



Substantiation of the technology for integrating the physical and technical preparation of swimmers aged 11–14 years

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Abstract

Objective of the study is to substantiate the technology for integrating the physical and technical preparation of swimmers aged 11–14 years.

Methods and structure of the study. The scientific work used the analysis of literature data; various approaches to the development of physical qualities and technical preparedness were studied; the results of the authors' own long-term observations, conducted on a contingent of 124 swimmers aged 11–14 years, were generalized. The study included the application of methods of computer video analysis, testing, hardware diagnostics (Swim Force Test, VASA Swim Ergometer), design, modeling, as well as methods of mathematical statistics. The data processing was carried out using correlation, regression, and ROC analysis.

Results and conclusions. The following components of the technology for integrating the physical and technical preparation of swimmers are proposed: conceptual, content-related, and procedural, based on the principles of level-based continuity, integrative systematicity, complementarity, and synergism. The application of special methods (conjugation, level-based construction, technique stabilization, complementation of means, stress impacts) and selected exercises, including those on simulators, makes it possible to ensure the conjugated development of physical qualities and swimming technique, creating conditions for the effective transfer of fitness into the structure of the competitive action.

Keywords: *integration, technology, physical and technical preparation, synergism, young swimmers, conjugated methods and means of training, principles.*

Introduction. The training stage in the age range of 11–14 years is a critical link in the system of long-term preparation of swimmers. It is precisely during this period that the active formation of the motor skill occurs, an individual swimming style is formed, and the morphofunctional restructurings associated with pubertal development create favorable prerequisites for the growth of special working capacity. However, as practice shows and the data of scientific studies confirm, it is precisely at this stage that the contradiction between the development of physical qualities and the effectiveness of their realization in the structure of the stroke is manifested most acutely. The problem of the dissociation of physical and technical preparation has repeatedly become the subject of study in the works of leading specialists [1, 2, 5, 7, 8]. V.N. Platonov em-

phasized that the effective transfer of fitness is possible only under the condition of the biomechanical and physiological correspondence of the means of special physical preparation to the structure of the competitive exercise [5]. T.G. Fomichenko pointed out the need to divide strength preparation into general and special, with the latter to be carried out in conditions as close as possible to swimming [7]. And V.B. Avdienko and I.N. Solopov focus attention on the fact that strength developed in isolated conditions on land requires special "hydrodynamic tuning" for its realization in the stroke [1].

In the works of A.V. Arishin and A.I. Pogrebnoy, the need to revise the traditional approaches to the construction of the training process at the stages of long-term preparation is substantiated. The authors iden-



tified the key biomechanical parameters limiting the swimming speed in the 11–14 age group, and showed that the isolated development of physical qualities does not lead to an automatic improvement of technique [3, 4, 6]. A number of studies revealed that, with the traditional planning of the training process in swimmers aged 11–14 years, a multidirectional dynamics of the kinematic parameters of the stroke is observed, in which positive changes in some phases are accompanied by the degradation of others, which testifies to a violation of the established biomechanical structure [2, 3].

Of particular importance for our study are the works of recent years, in which it has been established that, under the condition of the synergetic interaction of the means of physical and technical preparation, an emergent effect arises, as a result of which a qualitative leap in the level of integral technical-physical preparedness is achieved. In our works of 2024–2025, these provisions received further development with regard to the 11–14 age group, where pubertal changes create both favorable prerequisites for the growth of special working capacity and risks of the formation of irrational technique [2, 3].

Thus, the analysis of the scientific literature and the generalization of the results of the authors' own long-term observations unambiguously indicate the need to develop a specialized pedagogical technology that would make it possible to overcome the existing fragmentation and to ensure the integration of the physical and technical components in a unified training process.

Objective of the study is to substantiate the technology of the integral physical and technical preparation of swimmers aged 11–14 years.

Methods and structure of the study. The scientific work used the analysis of literature data; various approaches to the development of physical qualities and technical preparedness were studied; the results of the authors' own long-term observations, conducted on a contingent of 124 swimmers aged 11–14 years, were generalized. The study included the application of methods of computer video analysis, testing, hardware diagnostics (Swim Force Test, VASA Swim Ergometer), design, modeling, as well as methods of mathematical statistics. The data processing was carried out using correlation, regression, and ROC analysis.

Results of the study and discussion. The proposed pedagogical technology of integral physical and

technical preparation represents a part of the pedagogical system and includes three obligatory components – conceptual, content-related, and procedural, each of which makes its contribution to achieving the final goal, which consists in achieving the maximum swimming speed in the structure of the competitive exercise.

The conceptual component of the technology is based on the theory of synergism and systematicity, which makes it possible to rethink the traditional approaches to the preparation of swimmers. At the basis of the proposed concept lies the provision that the training process should be built not as a sum of isolated impacts on physical qualities and technique, but as an integral system, where the means of preparation are selected taking into account their mutual reinforcement [2]. The key notion here is the principle of level-based continuity, which presupposes that the means of long-term preparation used are not simply summed up, but reinforce the effect of the previously applied approaches. This becomes possible when the pedagogical impacts correspond to the anatomical and physiological features of the athletes at each age stage, to their genetic and phenotypic sensitivity. The load in this technology is considered as an instrument of synergism, when the orientation of one work complementarily supplements and reinforces the effect of another. The principle of complementarity consists in the use of interdependent training means at various levels of functional load. Each new level of preparedness is thereby defined as a new, “zero” level, since, from the standpoint of the theory of the self-organization of systems, there is no way back, and development proceeds along a spiral-shaped trajectory [2, 3].

