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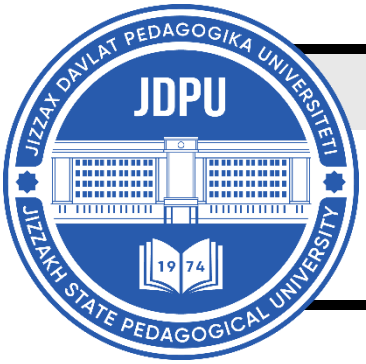

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MONITORING TRAINING IN SPORTS GAMES THROUGH DIGITAL AND INNOVATIVE METHODS

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ABOUT ARTICLE

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Abstract: The article analyzes innovative technologies currently used by sports specialists and coaches during competitions and training sessions. In addition, information is provided on the system for the effective use of innovative technologies in sports games. Based on this information, readers can become familiar with innovative technologies suitable for various sports and learn how to apply them effectively in training and preparation processes.

Introduction. In recent years, the increasing complexity of tasks and higher demands in the training of athletes involved in sports games has become an urgent issue. The search for effective methods and tools to develop athletes in various areas—technical, tactical, and physical preparation—requires the use of innovative technologies as one of the main objectives in the field of sports. In particular, in preparing highly skilled athletes, global practice shows that precise and effective execution of technical movements with the ball under high pressure from opponents is one of the key indicators of sports performance. Under such conditions, the ability of athletes to execute movements accurately and quickly, analyze situations, and make effective decisions plays a critical role in achieving success in competitions [2,5,8,9].

However, the complexity of technical-tactical movements performed by athletes and the variability and rapid changes of situations with the ball indicate limitations in assessing accuracy through traditional methods. Therefore, in modern sports, there is an increasing need

for effective methods to evaluate physical preparedness, the speed of performing technical movements, and their precision (1,4).

At the same time, one of the main trends in the development of modern sports is its informatization. Today, information technologies are rapidly entering all spheres of life, including sports. Information technologies serve not only as a tool for analyzing and monitoring athletes' training but also as an effective resource for coaches, instructors, and specialists. Through these technologies, it becomes possible to obtain accurate and rapid data on athletes' technical and physical performance, their movements during competitions, and individual results. Additionally, they simplify communication and the process of experience sharing in the training process [3,4,7].

Despite the challenges associated with the organizational, material-technical, and scientific-methodological aspects of developing and implementing modern information technologies in sports, they generate particular interest among athletes and coaches. Currently, the efficiency of data collection, processing, and analysis using traditional tools is limited; therefore, modern innovative technologies provide opportunities to automate and improve these processes [5].

Furthermore, effective collection and analysis of data through innovative technologies not only allows for the assessment of athletes' preparedness but also facilitates independent learning, improvement of teaching methods, preparation of highly skilled athletes and referees, and the promotion of sports and health activities among the population. For this reason, the effective use of innovative technologies in sports games and methods for accurately evaluating athletes' levels of preparedness have been highly relevant for many years and continue to retain their importance today.

Materials and methods. Research Aim. The main aim of the study is to systematize and analyze the existing information on innovative technologies applied in competitions and training sessions in sports games.

Research Objectives

1. To analyze foreign and local literature on methods for assessing the targeted accuracy of technical movements in sports games through innovative technologies.

2. To create a database of information on the system of using innovative technologies in sports games and to identify its structural components.

Research Methodology In the course of the study, the primary method employed was the analysis of foreign and local literature published by specialists to determine methods for assessing the targeted accuracy of technical movements in sports games through innovative

technologies. This method allowed for evaluating the effectiveness and applicability of existing innovative technologies in assessing athletes' technical and tactical performance.

Result and discussion. Nowadays, information technologies are firmly integrated into the activities of specialists in the field of physical education and sports. Their application ranges from simple tasks—such as office work, creating databases, and preparing reports—to more advanced levels that require specialized knowledge and skills, including biomechanical analysis of athletes' movement techniques, planning sports training, assessing functional states, and determining the ability to adapt to training loads [5, 8]. These processes play a crucial role in accurately and effectively evaluating athletes' preparedness.

