasyl KUZMENKO[3],
Nina SLYUSARENKO[4],
Oksana ROMANYSHYNA[5],
Eduard SYVOKHOP[6],
Olha KOLOMIITSEVA[7],
Lyudmila ROMANISHYNA[8],
Ivan MARIONDA[9],
Vira VYKHRUSHCH[10],
Mariia OLIINYK[11],
Andrii KOVALCHUK[12],
Mykola HALAIDIUK[13],
Iryna MAKSYMCHUK[14]

[1] Pavlo Tychyna Uman State Pedagogical University, Uman, Ukraine, Sergei.karasevich77@gmail.com
[2] Izmail State University of Humanities, Izmail, 0674256781@ukr.net
[3] Communal Higher Educational Establishment "Kherson Academy of Continuing Education" of Kherson Regional Council, Kherson, Ukraine, kuzmenkovasiliy@gmail.com
[4] Kherson State University, Kherson, Ukraine, ninaslusarenko@gmail.com
[5] Ternopil Volodymyr Hnatiuk National Pedagogical University, Ternopil, Ukraine, oks_roman@ukr.net, 0000-0002-2887-5023
[6] State University "Uzhhorod National University", Uzhhorod, Ukraine, sivokhop@gmail.com
[7] Yaroslav Mudryi National Law University, Kharkiv, Ukraine, kolomiitseva7@ukr.net
[8] Khmelnytskyi humanitarian and pedagogical academy, Khmelnytskyi, Ukraine, romanyshyna43@ukr.net, 0000-0002-6026-2614
[9] State University "Uzhhorod National University",

Abstract: *The article proves the need to create an effective system of training athletes, which is the basis for ensuring higher achievements in sports and causes a certain rise in the field of scientific and pedagogical research on the problems of sports pedagogy, physical education, and education of youth. It urges one to optimize educational conditions for training future physical education teachers for physical and sports activities based on the latest neuropedagogical and didactic requirements. The research aims to experimentally verify the newly created or updated pedagogical conditions required to train future physical education teachers for sport and physical activity at secondary schools. Research methods are as follows: modelling, observations, tests, questionnaires, pedagogical experiment, tests determining the level of physical development, the PWCno test, anthropomorphological measurements (body weight, height, chest circumference, lung capacity), heart rate, respiratory rate; methods of mathematical statistics (Student's t-test, Pearson's χ2 criterion). The experimental group consisted of 180 respondents and the control group – 189 respondents. A high level increased by 16.5%, an average level – by 24.3%; a low level decreased by 40.8%. Conclusions. It has been found that the experimental group students have higher levels of readiness for sport and physical activity at secondary schools. Moreover, the indicated differences in the levels are not coincidental and are the result of the implementation of relevant pedagogical conditions. The international relevance of the article lies in expanding the formative and diagnostic instruction tools within the updated conditions, which corresponds to innovative technological and neuropedagogical approaches to developing a physical education teacher today.*

Keywords: *motivation, interest, theoretical knowledge, self-improvement, self-improvement journal, tests, training sessions, teacher placement.*

How to cite: Karasievych, S., Maksymchuk, B., Kuzmenko, V., Slyusarenko, N., Romanyshyna, O., Syvokhop, E., Kolomiitseva, O., Romanishyna, L., Marionda, I., Vykhrushch, V., Oliinyk, M., Kovalchuk, A., Halaidiuk, M., & Maksymchuk, I. (2021). Training Future Physical Education Teachers for Physical and Sports Activities: Neuropedagogical Approach. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience, 12*(4), 543-564. https://doi.org/10.18662/brain/12.4/264

Uzhhorod, Ukraine, ivan.marionda@uzhnu.edu.ua
[10] National University «Lviv Polytechnic», Lviv, Ukraine, nazarenkovira@i.ua
[11] Yuriy Fedkovych Chernivtsi National University, Chernivtsi, Ukraine, oliynykm69@ukr.net
[12] Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University, Vinnytsia, Ukraine, andrqxa2009@ukr.net
[13] Vinnytsia Mykhailo Kotsiubynskyi State Pedagogikal University, Vinnytsia, Ukraine, halaidiuk.kolya@gmail.com
[14] Izmail State University of Humanities, Izmail, 0963113686@ukr.net

Introduction

Recent scientific and pedagogical research has provided a theoretical basis for further justification of the issues of physical education pedagogy. In particular, the following issues were addressed: individualization and differentiation in physical education of students; integration of physical education with other aspects of personality development – aesthetic, moral, valeological ones; organization of mass participation sports events; professional competency development of future physical education teachers (Denysenko, 2009; Marušić & Oikonomou, 2013; Omelchenko, 2007; Solopchuk, 2003; Sovhira & Honcharenko, 2015). The scholars agree that physical education and sports training of future teachers require serious transformations under today's conditions. In recent scientific publications, one can observe a shift in emphasis towards increasing the role of the educational orientation of physical education and sports as the main condition for effective development of the individual's physical culture, as well as the selection and use of neurophysiological mechanisms to increase such effectiveness (Bakhmat et al., 2019; Komogorova et al., 2021; Maksymchuk et al., 2020a, 2020b; Palamarchuk et al., 2020).

The article finds that Ukrainian and foreign science contains many works related to the training of future physical education teachers for physical and sports activities in secondary schools. Despite all the variety of approaches to it, this problem has not been properly covered yet. Only some aspects of it are considered. Indeed, Akhmetov and Shaverskyi (2007) and Bilokopytova (2000) deal with the organization of physical and sports activities during and after school hours. They distinguish three main areas of physical and sports activities in schools. The first area includes those forms that are in some way related to sports activities (sports sections in school premises, physical education and sports holidays, sports festivals, and competitions). The second area involves those forms maintaining links between sports activities and physical education (general physical training in sections and individually, as well as athletic gymnastics and weight training (mostly in high school)). The third area combines the forms aimed at motor rehabilitation (training in special medical groups, gyms; walking; cold training). The area is closely correlated with neurophysiological principles of sports and physical education since it requires one to mobilize personal motivation by considering the individual lateral profile and developing individual rehabilitation programmes.

