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STUDENTS' COORDINATION SKILLS TESTING IN PHYSICAL EDUCATION: ICT APPLICATION

Abstract. The informatisation of modern education necessitates the development of a new model of physical education, based on interdisciplinary integrative processes using ICT. This paper considers using ICT for testing coordination skills in physical education of students. The main idea of integrating ICT into the monitoring is to intensify the pedagogical control process in order to reinforce its information capabilities. The purpose of the paper is to justify and show how to implement ICT in students' coordination skills monitoring, while they undergo physical education. Foremost, it concerns a personalist approach to education and training, and an integrated approach in the implementation of monitoring and evaluating its results. The device that measures movement is the result of a research aimed at integrating ICT into students' coordination skills testing. Its function is to provide a high level of control and assessment of students' coordination skills. The device is based on the latest advances in energy-saving technologies, using optical sensors, multifunctional microcontroller development boards and software developed in Proteus Design Suite. The developed infrastructure of the device of movement control provides quick processing of received testing results using the methods of multidimensional mathematical analysis as well as the formation of integrated database for coordination skills controlling. The interface used for this provides a high level of ergonomic properties of the developed device and the possibility of effective work of specialists with the data of testing. The effectiveness of using the designed device in testing students' coordination skills is achieved through the ease of use and compactness of the device, student-friendly testing procedure and the efficiency and reliability of control. Implementation of the unique possibilities of ICT provides state-of-the-art didactic method of intensification of control process in physical education of students.

Keywords: ICT; student; control; testing; physical education; device; microcontroller platform; software.

1. INTRODUCTION

The problem setting. The formation of the model of innovative education in Ukraine takes place in the context of the transition to an information society. The guidelines for the shift to a new educational paradigm in the general system of higher education include reshaping the doctrine of physical education to match European standards, corresponding modernisation of its content and optimization of its technological support for achieving new quality standards [1]. This is in harmony with the contemporary trends in the field. For instance, the Ministry of Education and Science of Ukraine has defined and endorsed the strategic trends of modernization of the system of physical education of youths in educational establishments.

The relevance of finding ways to modernise physical education increases significantly in connection with the reorganisation of the Ukrainian educational system according to the European standards. The physical training in higher education, the latter being an important part of social policy, is characterised by powerful evolutionary changes. Informatisation of modern education necessitates the development of a new model of physical education, based on interdisciplinary integration processes applying ICT.

It is crucial to increase the level of scientific research in physical education, integrating it into the global process of informatisation, as it is indicative of the development of the field [3]. In view of the above, innovations in the field of physical education have been gaining importance. They are aimed at introducing scientific achievements into its development and the dissemination of best practices in informatisation to ensure its effectiveness.

The analysis of recent studies and publications. There has been an increase in the amount of studies of effective ways to improve the quality of education and training. A number of studies (V. Koryahin, O. Blavt [3], A. Sokolov [4], and K. Armour [5]) have dealt with the use of innovative ICT in the pedagogical practices of physical education as well as their didactic and methodological aspects. As O.A. Kachan noted, the process of modernising physical education is now evolutionary and is based on the introduction of new achievements and best practices in the relevant field and the other fields of knowledge on an interdisciplinary basis [6]. At the same time, according to O. Volyarska and T. Ponedko [7], it involves significant changes due to the current trends in technological development. Researchers V. Prykhodko [8], D. Shyrobokov, Ya. Malinina and V. Malinin [9] emphasise the need to find ways to provide informational support for physical education using ICT.

According to A. Krasnikov [10], the accumulated experience of educational innovations using ICT in pedagogy, theory and practice of physical education, is a significant contribution to the educational techniques of higher education institutions. It is consistent with the requirements of the aforementioned resolution [2], which states that to reform the educational system, it is necessary to provide clearer regulation and control of physical education in order to ensure the effectiveness of this process. Considering permanent informatisation of education, the use of ICT is a major contributing factor. A significant increase in the informatisation of physical education has created new opportunities for introducing new means of control [6]. The objective assessment of physical abilities applying the methods of student monitoring remains a challenge in physical education.

However, from analysing scientific developments and the level of application of ICT in physical education, it became clear that although this issue is at the centre of scientific research in the field, there is a lack of research investigating the issues of monitoring in physical education of students. So far, only some aspects of this issue have been developed and the approach proposed in this paper has not been used. Effective physical education of youth is historically one of the foremost pedagogical challenges and the heart of innovative

pedagogical movement. Among the current trends in the development of pedagogy of physical education, the issue of ensuring its quality, which implies the introduction of ICT, remains difficult and unresolved.