In modern sports, the "PolarTeamPro" computer system and "Polar V800" heart rate monitors (manufactured by Polar Electro Oy) are widely used to assess physical fitness and movement activity. These systems consist of integrated components—including sensors, smart vests, and other monitoring elements—that allow continuous tracking of an athlete's heart rate, movement intensity, and position on the field via GPS. The "PolarTeamPro" smart vest not only records the athlete's heart rate in real time but also ensures optimal reception of GPS signals, making it suitable for use in official competitions as well (see Figure 1).

Figure 1. "POLAR TEAM PRO" system.

The system allows tracking of the following indicators:

- Monitoring players' movements on the field via GPS;
- Determining movement speed according to different speed zones (up to 2 m/s, 2–4 m/s, 4–5.5 m/s, 5.5–7 m/s, and above 7 m/s);
- Calculating the distance covered during training or a match;
- Assessing workload through heart rate frequency;
- Determining the number and parameters of accelerations (across five speed zones);
- Counting the number of maximum sprints and step frequency;
- Measuring energy expenditure and the distance covered in various speed zones.

For example, Figure 2 presents reports on training load parameters recorded for an athlete. These reports allow for detailed analysis of various training load parameters, including

the volume of physical activity, energy expenditure, movement speed, and other indicators, while also enabling comparison with previous training results.

The main capabilities of working with “PolarTeamPro” include:

- Accurately assessing the athlete’s physical readiness for a game;
- Analyzing the volume of movement activity (in kilometers) across five speed zones;
- Calculating the amount of energy expended during training;
- Comparing obtained results with previous data and creating a database.

In football and other sports games, modern information technologies—particularly the “PolarTeamPro” system—serve as an essential tool for monitoring athletes’ movements, assessing physical fitness, and evaluating the effectiveness of training loads. These technologies not only enhance the efficiency of coaches and trainers but also provide the means to plan individual training processes accurately and effectively.

Figure 2. Report on training load parameters recorded for an athlete.

In football, specialists widely use various analytical and innovative systems to assess the targeted accuracy of technical skills. In particular, platforms such as “InStat” and “Wyscout” play a significant role in this process (see Figure 3). In several studies, the “Wyscout” platform has been used as a primary analysis tool, allowing video recordings of matches to be uploaded to specialized software for detailed analysis at different levels of play. Additionally, the “Hudl” program enables precise and visual analysis of technical and tactical movements.

Through these systems, athletes’ on-field movements—including passes, shots, turns, and sprints—are analyzed. Based on the analysis results, coaches can plan individual training

sessions, identify mistakes, and implement effective corrective measures. Therefore, these platforms are not only important for analysis but also serve as essential tools for objectively assessing technical and tactical performance through innovative technologies.

Moreover, modern analytical platforms allow tracking parameters such as players' speed, distance covered, and workload. This capability is crucial for accurately analyzing on-field situations, adjusting training loads, and improving the targeted accuracy of technical skills. Thus, innovative technologies like "InStat," "Wyscout," and "Hudl" serve as effective tools for monitoring and evaluating technical and tactical preparation in football.

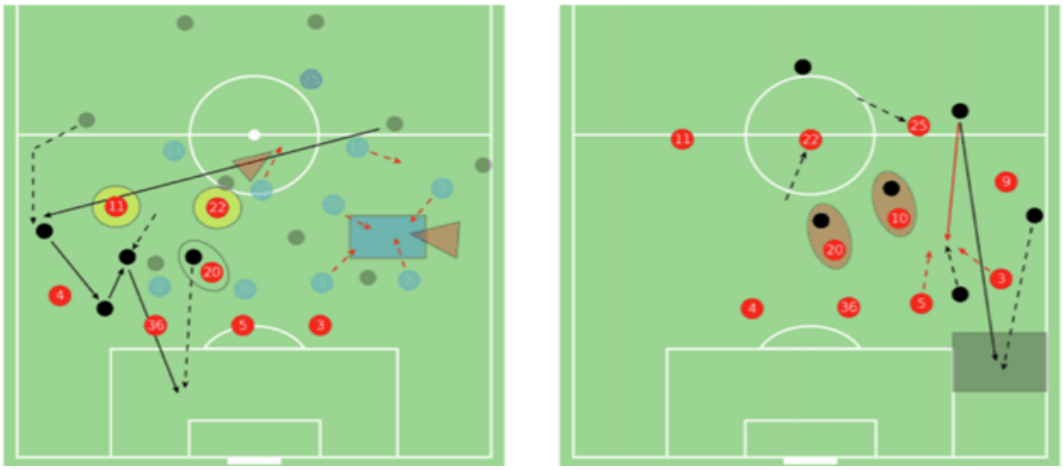

Figure 3. Results obtained from the "Wyscout" platform.

