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ANTONIUK Oleksandr
Khmelnytskyi National University
https://orcid.org/0000-0003-1483-7883
e-mail: Antoniuko@khmnu.edu.ua
PAVLIYK Oksana
Khmelnytskyi National University
https://orcid.org/0000-0003-0016-2416
e-mail: pavliuko@khmnu.edu.ua
CHOPYK Tetyana
Khmelnytskyi National University
https://orcid.org/0000-0003-1460-2953
e-mail: chopykt@khmnu.edu.ua
KYDANCHUK Maksym
Khmelnitsky National University
https://orcid.org/0009-0000-7688-5050
e-mail: maxim.kydanchuk@gmail.com
TOSTANOVSKYI Yan
Khmelnytskyi National University
https://orcid.org/0009-0000-1655-2326
e-mail: maxim.kydanchuk@gmail.com

THE HISTORY OF USING INFORMATION TECHNOLOGIES IN PHYSICAL EDUCATION AND SPORTS

This article examines the historical development and implementation of information technologies in physical education and sports. Through comprehensive analysis of scientific literature and online sources, the study explores early innovations in computer programs and software applications designed for biomechanical analysis, monitoring of physical condition, training modeling, and individualized program creation in sports and fitness. Key contributions from researchers at the National University of Physical Education and Sports of Ukraine are highlighted, including significant developments in posture analysis, foot diagnostics, and video-based motion capture systems. The paper thoroughly reviews specialized software for professional bodybuilding, aqua aerobics, family health management, and student physical education, demonstrating the breadth of applications across various domains. A detailed classification system for information technologies in physical culture and sports is presented, categorizing applications by areas such as sports training, physical education, and rehabilitation. The research demonstrates the widespread adoption of information technologies across diverse aspects of physical education and sports, enabling sophisticated biomechanical assessments, comprehensive physical state monitoring, advanced training simulations, and personalized program development. The authors conclude that information technologies have become integral tools in enhancing physical education and sports practices, with significant potential for further implementation in higher education curricula. The study also emphasizes the need for continued research and development in this rapidly evolving field, particularly in areas such as virtual reality applications and mobile technologies for promoting physical activity and health.

Keywords: *information technologies, computer programs, physical education, sport, fitness.*

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1. PROBLEM STATEMENT AND ITS LINKS TO SIGNIFICANT SCIENTIFIC OR PRACTICAL TASKS

The late 20th and early 21st centuries have marked the shift from an industrial to an information society. Information technologies (hereinafter as "IT") penetrate every aspect of human activity, fundamentally transforming daily life. In earlier times, technological advancements were not a priority for physical education. However, in the current era, the issue of incorporating IT has become increasingly critical, particularly in the field of physical education and sports. The development and implementation of information and management systems in this domain are now viewed as promising areas within electronic communications. Consequently, analyzing existing information systems in physical education and sports, exploring key areas for IT use and devising recommendations for the application of information systems have become especially relevant for researchers.

2. OVERVIEW OF RECENT RESEARCH AND PUBLICATIONS

In Ukraine, numerous computer programmes have been designed for physical education and

health activities. Scientific centres across Kyiv, Odesa, Kharkiv, Dnipro, Ternopil, Rivne, Lviv and other cities are actively working on physical education and sports computerization. A detailed analysis of relevant scientific and methodical literature reveals that a significant portion of research in physical education focuses on a) creating training simulators, control and assessment systems, b) gathering information on physical fitness levels and health status through computer technologies, c) providing physical activity guidelines for schoolchildren (R. Raievskyi, V. Shandryhos, V. Shapovalova, O. Skalii), students (V. Bilohur, B. Ferenchuk, N. Naumova), athletes (R. F. Akhmetov, V. V. Hamalii, V. O. Kashuba, S. Yermakov) and other population groups. These expert innovations have allowed using automated systems, opening new opportunities to enhance the efficiency of physical education, sports and fitness processes.

The article aims to explore the early development and application of IT in physical education, sports and fitness.

Research objectives involve analyzing relevant scientific and methodical literature on physical education and sports, as well as gathering information from the Internet concerning the use of IT in physical education, sports and fitness.

To achieve the aim and objectives, the study employed **research methods** such as theoretical analysis of relevant scientific and methodical literature, generalization and classification.

3. RESULTS

The Department of Kinesiology at the National University of Ukraine on Physical Education and Sport pioneered advancements in information systems for physical education, sports and health-related activities and founded a "school" dedicated to this field.

