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PEDAGOGICAL AND METHODOLOGICAL ASPECTS OF DIGITALIZING PHYSICAL EDUCATION AND SPORTS TRAINING IN MILITARY PROFESSIONAL EDUCATION

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Abstract:
This article analyzes the pedagogical and methodical foundations of digitalizing physical education and sports training within the system of military professional education. It highlights the issues of increasing the efficiency of managing the physical preparedness of cadets and military personnel by introducing modern digital technologies, biometric monitoring tools, and artificial intelligence elements into the educational and training process. Furthermore, it substantiates methodological mechanisms for improving pedagogical approaches and standardizing individual loads under conditions of digital transformation.

Keywords: military professional education, physical education, digitalization, pedagogical aspects, methodological foundations, digital monitoring, biometric control, artificial intelligence.

Introduction

Currently, the rapid development of the digital economy and information technologies is fundamentally transforming the education system, including military professional education, alongside all other spheres. Modern tasks facing our Armed Forces require a high level of combat readiness, prompt decision-making, and maximizing the potential of the human factor. In this process, the

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necessity arises to elevate the organization system of physical training for future officers and military specialists to a new, qualitatively higher level.

In the modern system of military professional education, the training process for future military specialists implies not only the formation of theoretical knowledge and professional skills, but also the development of a high level of physical readiness, functional capabilities, endurance, and the ability to operate under complex conditions. From this perspective, organizing physical education and sports training on a scientific basis is one of the key factors determining the quality of military education [1].

Physical readiness under military service conditions is directly associated with long-distance movement, overcoming various obstacles, moving with loads, performing tasks requiring strength and agility, and maintaining performance under physical strain. Therefore, regularly monitoring the physical development of cadets, evaluating training effectiveness, and timely eliminating identified deficiencies constitute an important pedagogical task.

In traditional physical education classes, control is often based on standardized tests, teacher observation, and recording results at the end of the session. Although such an approach is important, in some cases the possibilities for detailed evaluation of daily changes in a cadet's physical condition, the impact of load during training, and recovery dynamics may be limited [2].

The development of digital technologies creates new opportunities for improving the physical education process. In particular, using heart rate measurement devices, electronic testing systems, physical activity tracking devices, and data analysis software makes it possible to monitor individual indicators of cadets, compare training results, and introduce appropriate pedagogical adjustments to the educational process.

In this context, digitalization should be understood not merely as the introduction of electronic devices, but as the formation of a holistic pedagogical system for planning, organizing, controlling, analyzing, and improving physical education training [3].

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Traditional physical education and sports training have often relied on general norms and subjective evaluation methods. However, modern military education practice necessitates the complete digitalization of the educational process, real-time monitoring of the functional state of each military service member, and the application of scientifically grounded individual programs.

Implementing digital technologies in military professional education is not just a technical update, but a profound pedagogical reform that fundamentally increases the quality of the educational and upbringing process. This process relies on important factors, pedagogical necessities, and practical conditions. The physiological capabilities, body constitution, genetics, and physical fitness level of each cadet or military service member differ. A standard approach may not be equally effective for everyone.

The use of digital technologies allows for the formation of a data-driven approach in organizing physical education classes. Here, a cadet's physical readiness is analyzed not only by the final test result, but also in combination with changes observed during training sessions, the volume of work performed, and recovery characteristics [4].

The main pedagogical opportunities of digitalization include:

Improving the individual approach: Cadets' initial physical fitness may not be identical. Digital records help identify differences in strength, agility, and endurance indicators and adapt training sessions to individual needs.

Ensuring continuity of pedagogical control: An electronic monitoring system creates the opportunity to regularly record training results, compare them with previous indicators, and monitor physical development dynamics.

Strengthening feedback: Based on feedback, a cadet can view their results and compare them with established goals. The teacher, in turn, reviews the training content and load volume based on the results.

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Improving educational process planning: Additional information is formed for planning training sequences, physical loads, and rest intervals based on digital data.

Documenting educational results: Electronic logs and databases help systematically record individual results of cadets, generate reports, and increase the justification of pedagogical decisions.

At the same time, the mere availability of digital data does not automatically increase physical readiness. Achieving results requires measurement reliability, correct selection of training methodology, and the teacher's professional competence (**Table 1**). Digital tools can be used in military professional education to assess various components of physical readiness, with each tool having its own measurement capabilities and limitations [5].