Bezliudnyi et al. (2019), Halaidiuk et al. (2018), Henseruk (2005), Hertsyk and Vatseba (2002), Maksymchuk et al. (2018), Sitovskyi et al.

(2019) and Volkova (2008), disclose various aspects of physical and sports activities, as well as their role in personality development. Their works widely cover the characteristics of physical and sports activities concerning future physical education teachers. They are as follows: physical education teachers must know how to use the techniques of a particular sport and methods of teaching physical exercises, which allows them to meet the standards of mass categories. Their professional effectiveness is equally determined by sports achievements and personal development. Besides, they should be able to convince parents to encourage their children to attend sports sections (especially children with poor motor skills or suffering from overweight).

One should also consider neurophysiological and neuropsychological aspects of physical and sports activities. Being between humanitarian and natural spheres, they act as a form of culture and social consciousness. From a neuropsychological point of view, such activities are based on motivational and emotional components (satisfaction with the process and result). Before creating new educational conditions, it is essential to recognize the pivotal role of emotions. It is positive emotions that directly stimulate motivation and increase academic and sports results (Li et al., 2018, p. 220).

The training of future physical education teachers for physical and sports activities consists of educational (self-educational) and sports-oriented components. Both components depend on the actualization of psychological and neurophysiological factors (subjectivity, self-reflection, personal and neurophysiological lateral orientation), motivational and volitional support of the educational and training process. Since physical and sports activities involve internal psychological factors and needs imitated by pupils, "the teacher trainees' motivation and self-education skills during the study process has to be promoted, therefore improving formation of students' pedagogic competences during the study process at university" (Samusevica & Striguna, 2017).

Physical education and its teaching methods ensure the interaction between the two newest educational tendencies, such as performativity and neurocentrism. The first one is a universal method of generating knowledge and achievements directly in the educational process, while the neuroscience approach (also cross-cutting) underlies the lateral and subjective determinism of educational and life trajectories of the athlete, coach, physical education teacher and his or her pupil. Neurosciences is congruent with physical education since neuropedagogy consider knowledge, perception and understanding, as well as all channels of information (tactile, kinaesthetic, intuitive, reflexive), as potentially equivalent (Trifonas, 2003).

Despite the possibility of receiving positive stimuli, physical education and sports are characterized by destructive neurophysiological factors (exhaustion, stress). Therefore, physical and sports activities should much focus on neuropsychological diagnosis of destructive influences. Being rather multifaceted, neurophysiological features of physical and sports activities include both physical and cognitive parameters, which eventually become tools of self-cognition and self-improvement. Nevertheless, neurosciences are primarily aimed at anatomical and physiological ways of improving athletes and physical education teachers (Randolph et al., 2005).

As noted by Vaidya & Fellows (2017), "the ventromedial frontal lobe is required for optimal learning from reward under dynamic conditions and contributes to specific aspects of value-based decision-making". Indeed, each intellectual or sports-related act is preceded by decision-making. The latter is of neurophysiological nature. A positive stimulus, which is the main in sports, helps one make decisions with the participation of the dorsomedial frontal lobe. This fact can be considered as proven when creating positive environments. The neurophysiological nature of sports or training activities is based on conscious rewards or unconscious reflexive stimuli.

Thus, the neurophysiology of sport covers a wide range of issues: from neuropsychological modelling to injury prevention and psychocorrection (Tsushima et al., 2018). At the same time, it is vital to boost motivation and neuropsychological stimulation via sports activities, prevent and correct negative influences from sports. Neurodiagnostics, monitoring, and observation can be considered as tools to ensure the above-mentioned aspects (Randolph et al., 2005).

Researchers believe that one restructures the pedagogical process in physical education by intensifying, optimizing, and enhancing learning; by developing intellectual potential, abilities, interests and inclinations of students; by boosting their motivation towards physical education and sports. The main difficulties hindering this process involve the too complicated nature of professional-pedagogical activities of physical education teachers, which, unlike other more static versions of pedagogical work, occur under the conditions of increased complexity. After all, physical education teachers must regularly monitor the physical and mental condition of children under rapidly changing circumstances, stimulate high motor activity in larges classrooms or the street under different weather conditions. All of which requires additional emotional and intellectual concentration. In this regard, the neuropedagogical approach seems to be the most relevant due to its multifacetedness and universality.

However, a theoretical analysis of scientific studies shows that this problem is not yet sufficiently covered in pedagogical theory and therefore, not properly reflected in the practice of educational institutions.

The research aims to theoretically justify and experimentally verify the newly created pedagogical conditions to train future physical education teachers for sport and physical activity at secondary schools.

Material & Methods

The experimental work was conducted at Pavlo Tychyna Uman State Pedagogical University, Communal Higher Educational Establishment "Kherson Academy of Continuing Education" of Kherson Regional Council, Kherson State University, Ternopil Volodymyr Hnatiuk National Pedagogical University, State University "Uzhhorod National University", Yaroslav Mudryi National Law University, Khmelnytsky humanitarian and pedagogical academy, S. P. Koroliov Zhytomyr Military Institute, National University "Lviv Polytechnic", Yuriy Fedkovych Chernivtsi National University, Olexandr Dovzhenko Hlukhiv National Pedagogical University. The experimental group consisted of 180 respondents and the control group – 189 respondents. The number of respondents in the groups corresponded to the requirements for forming the research sample and ensured the representativity of data. It must be noted that the respondents were selected on a personal-institutional basis (those who study in the institutions where the authors conduct educational and research activities). They were informed about the experiment and voluntarily agreed to participate in it. The experimental part and the lists of EG and CG respondents were agreed with the ethics committees of the above-mentioned educational institutions.

