

ФІЗКУЛЬТУРНА ОСВІТА

THE USE OF INFORMATION AND COMMUNICATION TECHNOLOGY FOR DETERMINING THE LEVEL MOBILITY IN JOINT IN PHYSICAL EDUCATION OF STUDENTS

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Abstract

The study objective is to the substantiation and implementation of modern ICT for improving the testing of mobility in the joints in physical education of students. The task of our work is the is the development of tools that will allow researchers in the sphere of physical training to determine parameters of flexibility with a high degree of accuracy and reliability.

Materials and methods. To solve the research tasks used the methods of comparing and contrasting are used and analysis, synthesis, abstraction, formalization and scientific modelling.

Results. The method of flexibility testing with the use of an electronic ruler was developed. Functioning of the electronic ruler is based on measuring changes of the electric capacitance formed on the surface of the dielectric substrate of metal electrodes when the student touches it with his hand in the course of the test task. When performing the test task, the subject of monitoring touches with the hand the ruler, which registers the exercise process and its outcome. The resulting signal is processed promptly by the signal transducer placed in the ruler. Then the digital signal enters the processor that ensures its further conversion and signal transmission to the personal computer.

Conclusions. The main results of the research – scientific substantiation and implementation of the developed technology and method of recording the results of measurements in the tests, which are aimed to assess the physical of mobility in the joints by using electronic ruler designed on the basis of modern ICT. We have developed and offer methods by means of which, with a high degree of accuracy, one can determine the level of flexibility. For the first time the possibility of their use in the practice in physical education of students is shown and this allows to provide the rapid obtaining of reliable test data.

Keywords: ICT, student, physical education, testing, flexibility, electronic ruler.

Introduction

Problem statement. The success of physical education is inextricably linked with the diagnostic of physical condition of students that was proved (Kachan, 2017). In recent years, the active forming of science occurs around the search for innovative approaches to optimize the evaluation criteria of physical fitness of students, which is an important prognostic indicator of the condition and level of health (Koryahin, Blavt, & Tsiiovkh, 2018).

Physical education in educational institutions is carried out according to the requirements of controlled

processes. In this case the decision of an expert (teacher), as the managing person, is based on the comprehensive, objective information about the mental and physical condition of students during the teaching process (Sokolov, 2007). During the medical and pedagogical observation of students in the process of physical education assessment of their level of physical development, provide a basis to reason about the dynamics of physical fitness in the process of physical education, help to solve the regulatory nature problem, volume and intensity of physical activity. Accordingly, the dynamics of physical fitness of students reflects the impact of exercise on the processes of physical development and state of functional systems (Anikieiev,

2015). In the teaching practice the objective assessment of physical capacity by means of students test control methodolog is regarded as one of the urgent issues.

The urgency of the study is determined by the need to find the ways to increase the effectiveness of physical education, which implies the necessity of more accurate regulation of the order and the organization of the control of this process in the educational institutions.

Analysis of recent research and publications.

Testing the level of physical development of students is considered as a component of physical education (Koryahin, Blavt, & Tsiiovkh, 2018). Substantiation of organizational and methodological system of control in physical education is dedicated a number of works of different authors (Ivashchenko, & Khudolii, 2016; Zatsyorskyy, 2006; Stroot, 2014). They are united in the thought that for achievement of desired result you need a constant monitoring of changes of physical condition (Stolyarov, 2015).

Despite numerous studies of domestic and foreign authors, the problem of finding effective ways to improve testing process in physical education of students by introducing modern information-communication technologies (ICT) is not enough highlighted. There is a need for a detailed study of the problem of objective evaluation of the level of physical fitness and question of methodology its diagnosis in a limited amount of time, physical education classes under conditions of education in a university (Armour, 2014). Interest in the assessment of physical fitness is also caused by the necessity of adequate selection of exercise used in physical education. In this context developing new ICT which are based on introduction of computerization of process of physical education is the subject of great interest (Zatsyorskyy, 2006; Koryahin, & Blavt, 2013).

The latest ICT in modern conditions are an important factor which causes progressive transformation in physical education of university students (Stolyarov, 2015). Specificity of new ICT in physical education of students involves methodical software training in the presence of new technical equipment (Zatsyorskyy, 2006; Koryahin, & Blavt, 2013).