Table 1. Digital tools used in physical education training and their pedagogical functions

Digital Tool	Monitored Indicators	Pedagogical Function
Heart rate measurement device	Heart rate, its changes during training	Monitoring response to physical load
Physical activity tracker	Duration of activity, number of steps, movement intensity in some models	Recording daily activity and training volume
Electronic testing system	Running time, number of repetitions, test results	Recording and comparing results
Video analytics tools	Movement technique, body position, sequence of exercise execution	Analyzing movement technique and identifying errors
Electronic educational platform	Training plans, assignments, tests, and results	Managing the educational process and feedback
Data analysis software	Dynamics of results, group indicators, individual changes	Justifying pedagogical decisions

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When the tools listed in the table are integrated with each other, an opportunity arises to collect training data in a single system. For example, heart rate and duration of work performed during a running workout can be recorded and subsequently analyzed together with test results. However, data measured by different devices do not always have the same accuracy. Therefore, when interpreting results, the technical characteristics of the device, measurement conditions, and reliability of the recorded indicator must be taken into account.
Within the framework of the study, a six-stage methodical model of digitalizing physical education training is proposed (**Table 2**).

Table 2. Structural stages of the digital monitoring model

Stage	Main Content	Expected Pedagogical Result
1. Diagnostic	Assessing initial physical readiness through tests	Determining individual levels of preparedness
2. Planning	Setting goals and training loads	Developing individual or group training plans
3. Implementation	Conducting training sessions based on established methodology	Developing physical qualities
4. Digital monitoring	Recording training results and relevant indicators	Tracking change dynamics
5. Analysis and correction	Comparing results with planned indicators	Adapting load and training content as needed
6. Final evaluation	Re-testing and summarizing results	Assessing mastery and physical development dynamics

A unique feature of this model is that digital monitoring is viewed not as a separate stage of training, but as a mechanism embedded throughout the entire pedagogical process. When implementing the model into practice, cadets' initial results are recorded first. Then the goals of physical readiness and training content

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are determined. Data collected during training sessions is regularly analyzed, and appropriate changes are made based on an individual approach when necessary. In the final stage, initial and final indicators are compared. If the model is tested through a pedagogical experiment, differences in results can be verified using statistical methods. This allows for evidence-based conclusions regarding the practical effectiveness of digital tools.

Cadets' physical capabilities, training experience, and recovery rates can vary. Therefore, assigning the exact same load to all cadets is not always the most optimal pedagogical solution. Digital monitoring serves as an auxiliary tool in organizing an individual approach. Here, physical readiness tests, session duration, number of repetitions completed, heart rate, and the cadet's subjective rating of perceived exertion can be analyzed together. For example, in training aimed at developing endurance, running time is taken into account alongside load signs observed during training. In strength exercises, the number of repetitions completed, correct execution technique, and rest time between exercises are controlled (**Table 3**).

Table 3. Using digital monitoring in developing physical qualities

Physical Quality	Evaluation Method	Function of Digital Tool
Agility	Time taken to cover a designated distance	Automatically or electronically recording the result
Endurance	Running a designated distance or standard endurance test	Comparing result dynamics
Strength	Standardized strength tests, pull-ups, or other standard normative exercises	Recording number of repetitions and results
Flexibility	Designated flexibility tests	Storing results in an electronic database
General physical work capacity	Complex of standardized tests	Analyzing indicators together
Functional response	Heart rate and post-training recovery indicators	Monitoring response to load

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In individualizing physical loads, digital indicators should not automatically be used as the sole decision-making criterion. They must be evaluated in conjunction with teacher observation, the cadet's subjective state, medical recommendations, and current physical fitness standards. Especially when modifying loads based on heart rate or other physiological indicators, individual characteristics and measurement device accuracy must be considered. Decisions of a medical nature are made within the competence of relevant specialists.

The effectiveness of digitalization in military professional education institutions depends not only on the availability of technical tools, but also on organizational and pedagogical conditions:

Developing teachers' digital competence: A physical education teacher must possess skills in recording digital data, assessing their reliability, analyzing results, and drawing appropriate pedagogical conclusions.

Standardizing measurement criteria: It is necessary to organize testing under uniform conditions, define exercise performance rules, and establish result recording procedures based on unified criteria.

Maintaining an individual approach: It is taken into account that cadets with identical indicators on digital platforms may differ in their training history, training experience, and recovery state.

Ensuring data security: Access to cadets' personal and physiological indicators must be restricted to authorized persons, data must be stored in the established manner, and used exclusively for legal and pedagogically grounded purposes.

Accounting for technical and organizational capabilities: When selecting digital devices and software, their cost, maintenance capability, measurement accuracy, and compatibility with the institution's information infrastructure are evaluated.

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Integration with traditional pedagogical methods: Digital monitoring must be harmonized with direct teacher observation, explanations, demonstrations, practical exercises, and individual consultations.

Maintaining continuous interest and motivation for training among military service members is an important task. Modern smart devices and digital rating systems turn training into an engaging competitive environment. Military service members constantly monitor the growth (or decline) of their personal results through electronic spreadsheets and applications. This fosters personal interest, responsibility, and a healthy competitive spirit in working on themselves [5].