The first pedagogical condition formulated at the pre-experimental stage was of neuropedagogical nature. It implied **promoting stable interest, positive motivation, and values-based views** of future physical education teachers on physical culture, sport and physical activity based on the selection of technologies and instruction tools, envisaged impact on the process of developing the motivation and value criterion of their readiness for sport and physical activity at secondary schools and was realized at the basic stage of the research. Its realization involved using various **forms of sports events, outdoor games, refereeing sports competitions**, especially those included in quadruples (running 60-meter and 500-meter dashes; jumping, throwing), sports holidays, exercises for specific muscles (running, walking, swimming, weight training exercises, flexibility exercises), active

methods: dialogues, role-playing and business games, technologies (fitness programmes, Internet resources) and instruction tools (athletics, sports games, swimming, sailing, gym).

The process of forming the motivation and values sphere was based on the dialogue during ***a role-playing game*** under the name "Choosing the forms of physical and sports activities". Students were divided into micro-groups. The first micro-group (analysts) identified a certain form of activities and a range scope of its application. The second micro-group (practicians) clarified the range of its application, supplemented the conditions associated with the individual characteristics of students. The third micro-group (managers) specified the nature and characteristics of future teachers' training for the implementation of the proposed form of lessons and the level of their involvement in the management of physical and sports activities of pupils.

During teacher placement, students familiarized themselves with the plan of educational work conducted by class supervisors and assisted in compiling the applications for participation in general school competitions and conducting competitions for the best runner. Future teachers were also involved in organizing and conducting health days.

The implementation of the first pedagogical condition included forming the readiness of students to organize physical and sports activities, prepare and implement sports holidays. It consisted of the following four stages: the second-year students studied, observed, and participated in sports holidays; the third-year students were responsible for certain functions defined within sports holidays, participated in collective and creative activities, and coordinated their support in preparing sports holidays; the fourth-year students planed sports holidays (games, competitions), selected the relevant material, and ensured the organization of sports holidays.

The neurological principles of motivation towards educational and labour activities lie in motivational and axiological contexts. Therefore, special attention was paid to the development of personal meaning in such activities.

The business game under the name "Dialogue" encouraged students to develop a values-based attitude towards physical and sports activities. It aimed to teach students to analyze the attitudes of people of different social status towards the same problem. All participants were divided into several sub-groups. They were informed about their roles and specific tasks. The game scenario is related to the fact that players need to propose solutions to the educational task using already prepared arguments. These arguments may differ significantly from their ones. Following another logic, however,

helped students to better understand their position by matching it with the given one. The positions for the demonstration were deliberately different so that all participants of the game could reflect on the existence of several views on one problem.

The second pedagogical condition implied students' **mastering theoretical knowledge of the essence and the content of sport and physical activity and methods of its implementation in school with the help of interactive forms and methods of instruction**, envisaged impact on the process of developing the intellect and cognition criterion and was realized at the practical and technological stage of the research. Its realization involved improving the educational process through updating the course on "Theory and Methods of Physical Education", coordinating "cross-cutting themes" of the basic courses on "Gymnastics and Teaching Methods", "Athletics and Teaching Methods", "Swimming and Teaching Methods", holding a special workshop on "Organization and Methodology of Sport and Physical Activities at School", organizing and realizing various forms of sport and physical activity during practical classes of basic courses (classes were conducted based on educational practice with its further analysis), *applying innovative forms and active methods of instruction* (lectures & discussions, binary lectures, exercises, pieces of training, round tables, seminars); technologies (information and communication technologies, cloud-oriented educational environment).

Theoretical material is constructed in such a way as to form knowledge about one's own body, the ways of its improvement in the interests of further professional development and life support, the possibilities on the way of its formation and the role of physical activity in this process, the values of physical activities.

At this stage, cognitive processes were stimulated by actualizing personal meanings related to valeology and physical education and ensuring the problem-based nature of the material presented. Lectures were conducted with the involvement of students in the system of active cognitive actions, which encourage them to use heuristic discussions, solve problems and perform creative tasks. The process of teaching these topics was based on the use of instructive lectures and dialogue-based lectures. In instructive lectures, students familiarized themselves with the technology of their future activities and characteristics and ways of performing individual actions.

For one, the lesson on the topic "Physical Education in the General Cultural and Professional Training of Teacher Students" aimed to first update students' knowledge about the essence of physical education and its

main components, as well as its role at the current stage of social development.

After that, students were divided into sub-groups and were expected to formulate the concepts of physical education and sport, to highlight the most significant differences and factors in the interaction between physical education and sports activities. At least for 30-35 minutes, they discussed the above-mentioned aspects and then one representative from each sub-group expressed the common opinion. Collective discussions were conducted to discover the solutions to them. Disputes were conducted in the form of a dialogue between students during seminars.

During seminars and discussions, *business games* were used. The participation of students was stimulated by unusual scenarios, communication, confrontation, extreme situations, attitude towards participation in the game as a means of self-cognition and self-evaluation of individual characteristics.

One of the forms of organizing physical and sports activities during extracurricular activities is *a competition*: multi-sport events, mountain climbing, orienteering, horseback riding, rowing. The tasks were selected individually for each student, considering their physical fitness, health, professional and applied knowledge and skills necessary for future professional activities. This stage has been supported by the neuropsychological mechanism based on acmeology, youthful maximalism and maximum individualization by sports.

The third pedagogical condition implied **activating students' physical self-improvement during independent work**, envisaged impact on the process of developing the activity and practice criterion of readiness of future physical education teachers for sport and physical activity at secondary schools and was realized at the corrective and developmental stage of the research. Its realization involved applying *tests, conversations, discussions, reflections, pedagogical situations, and practical activities*, performing individual assignments, during which sports holidays, health days, outside games, sports hours, sports, and entertainment activities as part of extracurricular activities were organized. It has been found that one of the effective tools in independent work is keeping *the Self-Development Journal* and preparing an E-portfolio. This condition has been realized based on the neuropsychological mechanism of forming and implementing "self-concept" via human subjectivity. Thus, most methods and approaches contained the prefix "self" (self-analysis, self-control, self-development).