The company "Hexoskin" has developed a specialized smart shirt equipped with all the essential sensors to monitor athletes' activity. This shirt continuously tracks parameters such as breathing rate, heart rate, sweat output, and body temperature. Based on the collected data, it is possible to optimize the intensity and content of training sessions and improve athletes' technical and physical preparedness. This technology is adaptable not only for football but also for various types of physical activities.

In addition, specialized sensor and smart devices are being developed for different sports. For example, systems to analyze swings for baseball players, smart socks for basketball players, and devices designed to assess jump quality for snowboarders are available. These technologies help analyze athletes' movements accurately and objectively while also enabling the individualization of training processes.

Furthermore, virtual reality (VR) technologies are emerging as a significant direction in sports. Through VR, athletes can simulate real-game situations, developing technical and tactical skills safely and effectively (see Figure 4). These technologies not only make training more engaging and interactive but also enhance athletes' reaction speed, decision-making abilities, and overall preparedness.

Thus, “Hexoskin,” various smart sensors, and VR technologies play a crucial role in modern sports as innovative methods for analyzing and optimizing athletes’ technical and physical training.

Figure 4. Specialized shirt equipped with sensors recommended by the “Hexoskin” company.

The Australian company “Catapult Sports” develops some of the world’s most advanced technologies for analyzing athletes’ movements and optimizing their training processes. During training sessions, athletes are monitored using GPS trackers, acceleration sensors, and heart rate monitors. These devices provide accurate data on athletes’ physical condition, adaptability to training loads, and technical movements.

Additionally, the “Zepp Play Soccer” device includes a specialized sock equipped with a sensor placed in the calf area. This sensor records various performance metrics such as distance covered, speed, accelerations, number and force of kicks. The collected data is transmitted to a smartphone application, allowing coaches to analyze in real time the accuracy of players’ movements and their physical readiness for the game.

New methods of data analysis allow for precise observation of athletes’ on-field movements, quantitative evaluation of their abilities, and reduction of injury risk. These methods provide the ability to monitor and control various aspects of preparedness through the use of innovative technologies.

Innovative technologies used in sports provide the following capabilities:

- Continuous monitoring of athletes’ kinesiological systems during training and competitions;
- Optimization of training load volume and intensity, as well as synchronization of rhythm dynamics during preparation phases and individual training sessions;

- Prevention of adaptation interruptions during periods of intensive training and competition participation;
- Improvement of sports training structure and efficiency through the exploration of non-traditional technologies and alternative approaches;
- Support for high-performance sports development via effective information-analytical systems;
- Creation of infrastructure to scientifically and technologically support the preparation of national teams and reserves at specialized and multi-purpose sports centers and mobile group bases.

Thus, innovative devices such as “Catapult Sports” and “Zepp Play Soccer” play a critical role in monitoring athletes’ technical and physical preparedness, planning training sessions, and enhancing their effectiveness. These technologies not only assist in analyzing on-field movements but also enable accurate assessment of individual characteristics and functional status of athletes.

Conclusion. It should be noted that the use of the latest innovative technologies has become standard practice in leading foreign sports clubs and organizations. However, in national teams and various sports clubs in our country, such methods are not yet widely applied. Therefore, the development of modern technologies to improve technical skills and their implementation in athletes’ training processes is an urgent issue and is justified as an objective requirement.

Thus, in sports games, it is necessary to utilize various innovative technologies to accurately assess athletes’ physiological functions and sensory systems. Such technologies not only allow monitoring of technical and physical readiness but also enable optimization of training loads, precise analysis of movements, and reduction of injury risk. This approach is particularly important for planning training sessions while taking into account individual characteristics of athletes to achieve effective results.

Moreover, the use of innovative technologies provides coaches and trainers with the ability to make informed decisions based on accurate data, thereby contributing to the development of national sports and the effective preparation of high-performance athletes.

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