Analysis of the given literature (Ivashchenko, 2016; Koryahin, Blavt, & Tsiiovkh, 2018; Sokolov, 2007) shows that the indicators used in the control of physical development should give useful information and there should be a minimum number of them, in order to minimize the time for testing. One of the most informative indicators of physical fitness of students is the indicator of the level of mobility in joints – flexibility (Arajo, 2004; Hubble-Kozey, 1991). The determination of the level of mobility in joints is one of the determinants that defines the dynamics of physical fitness and allows purposefully to manage this process at the systematic classes of physical education (Ivashchenko, & Khudolii, 2016).

In the available special literature (Koryahin, & Blavt, 2013; Stolyarov, 2015), authors agree in the statement that that is almost impossible for a specialist in physical education to make an objective test of in exercises to determine the level of mobility in joints, due to a great variety of measurement techniques, unlike other test requirements with a clear standardization of testing procedures and objective measurement by the stopwatch, tape measure and more. Thus cite data do not provide objective information. Impossibility of objective evaluation of these parameters makes it impossible to optimize employment and retards the development of adequate technologies of physical education that it is necessary for a logical end classes at each stage of physical work of the university (Koryahin, Blavt, & Tsiiovkh, 2018; Sokolov, 2007).

Analysis of theoretical research on this issue found incongruities between the need to ensure the objectivity of testing and lack of opportunity to do so. The literature sources emphasize that this problem is related to the use of ICT in physical education in order to obtain objective information (Zatsyorskyy, 2006; Kachan, 2017; Koryahin, & Blavt, 2013). Finding ways to improve the determination of the level of mobility in joints as a part of physical fitness of students caused the choice of the direction of research. Mentioned (Anikieiev, 2015; Koryahin, Blavt, & Tsiiovkh, 2018; Sokolov, 2007) that in theory and practice of physical education of students questions, associated with meaningful content testing procedure and dynamics of physical fitness in the process of training, were not developed enough, and it is recognized by scientists.

It is believed that one of the promising areas of the improvement of testing system is the development and practical implementation of new, highly efficient tools, methods, technologies of test control. According to authoritative scholars, the progress in the knowledge of the theory and methods of physical culture requires the development of test control methods that allow in the shortest possible time to get maximum results (Ivashchenko, & Khudolii, 2016; Kachan, 2017; Koryahin, & Blavt, 2013). A constructive solution of this problem is of theoretical and practical significance for improving the methods of complex testing.

Hypothesis of the research. The general hypothesis of the study is based on the assumption that the qualitative control in the physical education of students, as a major factor in the formation of the competent management decisions, is the basis for improving the efficiency of physical education.

All about-mentioned became the basis for our integrated researches aimed at improving the process of testing the level of mobility in joints during physical education students. We believe that the promising direction to improve the quality of testing is the development and integration of special electronic

devices into this process, which should ensure the objectivity of the results. At this stage of development of ICT, there is a substantial opportunity to improve the process.

Purpose of the research is the substantiation and implementation of ICT for improving the testing of mobility in the joints in physical education of students. The task of our work is the development of tools that will allow researchers in the sphere of physical training to determine various required parameters with a high degree of accuracy and reliability.

Materials and methods

To solve the research tasks used the methods of comparing and contrasting are used and analysis, synthesis, abstraction, formalization and scientific modelling.

Results of the research

Control over the development of flexibility is carried out by means of special instruments – goniometers of different modifications that allow you to determine the amplitude of passive and active movements in a particular joint angle in degrees. Total flexibility of the musculoskeletal system is estimated according to the results of several control exercises (Arajo, 2004; Hubley-Kozey, 1991). Typically flexibility as an integral factor in the physical education practice is evaluated by the ability to perform a tilt forward from a standing position. The expediency of using this test is due to the fact that from a practical point of view, the most important is the flexibility of a spine and it is believed that

the «combined flexibility of the body» can be judged by bending forward. In addition, it is simple and accessible for measurements during mass examinations and does not require special conditions of conducting (Koryahin, & Blavt, 2013). At the same time, we should note that to provide standartisation of testing procedures by this method is almost impossible. This method of flexibility testing is characterized by the certain dependence of subjective assessment in determining the results of the exercise. The defined facts make impossible and difficult the obtaining of the reliable informative monitoring results due to a large number of uncontrolled variables and the absence of a certain registration system for test results. Hence, there is a need for a radically new approach to this issue.