The journal of self-improvement includes goals and tasks of athletic improvement: the potential goal (1-2 years ahead), the annual goal (the

general goal and the goal accorded with periods of training), the current and next tasks. After that, specific tasks are given and the ways and means of solving each of them are discussed.

In the course of the pedagogical experiment, independent tasks and tests were designed to determine ***the level of physical development***, physical fitness and ability: the level of overall endurance was estimated based on the results of running a 3000-meter distance (minutes per second); active flexibility of the spine and hip joints was determined by the results of forward leaning from a sitting position with the simultaneous flexion of arms (centimetres); speed and speed-strength skills in combination with agility: determined by the results of running a 100-meter distance (seconds); dynamic strength endurance of flexors and adductor muscles of the body was estimated during pull-ups (boys, the number of times), bench push-ups (girls, the number of times); the absolute strength of back muscles, left and right hands were measured using dynamometers; physical ability as an indicator of the state of the cardiovascular system was determined due to the PWCno test.

The current research identified the characteristics of the ratio between the motor and vegetative functions due to *the PWCno test*. During the repetition, *heart rate* (HR) and *respiratory rate* (RR) were recorded (HR and RR were re-calculated to obtain a result in 1 minute); the frequency of steps was known since it was defined by a metronome. The ratio between the motor and vegetative functions was estimated based on the correlation between HR, RR, and the frequency of steps. The selected tests most fully characterize the physical fitness of students and are rather easy to conduct (the coefficient of objectivity is equal to 0.75-0.91; the coefficient of reproduction – 0.62-0.93).

Studying the physical development of students one can regulate the nature, volume, and intensity of physical activity during self-improvement following anthropomorphological characteristics. Besides, the physical development of students reflects the impact of physical exercises on growth, as well as the characteristics of body type and the condition of the musculoskeletal system.

The program of ***anthropomorphological measurements*** included the following indicators which most clearly characterize physiological parameters: body weight (measured with decimal (metric) scales to within 0.5 kg); body height (measured with a standard height meter to within 1 cm); chest circumference in a state of "pause" (measured with a centimetre tape to within 0.5 cm at the lower edge of the shoulder-blade in boys and the front chest in girls); lung capacity (measured with a standard spirometer in

the standing position after full inhalation at full exhalation (up to 50 ml)). The measurements were carried out with standard devices according to the generally accepted methodology simultaneously in all groups.

Discussions, group psycho training sessions and practical classes on various topics were held *to help students to disclose their characteristics*. The topics included the following: "How can one deal with self-doubt and quit bad habits?", "Introduction to the experience of work in sports teams", How can one develop will-power?", "The team you live in".

An effective health-improving means of self-improvement is a system of activities aimed at increasing the body's resistance to various environmental influences, namely, outdoor sports (skating and skiing, orienteering, hiking), cold-water treatments.

An important role in the self-improvement of students belongs to **teacher placement**. The current research offers a list of tasks within teacher placement to ensure a higher level of students' professional training for physical education and sports activities and widen their practical experience. Thus, students are expected to design at least three sets of physical exercises to conduct in the classroom, hallway, recreation area, playground; to design at least two sets of gymnastics before classes; to make cards with a description of three movement games; to design and conduct "sports hours" with the selection of movement games with the directed intensity in the following sequence: one game – moderate intensity (warming up); two games – medium and high intensity; one game – low intensity; to design a programme and scenario for a sport holiday; to prepare a plan of different events, two plans for competitions in a preschool camp; to design a programme for training and organization of camping trips; to prepare tips for tourists and recommendations for arranging swimming activities during camping trips; to act as a class supervisor and a physical education teacher; to strictly follow safety rules when organizing the above-mentioned and extracurricular physical activities (to know and be able to provide first medical care for injuries in physical education and recreation classes); to design a plan of extracurricular physical activities of middle-school and high school pupils for half a term, term, academic year; to prepare thematic discussions with parents on healthy lifestyles.

An electronic portfolio was introduced to help students to realize the importance of independent physical and sports activities. The electronic physical and sports portfolio is a current educational technology that makes it possible to record, accumulate and evaluate individual athletic achievements of students during a certain period of their training. This technology is consistently expanding the scope and forms of its

implementation since it meets various requirements of life today: the requirements of higher education institutions for general education institutions, the requirements of the business for the education system in general. The portfolio serves as a dynamic process of comprehending one's capabilities, designing the ways to implement life and professional plans and, finally, a positive personality change.

To determine statistical validity and specify the difference between average levels of future physical education teachers' readiness for sport and physical activity at secondary schools in the control and experimental groups, the t-test (Student's t-test) was applied. To verify the validity of the obtained results, Pearson's chi-squared test ($\chi 2$) was applied.

Results

The ascertaining experiment identifies a low level of readiness for physical and sports activities among students. This fact can be explained by *insufficiently developed* technological and methodological knowledge, motivation, and professional-pedagogical focus on practical participation in physical education of pupils, needs for regular physical exercise with the aim of self-improvement, abilities, and skills in organizing physical and sports activities with pupils and using professional knowledge in concrete actions and other types of tasks.

The results of the ascertaining stage conclude that it is essential to update the training of future physical education teachers to prepare them for physical and sports activities in secondary schools.

During the control diagnostics, quantitative indicators of future physical education teachers' readiness for sport and physical activity at secondary schools in the control and experimental groups have been analyzed. It allowed determining the appropriate dynamics of their levels (see Table 1).

The experiment results have proved positive changes in the levels of future physical education teachers' readiness for sport and physical activity at secondary schools in the experimental group: a high level increased by 16.5%, an average level – by 24.3%; a low level decreased by 40.8%. In the control group, a high level increased by 3.3%, an average level – by 13.9%; a low level decreased by 17.2%.