To fully implement this system, the following conditions must be created:

Material and technical base: Providing modern sensor devices, high-speed internet networks, analytical software, and specially equipped sports complexes.

Personnel capacity: Raising the digital literacy of physical education teachers, coaches, and instructors, and launching continuous professional development courses to teach them how to work with modern technologies.

Information security: Developing and implementing secure protocols to protect the personal and biometric data of military service members.

Digitalizing the physical education process in military education is a modern demand that serves as a solid pedagogical foundation for training highly combat-ready, physically strong, and tactically proficient military personnel. Using modern digital tools in the methodically correct management of physical education and sports training plays a decisive role in increasing training effectiveness, ensuring safety, and establishing a scientific approach [6]. This process relies on the following important methodological directions and principles:

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Properly evaluating the physiological reactions of the body during physical training prevents excessive strain and negative consequences.

Using specialized heart rate monitors, smart bracelets, and sensitive sensors allows real-time tracking of cadets' heart rate (HR). Training is managed by dividing into aerobic, anaerobic, and maximum exertion zones. Based on the data obtained, the instructor precisely determines which military service member can handle the load and who immediately needs a rest or recovery period. This ensures that the physical education process is safe and scientifically grounded.

The perfection of combat-practical movement techniques is a guarantee of safety and successful task execution. The process of passing through obstacle courses, lifting heavy loads, hand-to-hand combat elements, or performing applied sports is recorded via high-definition cameras and analyzed using specialized software [8]. The software displays movement trajectories, body part angles, and the center of gravity. This gives both the coach and the cadet the ability to visually identify errors and develop precise methodological recommendations to correct them.

The era of maintaining physical fitness indicators in paper form has passed, and digital databases are acquiring priority importance [9].

Maintaining the dynamic growth of cadets' physical development in a single cloud database is established in military units and educational institutions. The system automatically performs a comparative analysis of military service members' indicators over months and years. Through this, physical development trends of each cadet are identified, creating the opportunity to predict future results.

The highest and most effective stage of the digitalization process involves deep analysis of large-scale data (Big Data) and the introduction of artificial intelligence (AI) algorithms into military education and physical training practice. This approach is not merely keeping records, but foreseeing, preventing risks, and automating educational quality.

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The health and physical potential of military service members is the primary factor of combat readiness. Physical strains and injuries often result from improperly distributed loads or failing to notice signs of fatigue in the body in a timely manner. AI systems analyze previous training results, recovery periods, sleep quality, heart rate, and biometric indicators of each military member based on Big Data. The system gives immediate warnings when excessive strain and chronic fatigue symptoms are recorded in the body. In situations with a high risk of traumatism (e.g., excessive pressure on joints or muscles), algorithms provide recommendations to the instructor to change the training type or temporarily reduce the load. This sharply reduces the probability of military service members sustaining injuries.

In traditional methods, the same training programs are applied to all groups or units, which cannot fully cover individual differences. Based on the obtained biometric data, artificial intelligence automatically forms interval or functional training complexes corresponding to the real physical condition of each training group or individual military member [10]. The system modifies the training schedule in real-time depending on physical growth dynamics. If a group quickly masters a certain norm, the load level is automatically made more complex, and in reverse cases, it is optimized.

Research Conclusions:

Holistic approach: Digitalizing physical training should be organized not merely as the application of electronic devices, but as a holistic methodological system combining diagnosis, planning, monitoring, analysis, and pedagogical corrections.

Auxiliary tool utility: Heart rate measurement devices, electronic testing systems, physical activity trackers, and video analytics tools can serve as

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auxiliary instruments in recording physical readiness indicators and analyzing training sessions.

Individual capacity integration: Considering cadets' individual physical capabilities is an important methodological requirement in planning training loads and evaluating their results. Digital indicators must be interpreted in conjunction with teacher observation and relevant standards.

Model application: The proposed six-stage digital monitoring model defines interconnected stages of organizing physical training sessions. Before introducing it into practice, technical capabilities, pedagogical conditions, and evaluation criteria must be clarified.

Prerequisites for efficiency: To ensure the effectiveness of digitalization, it is necessary to develop teachers' digital competence, standardize measurement methods, ensure data security, and establish integration with traditional pedagogical methods.

Future research directions: In future research, it is advisable to evaluate the effectiveness of training based on digital monitoring through pedagogical experiments, compare initial and final results of cadets, and statistically analyze factors influencing physical readiness dynamics.

Overall, digitalizing physical education and sports training is a promising direction that expands the pedagogical possibilities of military professional education. Its practical value is determined not by the availability of technologies, but by their scientific, safe, and pedagogically appropriate use.

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