Within the outlined direction of the study, the method of flexibility testing with the use of an electronic ruler was developed. Functioning of the electronic ruler is based on measuring changes of the electric capacitance formed on the surface of the dielectric substrate of metal electrodes when the student touches it with his hand in the course of the test task.

The offered method of the evaluation of flexibility in physical education of students, according to which the monitoring of the overall level of joint mobility of locomotor system is carried out, is to use the electronic ruler (Fig. 1). When performing the test task, the subject of monitoring touches with the hand the ruler, which registers the exercise process and its outcome. The resulting signal is processed promptly by the signal transducer placed in the ruler. Then the digital signal enters the processor that ensures its further conversion and signal transmission to the personal computer. In

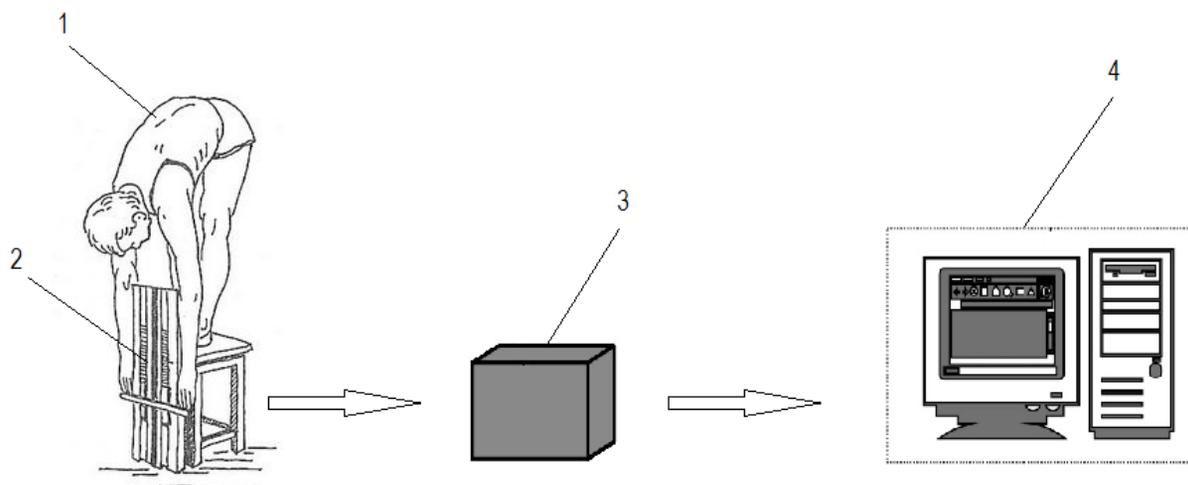


Fig. 1 Structural diagram of constructive method of the evaluation of flexibility:
1 – student; 2 - electronic ruler; 3 –processor; 4 – computer

the computer the signal is processed by developed software and is shown to the specialist on the screen in an easy to understand form.

The electronic ruler is the basis of a circuit board is made from fiberglass with formed copper electrodes, lines and switching lanes for the soldering the integrated circuits of signal transducer. Measurements are carried out by using the capacitive sensors concept (Baxter, 1997). The primary transducer (sensitive elements) of capacitive sensors is the matrix of capacitors modulated by external factors between electrode electric capacity (Bracke, W., Puers, R., & Van Hoof C. 2007). In this case are used the structure under the external environmental object influence, including student fingers. This structure is shown in Figure 2.

Treatment of obtained data in the course of student test task, and their visualization is carried out by software. For program development software environment was used Borland Delphi 6.0. The position to control input data every 100 ms. All text boxes asking for parameters (such as the duration of exercise or conversion ratio of

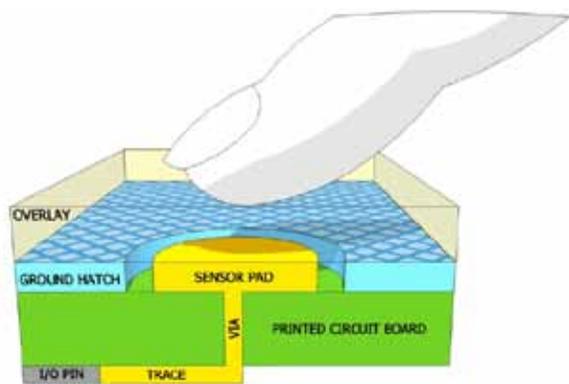


Fig. 2. The structure of the primary transducer of capacitive sensor: Printed circuit board – PCB, Sensor pad – touch electrode, Ground hatch – grounding circuit, Overlay – dielectric protective film, in particular, enamel, Via – through holes, Trace – Track signal lines, I/O pin – conclusions inputs (Input) and outputs (Output) signal transducer integrated circuits.