Table 1. Dynamics in levels of future physical education teachers' readiness for sport and physical activity at secondary schools before and after the experiment (%)

Levels	Ascertaining experiment	Formative experiment	Dynamics	Ascertaining experiment	Formative experiment	Dynamics
	Control group			Experimental group		
High	2 (1.1%)	8 (4.4%)	+3.3	5 (2.6%)	36 (19.1%)	+16.5
Average	76 (42.2%)	101 (56.1%)	+13.9	85 (45.0%)	131 (69.3%)	+24.3
Low	102 (56.7%)	71 (39.5%)	-17.2	99 (52.4%)	22 (11.6%)	-40.8

The results of experimental work show that EG students are at higher levels of readiness for physical and sports activities in secondary schools. Besides, the differences in these levels are not accidental and come from the implementation of appropriate pedagogical conditions.

Discussion

The scientific value of the research is as follows:

- the pedagogical and neuropedagogical conditions for training future teachers for physical and sports activities in secondary schools (promoting stable interest, positive motivation and valuable views of future physical education teachers on physical culture, sport and physical activity based on the selection of technologies and instruction tools; mastering theoretical knowledge of the essence and the content of sport and physical activity and methods of its implementation in school with the help of interactive forms and methods of instruction; activating students' physical self-improvement during independent work) have been *justified*;

- the key research concepts ("training future teachers for physical and sports activities in secondary schools" and "readiness of future physical education teachers for physical and sports activities in secondary schools") have been specified; the criteria (motivation and value, intellect and cognitive, activity and practice), indicators (interests, aspirations, values, needs, knowledge, skills in physical and sports activities) and levels (high, average, low) of such readiness have been *clarified*;

- the forms, methods and tools of training future physical education teachers for physical and sports activities in secondary schools have been improved;

- the integration processes of training future physical education teachers for physical and sports activities in secondary schools have been *updated* and *further developed*.

The practical value of the research lies in developing and implementing the methodology for identifying levels of readiness in future physical education teachers for physical and sports activities in secondary schools in the educational process of higher education institutions. It also implies creating author's programmes aimed at training future physical education teachers and realizing methodical support, namely, updating the content of the course on "Theory and Methods of Physical Education"; coordinating "cross-cutting themes" of the basic courses on "Gymnastics and Teaching Methods", "Athletics and Teaching Methods", "Swimming and Teaching Methods", "Sports Games and Teaching Methods", "Skiing and Teaching Methods", "Moving Games and Teaching Methods"; holding a special workshop on "Organization and Methodology of Sport and Physical Activity at School"; reinforcing independent work of future teachers so that they could obtain knowledge and skills in physical and sports activities.

Research materials can be used in the context teaching of professional sports and methodological courses, special workshops to prepare future physical education teachers for physical and sports activities in secondary schools. They can be applied to further develop the strategies for developing a physical culture in students during reforms in the Ukrainian educational system, as well as in subsequent studies on theory and methods of professional education, philosophy of education.

Indeed, the future teacher of physical education is the organizer of various activities in general education institutions. Panchenko (2011) studied the level of competency of physical education teachers in organizing and conducting sport, physical and health-improving activities, as well as the factors that inhibit the activation of this important part of professional activity. It is proved that it is necessary to deepen practical knowledge about conducting extracurricular physical and sports activities to stimulate students' interest in them. It is also necessary to increase the level of knowledge about medical and pedagogical sports courses.

The current research relies on Eremeev's statement (2011) that biological needs play an important role in igniting the interest of students in physical education and sports. Therefore, one can enhance students' motivation only due to proper organization of physical education and sport. A positive character of motives is determined by the individual's aspirations. As a result of the implementation of the first pedagogical condition, it is found that the main factors ensuring the effective functioning of the

motivational sphere are aspirations, interests, needs for preparation, organization and implementation of sports activities, regular monitoring; achievability of the set short-term and long-term goals.

According to certain research (Operailo et al., 2005; Zvolinskaya & Maslov, 1998), the ranking system of assessing student independent work is an important stimulus factor for learning since it has several advantages, namely visibility of ranking dynamics, strengthening of an objective factor in the assessment of knowledge.

The formative experiment on verification of the content, methods and forms of conducting lessons with the use of interdisciplinary connections when teaching basic sports courses shows: the use of interdisciplinary connections in lectures changes the nature of the teacher's explanation of the new material, helps students to understand it deeper due to timely performed independent work since they can revise knowledge of other subjects; the interest of students in obtaining a high grade for independent work contributes to more active intellectual activity when completing a map of the reproduction of previously acquired knowledge. This, in turn, allows teachers to improve the quality of the whole process of mastering knowledge; using maps in lectures significantly affects the further character of student independent work.

Conclusions

The effectiveness of the pedagogical conditions has been proved due to the results of the formative experiment: the number of students in the control group who have a high level of readiness for sport and physical activity at secondary schools increased, whereas the same level did not increase significantly in the control group. The research findings indicate dynamic positive changes in the indicators of future physical education teachers' readiness for sport and physical activity at secondary schools in the experimental groups under the influence of the proposed innovations, which have accelerated the neurocognitive potential of students.

1. The analysis of scientific findings on the problem under study in psycho-pedagogical literature and educational practice shows that most works deal with certain issues and areas of this process. They reveal methodological principles and general theoretical issues in the training of future physical education teachers. Besides, they study the individualization and differentiation of physical education in schools, conduct relevant diagnostics in the field of physical education and sports and justify the process of developing professional competency in future physical education teachers. Particular attention *is* paid to the peculiarities of physical and sports

activities concerning future physical education teachers. Despite the steady interest in this problem, it remains insufficiently covered in the theory and practice of professional education today.

The analysis of research terminology (physical education, physical culture, sports, sports activities, physical activities, physical and sports activities, teacher training) allows one to clarify the essence of such key concepts as "training future teachers for physical and sports activities in secondary schools" and "readiness of future physical education teachers for physical and sports activities in secondary schools".