Under the guidance of committed scientists, the school created specialized computer programmes tailored for analyzing sports biomechanics and morphology. Particularly noteworthy is V. Kashuba's groundbreaking work in developing a technology for biogeometric analysis and measurement of human posture. This innovative approach employs photogrammetry to capture sagittal and frontal body profiles referenced against a somatic framework, enabling precise calculation of angular and linear posture metrics concerning the sagittal plane [4]. The algorithm used in the "Torso" programme involves four key stages: 1) creating a new account, 2) digitizing the image, 3) performing statistical analysis on the data obtained, 4) visualizing the results and generating printable reports.

K. Serhienko created "Big Foot", software designed to assess the morpho-functional characteristics of foot support-resort functions. The "Foot-Print" programme automates the analysis of one's footprints, enabling precise determination of morphobiomechanical foot characteristics [5]. K. Serhienko also contributed to developing "Telemeter", an informational-methodical programme adapted for physical education, health classes across diverse populations [3] and sports. This programme facilitates anthropometric measurements using athlete photogrammetry through a 12-segment kinematic chain, aligning with key body segments and major joint coordinates [2].

I. Khmelnytska pioneered the technology for computerized monitoring of human motor skills through a package of applications known as "BioVideo" [6]. This innovation facilitates the extraction of biomechanical characteristics for individual body parts and the entire human body across each frame and specific movement phases. The programme processes input data from single-plane video recordings of human movements.

The "BioVideo" package comprises four modules:

- A module for building models of the human musculoskeletal system (MSS) using a 14-segment branched biokinematic chain. Segment coordinates correspond to spatial positions of human body parts based on geometric features, with key joint coordinates as reference points. This module supports the creation of multi-link MSS models containing around 100 reference points.

- A module for determining point coordinates relative to the somatic reference system.

- A module for computing biomechanical characteristics of human motion based on MSS model coordinates. This module's software capabilities include determining the localization of body part centres of mass (CM) and the total body centre of mass.

- A module for constructing a biokinematic diagram (BMD) of the human body from video footage of movements. This module identifies trajectories of joint centres, CM of body parts,

and the total body centre of mass of the human body [6].

Concluding the suite of specialized software products used in video-computer diagnostics of biomechanical parameters, the "PERFECT BODY" programme was developed by T. Ivchatova under the supervision of V. Kashuba [7]. This programme is specifically designed to track changes in the body mass geometry of women aged between 19 and 35 during fitness training. It operates as an information system that collects, stores and uses monitoring data, thus facilitating biomechanical correction of the spatial arrangement of women's body parts in early adulthood. The "PERFECT BODY" programme is an automated management system for fitness training processes, featuring a modular database structure that includes modules for measurement and analytical assessment, correction, monitoring, nutrition, reference, terminology and history. Crucially, this software allows for tailoring pedagogical processes to physical condition of participants, considering the spatial organization of their bodies [7].

One of the first programmes for professional bodybuilding in Ukraine is "Athlete", created by V. Usychenko [16]. It is endorsed by the author for use in training highly skilled bodybuilders. This information-methodical system is known for its accessibility, ease of practical use, high informativeness and reliability.

The programme features several modules: "Athlete" integrates informational and computational components; "About the Programme" details the database structure and its capabilities as a database management system; the "Monitoring" module provides quantitative data on athletes' morpho-functional characteristics and allows comparison of individual body metrics with average statistical indicators using a selective approach.

Since the early 2000s, computer programmes have been developed and extensively employed in fitness training. For instance, O. Huboreva [8] created the "Fitness Center" software. It encompasses modules, including "Medical Office", "Museum", "Restaurant", "Gym" and "Sports Shop". These modules cater to functions such as initial and detailed assessments of physical condition improvements, tailored approaches to designing fitness sessions and capturing workout videos accompanied by music.

The "Fitness Centre" computer programme conducts initial and detailed assessments of physical fitness indicators for individuals involved in fitness activities. Following the initial assessment, users can choose from four standardized programmes aligned with their fitness levels: "Beginner", "Amateur", "Regular" and "Professional". Users can select these standard programmes or customize sessions to meet specific fitness goals. The programme supports the playback of workout videos accompanied by music and allows further customization by selecting one or more specialized programmes tailored to particular fitness objectives. The "Fitness Centre" programme includes nine specialized programmes: cardio fitness, flexibility, body contouring or targeted training, balance and vestibular stability training, choreography, dancing, disease prevention, relaxation and other types of physical activities.

O. Liadska [9] developed the computer programme, called "Fitball Training" to enhance the organization of health fitness sessions using fitball methods. It focuses on correcting posture in young women and improving their physical fitness and overall health. It consists of five sections: "Personal Data", "Physical Fitness Profile", "Physical Development", "Health Level" and "Results". The programme offers 24 workout models customized to participants' physical fitness levels, namely, low, below average, average and above average (with six models per level). The effectiveness of the training programme can be evaluated based on the indicators of physical development.