Of fundamental importance for the technology is the identification of the principle of integrative systematicity, which can be formulated as “technique is greater than the sum of the technical elements composing it.” This means that the interaction of the means of physical and technical preparation generates a systemic effect (emergence), expressed in the appearance of new levels of preparedness, unattainable with the isolated use of these means [2].

The content-related component of the technology includes a system of pedagogical tasks, distributed by the years of preparation, and special training methods ensuring their solution. At the basis of constructing the content are the results of the ROC analysis, which revealed the dominant, highly specific parameters in-



fluencing the maximum swimming speed in the 11–14 age group [2, 3].

To realize the set tasks, the technology proposes using five special methods of sports training [2]. The method of conjugation consists in the selection and use of means from the arsenal of physical and technical preparation, making it possible to harmonize the simultaneous impact on the indicators of both types of preparedness. The application of this method finds its expression in the synchronization of training tasks on land and in the water, united by a single biomechanical structure and the same zone of intensity. The method of level-based construction implies the choice of a certain training pattern after passing the bifurcation point, taking into account the already achieved level of preparedness, which makes it possible to create conditions for controlled, systemic planning with a calculated target effect. The method of technique stabilization presupposes the performance of exercises at various levels of load – aerobic, threshold, and anaerobic-glycolytic – with control of the stability of technique at each level. If the element being corrected is not stabilized, a return to a lower level is provided for the introduction of additional conjugated means. The method of complementation of means consists in the application of highly specific exercises on land and in the water, aimed at achieving a high swimming speed, with the combining of these means taking into account the priority of the training tasks. The method of stress impacts is characterized by the inclusion in the training programs of random non-specific exercises that have no direct relation to the general algorithm of the task being solved, which serves as a stimulus for the further development of the system, bringing it out of the state of stagnation.

The procedural component of the technology determines the order of the organization of the training process in various structural formations – macro-, meso-, and microcycles. At the basis of the procedural component lies the idea of concentrating loads of a certain predominant orientation at a limited stage and of separating in time the loads with a different orientation of the training impacts. This ensures the possibility of a massed specialized impact and the achievement of a stable adaptation effect. The distribution of loads by zones of intensity is carried out taking into account the tasks of each stage of preparation. In the annual cycle, consisting of several macrocycles, the ratio of loads of various orientations varies: from predominantly aerobic in the preparatory periods to anaero-

bic-glycolytic and lactate in the pre-competition and competition periods.

In the mesocycles of preparation, the distribution of the intensity of tasks is planned on the basis of the tasks of the cycle. In the basic mesocycles associated with the transition to aerobic-strength loads, the methods of technique stabilization and conjugated impact are predominantly recommended. In the shock microcycles of an integrative orientation, the main volume of work falls on the zones of high intensity, which makes it possible to create a powerful training stimulus. Such microcycles include both morning and evening training sessions, ensuring the accumulation of the training effect. Of particular significance in the procedural component is the organization of an individual training session, which is divided into two parts – in the gym and in the water. The preparatory part includes exercises for flexibility and the imitation of arm work on land, as well as swimming in recovery zones. The main part contains several tasks, a significant part of which is conjugated. In the gym, on specialized simulators, movements imitating the stroke are performed, with an emphasis on increasing power in the propulsive phases. In the water, analogous tasks are simultaneously solved with the use of additional equipment (paddles of various areas, drag belts, snorkels) and without it. Such a construction of the session makes it possible to solve the tasks of increasing power in the propulsive phases of the stroke and at the same time to maintain the stability of technique against the background of pronounced fatigue.

For the realization of the procedural component of the technology, a wide arsenal of simulator complexes and auxiliary means is recommended. On land, specialized ergometers and simulators are applicable, making it possible to model the biomechanical structure of the stroke in conditions close to competitive ones. In the water – the use of paddles of various areas, variants of coordinating the stroke movements with various intensity and weights, as well as their combinations. The selection of means is carried out taking into account the parameters of the power of movements during the imitation of the stroke on land and the power of the stroke in the water, as well as taking into account the features of the kinematic structure of the stroke, which ensures their biomechanical correspondence.

Conclusions. The technology of integrating the physical and technical preparation of swimmers aged



11–14 years presented in the work is a natural result of the generalization of theoretical provisions and the results of the authors' own long-term studies. It is based on the conceptual principles of synergism, level-based continuity, integrative systematicity, and complementarity, which makes it possible to consider the preparation of a swimmer as an open self-organizing system. The key feature of the technology lies in the fact that it does not presuppose the simple summation of the means of physical and technical preparation, but creates conditions for their mutual reinforcement. The conjugated use of exercises on land and in the water, united by a single task, a similar kinematic structure, and the same zone of intensity, makes it possible not only to develop the necessary physical qualities, but also to simultaneously improve technique in conditions as close as possible to competitive activity. This ensures the creation of the necessary conditions for the successful transition of swimmers to the subsequent stages of long-term preparation and the achievement of high sports results.

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