Considering that since 2017 Ukraine's institutions of higher education have fallen under the decree which calls for mandatory annual monitoring of students [11], and given that now the development and introduction of ICT has been acquiring the status of a separate field of knowledge in pedagogy, related to updating monitoring of the physical education of students, current research is of high importance.

Given that informatisation is now a priority in pedagogy [13], which determines the objective need to increase the penetration of ICT in monitoring, the purpose of the paper is to justify and show how to implement ICT in monitoring coordination skills of students during physical education classes.

2. THEORETICAL BACKGROUND

In order to achieve the declared purpose, we have applied innovative ideas and a conceptual foundation for updating approaches to organising, postulating and realising the content of pedagogical control [10], [13], [14]. Foremost, it concerns a personalist approach to education and training [12], and an integrated approach in the implementation of monitoring and evaluating its results [4], [13].

Our innovative idea envisaged the integration of interdisciplinary and project-based approaches. The research strategy was focused on the integration of information resources for effective control. We aimed to intensify the pedagogical process of control by considerably enhancing its informative capabilities. Informatisation in monitoring in the context of our study was to build the infrastructure of means of receiving, storing, accumulating and processing information. This presumed the creation of a breakthrough compute-ahead device for controlling coordination skills, whose work was focused on ensuring the effectiveness of testing, enriching the control information data and enhancing the results.

The research has been conducted at the departments of Physical Education and Electronic Devices of Lviv Polytechnic National University in 2016-2017, within the research program "Issues of Physical Education and Sports among Students of Higher Education Establishments" (No. 5 0110 U004699).

3. RESEARCH METHODS

To achieve the abovementioned goal and objectives, we used theoretical and applied research methods. There are a number of theoretical instruments, available for studying the specificity of ICT use in testing and assessment. We used the analysis and synthesis for data collection, their generalisation and interpretation. The logical method offered an effective way to reveal a mechanism for determining the set of notions in the sphere of the quality of students' skills assessment. The study used abstraction and formalisation to gain the insights in the innovative ICT use in the pedagogical practices of physical education. We used induction and deduction to generalise the gathered theoretical and factual materials connected with the objective assessment of students' physical abilities applying ICT.

We used applied methods, namely technical modelling, which offered the possibility to develop the device based on the latest advances in energy-saving technologies, using optical sensors, multifunctional microcontroller development boards and software developed in Proteus Design Suite.

4. THE RESULTS AND DISCUSSION

The optimal management of the physical education effectiveness justifies the need to address the problem of pedagogical control. Being the operational method, pedagogical control provides the design, prediction and accurate reproduction of pedagogical processes that guarantee the high quality of students' physical education. The qualitative controlling provides the information on the pragmatism of pedagogical actions in general [1], [4]. This coincides with the provisions on the urgency of creating an informational and educational environment for physical education in order to ensure the quality of higher education [6], [9], [22].

The integration of ICTs in the students' coordination skills monitoring in the process of their physical education is carried out applying scientifically proven reproductive reorganisation of the current testing methodology and use of ICT capacities.

Currently, the shuttle run test is used in physical education classes to test students' coordination skills [3]. However, human factors may affect the logging of test results. This makes it nearly impossible to obtain reliable and informative test results. It does not contribute to the effectiveness of the educational process.

Using the capabilities of modern ICTs to eliminate time loss, ensuring the reliability of evaluation and eliminating human factor influences on the results of control, we have developed a device for monitoring movement. A block diagram of the Movement Control Device is shown in Figure 1.

The designed device consists of two mobile and one stationary measuring blocks. The mobile unit contains a control and measuring node (control device), a signal converter and a transmitting unit (transmitter). A stationary measuring block consists of a receiving and transmitting unit, a control and recording node, a microcontroller, an indicating unit, and an interface unit.

The device is controlled by a stationary measuring block. It exchanges information with the mobile units and generates measurement results based on the signals received from them. During this exchange, there is a consistent registration of time intervals at the time when students pass fixed control distances. Their values are transmitted using a wireless system to the stationary control unit for analysis and display of the results.