Signal conversion of the «capacity – digital code» measured matrix of electrodes placed on a measuring ruler – CapSense line meter, held Capsense processor on the bases of PSoC. The digital code is fed into the processor Signal transducer, for providing the following conversion and RF radiofrequency transmission in the personal computer (PC), including tablet (Hotra, Z., Holyaka, R., Marusenkova, T., & Potencki J. 2010).

screen pixels to physical units of length) are protected from incorrect input data (the user can not write in text boxes, symbols that can not be represented by numbers), set default value and allowable limits corresponding

numbers. In each observed time is recorded in files stored on disk and thus available for further processing. There is a calculation of maximum and after exercise displayed the best results presented in physical units. Exercise ends or when you click «Stop», or after a given duration of exercise. In all the time on the screen visible only to those elements that require the user, otherwise the not important graphics are hidden.

The program has successfully passed the diverse testing, including load-testing for large volumes of data to a file and large duration of exercise. In the long term plan to implement software processing data from more than one sensor simultaneously.

Determination of joints mobility eliminates the subjective determination related to the perception of a person who carries out this monitoring, because it contains the device, which are values which are judged on the state of joints motion, which allows to obtain reliable data and increases the efficiency of physical education for development of mobility in joints.

The advantages of the offered electronic system of flexibility monitoring compared to existing methods of evaluation is: ensuring of testing accuracy; usability and compactness of the device; ongoing monitoring, consisting of the time of getting information (usually within 20-60 s), the time of viewing the resulting data and the analysis of results; ensuring of durable monitoring with the update of processing results; the high reliability of monitoring; the automatic receipt of the results of multiple tests as an electronic protocol; the quick conducting of complex calculations with the presentation of results in digital or graphical form; easy to view the structure of the results and their dynamics.

Discussion of the research results

An objective estimation of a degree of physical development and of physical fitness has special importance during conducting physical education classes with students of the university's (Anikieiev, 2015; Koryahin, Blavt, & Tsiovkh, 2018; Sokolov, 2007). The study presents a new solution of the scientific applied problem of the non-conformity of the current control system in the physical education of students with the current requirements of the high-quality implementation of its tasks. We tried to solve a number of issues that inevitably arise in the test control process. The results of our study are consistent with a number of scientific developments (Anikieiev, 2015; Ivashchenko, & Khudolii, 2016; Kachan, 2017), one of the promising directions to improve the testing system is the development and practical implementation of new, highly effective means, methods, technologies for the integrated control and management of this process.

It is believed that today, one of the problems facing the researchers in the field of physical education is the need for the fundamental restructuring of the test control system in the direction of modernization, introduction of innovative approaches and modern technologies of its organization (Ivashchenko, 2016; Sokolov, 2007; Stolyarov, 2015). The adoption and use of modern ICT in the process of the physical education will help to solve entirely the problems of the current control (Estivalet, & Springer, 2009; Haake, 1996; Zatsiorsky, 2006). It is also a powerful methodological basis for the continuous science-based targeted correction of the training process based on the integrated approach to the development of physical and other qualities, that allows to increase the effectiveness of the physical education of students. The results of our study confirmed the existing points of view on this issue (Armour, 2014; Kachan, 2017; Sokolov, 2007).

The automated electronic measuring structure, developed on the base of the use of modern ICT and software, is offered for the first time and has significant advantages compared to existing methods of monitoring and control of the dynamics of the development of the joint mobility of locomotor system. The scientific potential of the technical equipment for testing in physical education allows to control and evaluate the indicators of test quality at a very high level.

The main methodical result of the work is that the using of the offered system allows to intensify the testing process during physical training of students. In turn, it allows to decide comprehensively the issue of current control and to judge with the sufficient substantiation the need for adjustments in the training program in accordance with the results, to improve the management of their physical education process. It is presented in accordance with literature data (Anikieiev, 2015; Stolyarov, 2015; Stroot, 2014)

Conclusions

One of the promising directions of improving the quality of the testing process is the development and implementation learning process in physical education ICT and special technical devices for testing, which should provide objective results.