The "Fitness for Women" software, developed by D. Lutsenko [10], is designed to support independent health fitness sessions. It features a) comprehensive details about female participants in fitness clubs, b) prescribed exercise sets accompanied by appropriate music, c) a glossary of key terms used in exercise descriptions, d) medical and biological aspects of fitness training, e) fundamentals of balanced nutrition, f) guidance on managing energy balance and body weight, g) information about sports equipment (attire, footwear, exercise machines, weights).

Importantly, this software allows users to access tailored exercise routines suited to their age and physical condition, complete with musical accompaniment. It also integrates feedback from trainers' pedagogical observations and provides access to participants' test results,

the developed system and expert insights on various fitness-related topics.

O. Fanyhina [11] developed the computer programme, called "Aquastudent+". This software is designed to model aqua-aerobics sessions tailored to the specific interests and physical fitness levels of female students. The programme features three main sections, such as "Aqua Aerobics", "Health Programmes" and "Support Functions". The "General Topics" section covers comprehensive information and requirements for health sessions conducted in aquatic environments, detailing session structures, organization and equipment used. In the "Health" section, there are discussions on monitoring and self-monitoring during sessions, as well as techniques for recovery and strengthening.

Numerous studies underscore the pivotal role of the family in influencing the need for support in both physical and psychological health. For example, I. Drozdiuk [12] devised the "Family Health" programme, which aims to diagnose, prevent and enhance health through lifestyle adjustments and wellness activities. Tailored to the health status of each family member, the programme offers guidance on physical activity, daily routine adjustments, hygiene education, balanced nutrition, body strengthening, fostering a positive emotional environment and promoting optimal neuro-psychological functions. A key feature ensuring adherence to these recommendations is an informational module comprising sections on essential health aspects and a healthy lifestyle in hypertext format, detailed pages on lifestyle components and support for programme implementation. The author of the programme believes that the use of this software fosters the development of family traditions, promotes an ideology of healthy living and enhances relationships both within and outside the family.

The "SHVSM" programme, developed by M. Malikov, introduces a novel methodical approach for assessing the functional readiness and state of individuals [13]. This programme builds on established theoretical data concerning how the body's functional state responds to varying intensities of physical exertion, alongside findings from extensive examinations of high-level athletes with diverse specializations and qualifications, as well as large cohorts representing different genders, ages and social backgrounds. Structurally, the "SHVSM" programme is organized into two interdependent blocks:

- The first block ("SHVSM") focuses on evaluating one's functional readiness across various genders, ages (12 years old and older), levels of training, sports qualifications and specializations.

- The second block ("SHVSM-Integral") assesses the functional state of key physiological systems (cardiovascular and respiratory) in these same groups. Depending on the research goals, the medical-biological assessments may be conducted separately for each block or combined across both subprogrammes [13].

The system developed by V. Vovk is designed to tackle information management challenges in professional training of future physical education specialists and organize and manage the physical education process for students in higher education institutions. This encompasses physical education issues, physical condition assessment, consultations on personal physical culture and the development of individual training programmes [14]. This information-diagnostic system (IDS) for assessing students' physical condition addresses the following areas:

- Creating the "Health Passport" for each student, which includes assessments of both actual and calculated data to determine health and physical fitness levels.

- Providing an overall health level assessment to evaluate the effectiveness of training programmes implemented by the physical education department. This assessment can serve as a credit after the semester or academic year.

- Monitoring individual changes in health indicators, adaptation and physical fitness, with computer-generated comments and recommendations.

- Issuing personalized training programmes to improve health levels, speed-strength indicators and overall endurance.

- Forming and maintaining a database of the assessed population.

- Comparing health and physical fitness indicators of students through repeated testing in subsequent courses.

- Collecting comprehensive statistical data on all 84 parameters of student testing (12 indicators) [14].