The training of future physical education teachers for physical and sports activities in secondary schools is defined as selective use of tools of physical education and sports to develop a system of professional knowledge for future specialists, provide them with the necessary set of pedagogical skills focused on physical education, sports, restoration of pupils' psychophysiological capacity and their personal development in the process of amateur initiatives.

Such concept as "readiness of future physical education teachers for physical and sports activities in secondary schools" indicates a dynamically developmental personal quality that reflects the required level of knowledge and skills in the field of physical and sports activities and strong motivation towards these activities.

2. The article clarifies the criteria of readiness of future physical education teachers for physical and sports activities in secondary schools and their indicators: *the motivation and value criterion* (the focus on physical and sports activities and their creative implementation; the awareness of their significance; the need for self-study and self-improvement in the field of physical education and sports), *the intellect and cognitive criterion* (the level of knowledge required to organize physical and sports activities in schools: theories and methods of organizing physical education classes as a social system; methods for identifying, developing and correcting motor skills; basic norms of physical activity during physical education classes), *the activity and practice criterion* (skills in planning and organizing sports classes, physical and sports activities during school hours and competitions, managing their organization, developing physical skills). These criteria and indicators allow one to describe the levels (high, average, low) in readiness of future physical education teachers for physical and sports activities in secondary schools.

3. The article identifies the levels of readiness of future physical education teachers for physical and sports activities in secondary schools. It finds that future specialists show a lack of attention to this activity, ignorance of their functions in the field of physical education, weak

methodological and practical readiness to organize physical and sports activities with pupils. It can be explained by the limited amount of information on the organization of physical and sports activities with pupils during after-school hours in the content of their training. Moreover, their current training does not fully consider horizontal and vertical connections in the system of teaching professional courses. Educational material seems to be duplicated, which results in irrational coordination of basic courses, including the course on "Theory and Methods of Physical Education".

The ascertaining experiment was conducted to develop the model and justify pedagogical conditions for training future physical education teachers for physical and sports activities in secondary schools. Its results prove that most physical education teachers are at low levels of readiness for such activities.

4. The article presents and validates the author's model of training future physical education teachers for physical and sports activities in secondary schools. It consists of the following blocks and their components: the methods and goals block (goals, approaches, principles), the content and procedures block (stages, content, forms, methods, technologies, tools), the assessment and results block (criteria, levels, corresponding results). They reflect the specifics of training future physical education teachers for physical and sports activities in secondary schools and ensure their readiness to organize this process in professional activities. The main components of the model interact through feedback mechanisms.

The article determines and implements the pedagogical conditions for training future teachers for physical and sports activities in secondary schools: promoting stable interest, positive motivation and valuable views of future physical education teachers on physical culture, sport and physical activity based on the selection of technologies and instruction tools; mastering theoretical knowledge of the essence and the content of sport and physical activity and methods of its implementation in school with the help of interactive forms and methods of instruction; activating students' physical self-improvement during independent work. Pedagogical condition 1 was implemented through using different types of classroom tasks aimed at realizing certain technological physical and sports activities and innovative technologies (fitness technologies, ICT); organizing various forms of physical culture and sports activities (moving games; refereeing sports competitions, especially those included in quadruple sprints; sports holidays) during extracurricular activities; developing certain muscle groups through physical exercise; using active methods (dialogues, role-playing and business games). Pedagogical condition 2 implied improving the educational process

by updating the course on "Theory and Methods of Physical Education", coordinating "cross-cutting themes" of the basic courses on "Gymnastics and Teaching Methods", "Athletics and Teaching Methods", "Swimming and Teaching Methods"; holding a special workshop on "Organization and Methodology of Physical and Sports Activities at School"; organizing and realizing various forms of physical and sport activity during practical classes of basic courses (classes were conducted based on educational practice with its further analysis); applying innovative forms and active methods of instruction (lectures & discussions, binary lectures, exercises, pieces of training, round tables discussions, seminars); technologies (ICT, cloud-oriented educational environment). Pedagogical condition 3 was implemented by applying active methods (tests, conversations, discussions, reflections, pedagogical situations and practical activities), organizational forms (performing individual assignments, during which sports holidays, health days, outside games, sports hours, sports and entertainment activities as part of extracurricular activities were organized; keeping the self-development journal and preparing an E-portfolio).

The results of the formative experiment prove the effectiveness of the pedagogical conditions. Indeed, the number of EG students with a high level of readiness for physical and sports activities in secondary schools has increased, whereas that of CG students has not changed significantly. Besides, one can see certain dynamic positive changes in the indicators of EG under the influence of the proposed innovations.

Further research should cover the following areas: university teachers' competency in the field of training future physical education teachers for physical and sports activities in secondary schools; an educational environment as a condition for training future physical education teachers for such activities.

Acknowledgments

The authors of the article have equally participated in the preparation of the article. Their work was divided into personal tasks, including a) search, review, and analysis of relevant studies on pedagogy and neurophysiology of physical education and sports; b) modelling and prediction of the effectiveness of modified or created educational conditions; c) evaluation of the effectiveness of the formative-diagnostic experiment; d) organization of discussions on the obtained results and formulation of conclusions.

References

Akhmetov, R. F., & Shaverskyi, V. K. (2007). Problemy y perspektyvy formuvannia profesiinoi maisternosti fakhivtsiv fizychnoi kultury zasobamy innovatsiinykh tekhnolohii [Problems and prospects of developing professional skills in physical education specialists due to innovative technologies]. *Visnyk Zhytomyrskoho derzhavnoho universytetu imeni Ivana Franka*, *34*, 50-52. http://eprints.zu.edu.ua/1519/1/07arfzit.pdf

Bakhmat, N., Maksymchuk, B., Voloshyna, O., Kuzmenko, V., Matviichuk, T., Kovalchuk, A., Martynets, L., Uchytel, I., Solovyov, V., Manzhos, E., Sheian, M., Alieksieiev O., Slyusarenko, N., Zhorova, I., & Maksymchuk, I. (2019). Designing cloud-oriented university environment in teacher training of future physical education teachers. *Journal of Physical Education and Sport*, *19*(4), 1323-1332. http://efsupit.ro/images/stories/august2019/Art%20192.pdf

Bezliudnyi O., Kravchenko O., Maksymchuk B., Mishchenko M., & Maksymchuk, I. (2019) Psycho-correction of burnout syndrome in sports educators (2019). *Journal of Physical Education and Sport, 19*(3),1585-1590. http://efsupit.ro/images/stories/septembrie2019/Art%20230.pdf

Bilokopytova, Y. A. (2000). *Osnovy teorii sheipinhu* [The fundamentals of shaping]. Naukovyi svit.