Positive characteristics of use of the proposed technology by us determine the level of mobility in joints is: accuracy of testing; urgent obtaining a result; ease of use and compactness of the device; accuracy of the results of testing; automatically obtaining results in the form of electronic record.

Using the latest ICT in the system of physical education a powerful methodological foundation for science-based process of improvement training of physical education of students that allow significantly increase the effectiveness of physical education classes

and the quality of the course in general, by means of amendments and supplements to the program of the university.

The applied importance of the materials presented in the work is conditioned by the offered specific methods of the control organisation which allow to characterize objectively the state of physical fitness.

Conflict of interest

The authors state no conflict of interest.

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ВИКОРИСТАННЯ ІНФОРМАЦІЙНО-КОМУНІКАЦІЙНИХ ТЕХНОЛОГІЙ ДЛЯ ВИЗНАЧЕННЯ РІВНЯ РУХЛИВОСТІ СУГЛОБІВ У ФІЗИЧНОМУ ВИХОВАННІ СТУДЕНТІВ

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Мета дослідження – обґрунтування та впровадження сучасних ІКТ для удосконалення тестового контролю рівня рухливості в суглобах у фізичному вихованні студентів. Завдання роботи полягало у розробці інструментарію для визначення параметрів гнучкості з високим ступенем точності та надійності.

Матеріали і методи. Для вирішення завдань дослідження використано методи порівняння аналізу, синтезу, абстрагування, формалізації та моделювання.

Результати. Розроблено методику тестування рівня рухливості в суглобах з використанням електронної лінійки. При виконанні тестового завдання, студент торкається руками лінійки, яка реєструє процес виконання вправи та її результат. Утворений сигнал оперативно обробляється сигнальним перетворювачем, вміщеним у лінійці.

Далі цифровий сигнал поступає у процесор, який забезпечує його подальше перетворення та радіочастотне передавання в персональний комп'ютер. У комп'ютері, сигнал обробляється розробленим програмним забезпеченням й представляється на екрані монітора у зручному для сприйняття фахівцем вигляді.

Висновки. Науково обґрунтовано методику тестування рухливості в суглобах з використанням електронної лінійки, розробленої на основі сучасних ІКТ. Розроблена методика, використання якої забезпечує високий ступінь достовірності та об'єктивності рівня гнучкості. Вперше запропоновано застосування електронної лінійки у практиці фізичного виховання студентів задля забезпечення швидкого отримання надійних даних тестування

Ключові слова: ІКТ, студент, фізичне виховання, тестування, гнучкість, електронна лінійка.

ИСПОЛЬЗОВАНИЕ ИНФОРМАЦИОННО-КОММУНИКАЦИОННЫХ ТЕХНОЛОГИЙ ДЛЯ ОПРЕДЕЛЕНИЯ УРОВНЯ ПОДВИЖНОСТИ СУСТАВОВ В ФИЗИЧЕСКОМ ВОСПИТАНИИ СТУДЕНТОВ

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Цель исследования – обоснование и внедрение современных ИКТ для совершенствования тестового контроля уровня подвижности в суставах в физическом воспитании сту-

дентов. Задача работы состояла в разработке инструментария для определения параметров гибкости с высокой степенью точности и надежности.

Материалы и методы. Для решения задач исследования использованы методы сравнения анализа, синтеза, абстрагирования, формализации и моделирования.

Результаты. Разработана методика тестирования уровня подвижности в суставах с использованием электронной линейки. При выполнении тестового задания, студент касается руками линейки, которая регистрирует процесс выполнения упражнения и его результат. Образованный сигнал оперативно обрабатывается сигнальным преобразователем, помещенным в линейку. Далее цифровой сигнал поступает в процессор, который обеспечивает его дальнейшее преобразование и радиочастотную передачу в персональный компьютер. В компьютере, сигнал обрабатывается

разработанным программным обеспечением и представляется на экране монитора в удобном для восприятия специалистом виде.

Выводы. Научно обоснована методика тестирования подвижности в суставах с использованием электронной линейки, разработанной на основе современных ИКТ. Разработана методика, использование которой обеспечивает высокую степень достоверности и объективности уровня гибкости. Впервые предложено применение электронной линейки в практике физического воспитания студентов для обеспечения быстрого получения надежных данных тестирования.

Ключевые слова: ИКТ, студент, физическое воспитание, тестирование, гибкость, электронная линейка.

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