A theoretical analysis of relevant scientific and methodical literature over the past 20 years

reveals various directions for using specialized software in physical education and sports. Many researchers have also presented their classifications of these programmes, highlighting their advantages based on different criteria: subject area, methods and tools for data processing, type of information processed, type of user interface, degree of automation, and more. However, IT should be primarily classified according to their field of application, aligning with practical tasks in physical education and sports. In this regard, Yu. Yukhno proposed what the authors of this article consider the most practically adapted classification of computer programmes used in physical education, sports and rehabilitation:

1. IT in Sports
   1.1 IT in athlete training activities
   1.1.1 Automated diagnostic systems for assessing athletes' physical condition
   1.1.2 Computer systems for monitoring athletes' functional state
   1.1.3 Computer-diagnostic systems for testing psychophysiological characteristics
   1.2 IT for analyzing athletes' movement techniques
   1.2.1 Automated video-computer systems for measuring and analyzing motor activity
   1.3 Computer-based training systems in sports
   1.4 IT in athletes' competitive activities
2. IT in professional training of specialists in physical education and sports
   2.1 Automated training systems
   2.2 Systems for monitoring student knowledge
3. IT in physical education
   3.1 Computer programmes for assessing children's physical development
   3.2 Video-computer systems for posture diagnosis
   3.3 Computerized systems for applied physical training of specialists
   3.4 Computer programmes in adaptive physical education
   3.4.1 Computer fitness programmes
   3.4.2 Computer programmes for assessing nutrition and diet
   3.4.3 Computer programmes for assessing fitness and body composition
   3.5 Computer programmes for physical education and wellness
4. IT in physical rehabilitation
   4.1 Computerized physical education and wellness tools in rehabilitation
   4.2 Computer diagnostic systems in kinesiotherapy [1].

4. CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH

The analysis of relevant scientific literature and online information confirms that IT are extensively used in physical education and sports. Their implementation is the culmination of years of work by researchers and practitioners, particularly from leading Ukrainian scientific schools.

The developed computer programmes facilitate a comprehensive analysis of human motor activity, encompassing biomechanical characteristics of movements, monitoring and recording physical condition, modelling training sessions, creating individual training programmes and assessing and self-assessing functional state. Notably, researchers from the National University of Ukraine on Physical Education and Sport have developed numerous innovative software products for biomechanical analysis, diagnosing the musculoskeletal system and monitoring physical condition.

A key aspect is the wide range of IT applications, namely, from professional sports to wellness fitness and physical education for various population groups. This highlights the universality and high adaptability of the latest IT to the needs of the physical education and sports sector.

Therefore, one can conclude that IT have become an integral part of today's physical education and sports system, significantly enhancing the capabilities of specialists in the field and increasing the effectiveness of their work. Additionally, the dynamic development of IT opens new horizons for further research and innovation in this area.

5. PROSPECTS FOR FURTHER RESEARCH

Given the rapid advancement of IT, a promising area for future research involves exploring the potential for integrating the latest technological solutions into the educational process at higher education institutions that train specialists in physical education and sports. More emphasis should be placed on developing and testing integrated information systems that address various aspects of athlete training and

physical education for the population, including biomechanical analysis, physiological monitoring, psychological preparation and training programmes individualization. Another crucial area of focus is investigating the effectiveness of mobile applications and virtual reality technologies in physical education and sports, as these innovations could create new opportunities for motivating and engaging diverse population groups in an active lifestyle.

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Анотація

АНТОНЮК Олександр, ПАВЛЮК Оксана,
ЧОПИК Тетяна, КИДАНЧУК Максим, ТОСТАНОВСЬКИЙ Ян

ІСТОРІЯ ВИКОРИСТАННЯ ІНФОРМАЦІЙНИХ ТЕХНОЛОГІЙ У ФІЗИЧНОМУ ВИХОВАННІ ТА СПОРТІ

Ця стаття досліджує історичний розвиток та впровадження інформаційних технологій у фізичному вихованні та спорті. На основі аналізу наукової літератури та інтернет-джерел, розглядаються ранні інновації в комп'ютерних програмах та програмному забезпеченні, розроблених для біомеханічного аналізу, моніторингу фізичного стану, моделювання тренувань та створення індивідуальних програм у спорті та фітнесі. Висвітлюються ключові внески дослідників Національного університету фізичного виховання і спорту України, включаючи розробки в аналізі постави, діагностиці стопи та системах відеозахоплення руху. У статті також розглядається спеціалізоване програмне забезпечення для професійного бодібілдингу, аквааеробіки, управління здоров'ям сім'ї та фізичного виховання студентів. Представлено систему класифікації інформаційних технологій у фізичній культурі та спорті, що категоризує застосування за такими напрямками, як спортивні тренування, фізичне виховання та реабілітація. Дослідження демонструє широке впровадження інформаційних технологій у різних сферах фізичного виховання та спорту, що дозволяє проводити біомеханічні оцінки, моніторинг фізичного стану, симуляції тренувань та розробку персоналізованих програм. Автори роблять висновок, що інформаційні технології стали невід'ємними інструментами вдосконалення практик фізичного виховання та спорту, з потенціалом подальшого впровадження в навчальні програми вищої освіти.

Ключові слова: *інформаційні технології, комп'ютерні програми, фізичне виховання, спорт, фітнес.*

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