Denysenko, N. (2009). Naukovo-doslidnytska robota studentiv pedahohichnoho koledzhu yak odyn zi stratehichnykh napriamiv fakhovoi pidhotovky maibutnoho vchytelia fizychnoi kultury [Research activities of students at teacher colleges as one of strategic trends in professional training of future physical education teacher]. *Fizychne vykhovannya, sport i kultura zdorovya u suchasnomu suspilstvi*, *1*, 29-32. https://sport.eenu.edu.ua/index.php/sport/article/view/1156

Eremeev, S. N. (2011). *Razvitie gotovnosti prepodavatelia vuza k realizatsii adaptatsionnogo potentsiala fizkulturno-sportivnoi deiatelnosti studentov* [Developing lecturers' readiness to implement the adaptation potential of physical and sports activities of students] [PhD thesis, Magnitogorsk State University, Magnitogorsk]. Dissercat. https://www.dissercat.com/content/razvitie-gotovnosti-prepodavatelya-vuza-k-realizatsii-adaptatsionnogo-potentsiala-fizkulturn

Halaidiuk, M., Maksymchuk, B., Khurtenko, O., Zuma, I., Korytko, Z., Andrieieva, R., Strykalenko, Y., Zhosan, I., Syvokhop, Y., Shkola, O., Fomenko, O., & Maksymchuk, I. (2018). Teaching approaches in extracurricular physical activities for 12-14-year-old pupils under environmentally unfavourable conditions. *Journal of Physical Education and Sport*, *18*(4), 2284-2291. http://efsupit.ro/images/stories/decembrie2018/Art%20344.pdf

Henseruk, H. R. (2005). *Pidhotovka maibutnikh uchyteliv fizychnoi kultury do zastosuvannia informatsiinykh tekhnolohii u profesiinii diialnosti* [Preparing future physical education teachers to use information technologies in professional activities] [Abstract of PhD thesis, Volodymyr Hnatiuk Ternopil National Pedagogical University, Ternopil]. Disslib. http://www.disslib.org/pidhotovka-majbutnikh-uchyteliv-fizychnoyi-kultury-do-zastosuvannja-informatsiynykh.html

Hertsyk, M. S., & Vatseba, O. M. (2002). *Vstup do spetsialnostei haluzi "Fizychne vykhovannia i sport"* [Introduction to degrees in Physical Education and Sports]. Ukrainian Technologies. http://repository.ldufk.edu.ua/handle/34606048/20284

Komogorova, M., Maksymchuk, B., Bernatska, O., Lukianchuk, S., Gerasymova, I., Popova, O., Matviichuk, T., Solovyov, V., Kalashnik, N., Davydenko, H., Stoliarenko, O., Stoliarenko, O., & Maksymchuk, I. (2021). Pedagogical Consolidation of Pupil-Athletes Knowledge of Humanities. *Revista Romaneasca Pentru Educatie Multidimensionala*, *13*(1), 168-187. https://doi.org/10.18662/rrem/13.1/367

Li, L., Gow, A. D. I., & Zhou, J. (2018). The role of positive emotions in education: a neuroscience perspective. *Mind, Brain, and Education, 14*(3), 220-234. https://doi.org/10.1111/mbe.12244

Maksymchuk, B., Gurevych, R., Matviichuk, T., Surovov, O., Stepanchenko, N., Opushko, N., Sitovskyi, A., Kosynskyi, E., Bogdanyuk, A., Vakoliuk, A., Solovyov, V., & Maksymchuk, I. (2020a). Training Future Teachers to Organize School Sport. *Revista Romaneasca Pentru Educatie Multidimensionala*, *12*(4), 310-327. https://doi.org/10.18662/rrem/12.4/347

Maksymchuk, B., Matviichuk, T., Solovyov, V., Davydenko, H., Soichuk, R., Khurtenko, O., Groshovenko, O., Stepanchenko, N., Andriychuk, Y., Grygorenko, T., Duka, T., Pidlypniak, I., Gurevych, R., Kuzmenko, V., & Maksymchuk, I. (2020b). Developing Healthcare Competency in Future Teachers. *Revista Romaneasca Pentru Educatie Multidimensionala*, *12*(3), 24-43. https://doi.org/10.18662/rrem/12.3/307

Maksymchuk, I., Maksymchuk, B., Frytsiuk, V., Matviichuk, T., Demchenko, I., Babii, I., Tsymbal-Slatvinska. S., Nikitenko, A., Bilan, V, Sitovsyi, A., & Savchuk, I. (2018). Developing pedagogical mastery of future physical education teachers in higher education institutions. *Journal of Physical Education and Sport*, *18*(2), 810-815. http://efsupit.ro/images/stories/iunie2018/Art%20119.pdf

Marušić, M., & Oikonomou, A. (2013). Value hierarchy of future subject teachers in Serbia in the context of Schwartz theory. *Zbornik Instituta za Pedagoska Istrazivanja, 45*(2), 241-259. http://www.doiserbia.nb.rs/Article.aspx?ID=0579-64311302241M#.YMcJAjYzYgo

Omelchenko, S. O. (2007). *Vzaiemodiia sotsialnykh instytutiv suspilstva u formuvanni zdorovoho sposobu zhyttia ditei ta pidlitkiv* [The interaction of social institutions in promoting a healthy lifestyle of children and adolescents]. Alma-mater.

Operailo, S. I., Ilchenko, A. I., Yermolova, V. M., & Ivanova, L. I. (2005). *Knyha vchytelia fizychnoi kultury* [The book of a physical education teacher]. TORSING PLUS. https://torsing.ua/download/library-teacher/kniga_vchitelya_fizkulturi.pdf

Palamarchuk, O., Gurevych, R., Maksymchuk, B., Gerasymova, I., Fushtey, O., Logutina, N., Kalashnik, N., Kylivnyk, A., Haba, I., Matviichuk, T., Solovyov, V., & Maksymchuk, I. (2020). Studying Innovation as the Factor in Professional Self-Development of Specialists in Physical Education and Sport. *Revista Romaneasca Pentru Educatie Multidimensionala*, *12*(4), 118-136. https://doi.org/10.18662/rrem/12.4/337

Panchenko, G. I. (2011). Problemy sovershenstvovaniia podgotovki budushchego uchitelia fizicheskogo vospitaniia k organizatsii i provedeniiu fizkulturno-ozdorovitelnoi i sportivno-massovoi raboty v obshcheobrazovatelnoi shkole [Improving the training of future physical education teachers to organize and conduct physical and sports activities in a secondary school]. *Pedagogika, psikhologiya i mediko- biologicheskiye problemy fizicheskogo vospitaniya i sporta*, *11*, 86-90. https://cyberleninka.ru/article/n/problemy-sovershenstvovaniya-podgotovki-buduschego-uchitelya-fizicheskogo-vospitaniya-k-organizatsii-i-provedeniyu-fizkulturno/viewer

Randolph, C., McCrea, M., & Barr, W. B. (2005). Is neuro-psychological testing useful in the management of sport-related concussion? *Journal of Athletic Training*, *40*(3), 139-154. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1250250/

Samuseviča, A., & Striguna, S. (2017). The development of teachers' pedagogical competence in the process of self-education at the university. *International Journal on Lifelong Education and Leadership*, *3*(2), 39-46. https://dergipark.org.tr/tr/download/article-file/551098

Sitovskyi A., Maksymchuk B., Kuzmenko V., Nosko Y., Korytko Z., Bahinska O., Marchenko, O., Nikolaienko, V., Matviichuk, V., Solovyov, V., Khurtenko, O., Sluysarenko, N. V., Zhorova, I., & Maksymchuk, I. (2019). Differentiated approach to physical education of adolescents with different speed of biological development (2019). *Journal of Physical Education and Sport*, *19*(3), 1532-1543. http://ekhsuir.kspu.edu/123456789/12211

Solopchuk, D. V. (2003). Problemy formuvannia zdorovoho sposobu zhyttia v uchniv zahalnoosvitnikh shkil [Some issues in promoting a healthy lifestyle among secondary school students]. *Moloda sportyvna nauka Ukrayiny* [Young Sports Science of Ukraine], 7*(2)*, 120-122. http://repository.ldufk.edu.ua/handle/34606048/13845

Sovhira, S. V., & Honcharenko, H. Y. (2015). *Rekreatsiine spriamuvannia fizychnoho vykhovannia studentiv u pozanavchalnyi chas. Perspektyvy rozvytku turystychnoi industrii v Ukraini: rehionalni aspekty* [Recreational trends in physical education of students during extracurricular activities]. Materialy III Vseukrainskoi naukovo-praktychnoi Internet-konferentsiyi "Perspektyvy rozvytku turystychnoyi industriyi v Ukrayini: rehionalni aspekty" [Proceedings of the Pan-Ukrainian III Scientific and Practical e-Conference on Prospects for Development of Tourism Industry in Ukraine: Regional Aspects] (pp. 88-90). Vizavi. https://dspace.udpu.edu.ua/xmlui/handle/6789/3619?show=full

Trifonas, P. (2003). The ethics of science and/as research: deconstruction and the orientations of a new academic responsibility. *Educational Philosophy and Theory*, *35*(3), 285-295. https://philpapers.org/rec/TRITEO

Tsushima, W. T., Jun Ahn, H., Siu, A. M., Yoshinaga, K., Yung Choi, S., & Murata, N. M. (2018). Effects of repetitive subconcussive head trauma on the neuropsychological test performance of high school athletes: a comparison of high, moderate, and low contact sports. *Applied Neuropsychology, 8*(3), 223-230. https://pubmed.ncbi.nlm.nih.gov/29393677

Vaidya, A. R. & Fellows, L. K. (2017). The neuropsychology of decision-making: a view from the frontal lobes. In J.-C. Dreher & L. Trembley (Eds.), *Decision Neuroscience: an Integrative Approach* (pp. 277–289). Academic Press. https://doi.org/10.1016/B978-0-12-805308-9.00022-1

Volkova, S. S. (2008). *Formuvannia profesiinoi kompetentnosti maibutnikh vchyteliv fizychnoi kultury* [Developing professional competency in future physical education teachers]. Materialy Mezhdunarodnoi nauchno-prakticheskoi Internet-konferentsii [Sovremennyye nauchnyye dostizheniya – 2008" [Proceedings of the International Scientific-Practical Internet Conference on Modern Scientific Achievements – 2008]. Education and science. http://www.rusnauka.com/24_SVMN_2008/Sport/27099.doc.htm

Zvolinskaya, N., & Maslov, V. (1998). Tendentsii razvitiia soderzhaniia professionalnogo fizkulturnogo obrazovaniia v sotsiokulturnom kontekste [Some trends in developing the content of professional physical education in the sociocultural context]. *Materialy Mezhdunarodnogo kongressa "Chelovek v mire sporta: Novyye idei, tekhnologii, perspektivy"* [Proceedings of the International Congress on the Individual in the World of Sport: New Ideas, Technologies, Prospects]. FON. http://lib.sportedu.ru/GetText.idc?TxtID=544