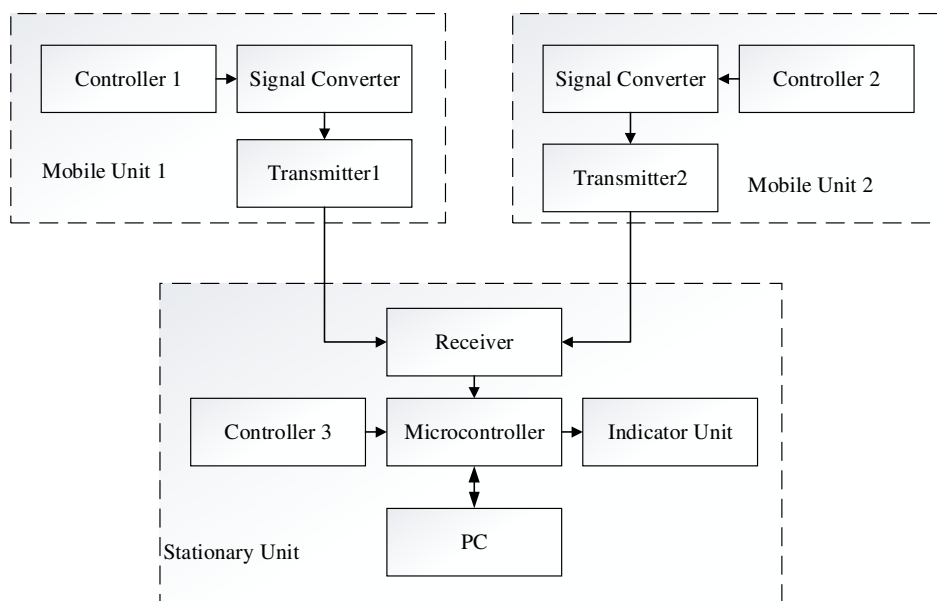


Fig. 1. Block diagram of Movement Control Device

Optical recording units are the control unit of mobile units. These register the time taken to reach the reference point and transmit the received input data to the signal converter for further analysis.

Optical recording units are constructed using optical sensors [15], [16], in conjunction with multifunctional microelectronic boards. These boards have been designed applying the latest advances in energy-saving technologies. Microcontroller boards provide high accuracy of measurement thanks to expansion boards and the possibility to program the boards [17].

The optical sensors used in the device function by applying microelectronic micropower signal converters. In order to ensure their operation, discrete algorithms for the analysis of input data signals are used. This significantly reduces the energy consumption of the sensor [18], [19]. Using signal converters of this type in combination with multi-functional microelectronic boards, along with a high accuracy of measurement, provides long off-line work and data transfer to the PC [20].

The device is coordinated by a microprocessor, which establishes wireless communication channels between autonomous mobile units and makes the necessary calculations. The microprocessor analyses the received signals in accordance with the algorithm of the internal software. Its function is to provide flexible (adjustable) timing control algorithms. The parameters of the algorithms can be programmed and compared with real values.

Our device uses a NodeMCU V3 microcontroller based on an ESP8266-12-E chip. Using this microcontroller has enabled us to create a wireless mobile system that supports the USB interface, power supply controller, and also contains internal inbuilt memory for storing the software code. This microcontroller is based on a 32-bit Tensilica Xtensa L106 processor with 80 MHz clock frequency, which ensures high performance of the device. An inbuilt Wi-Fi interface, UART, SPI and I²C are among many notable peripherals of the device [17].

The electric schematic diagram of the control device for coordinating abilities is presented in Fig. 2.

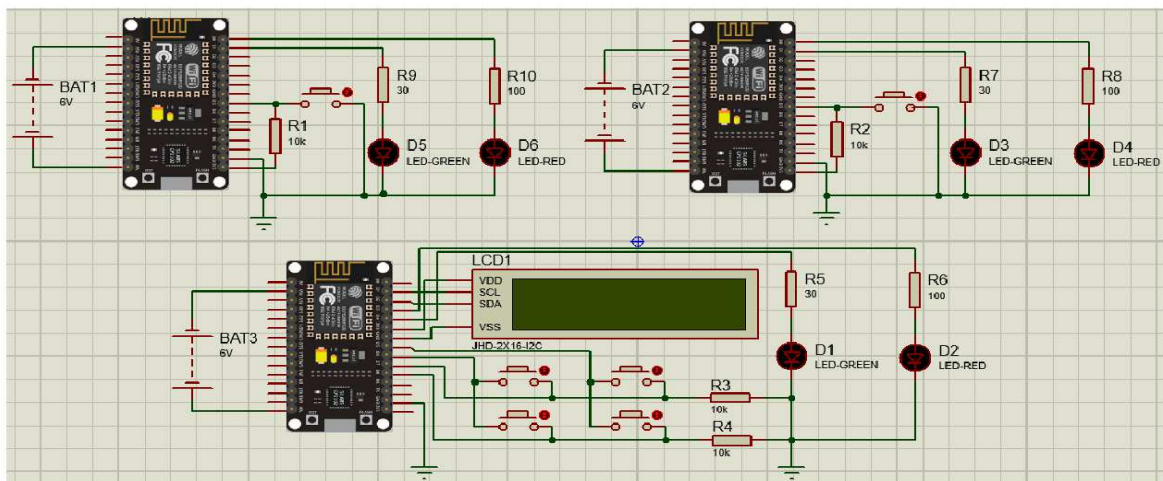


Fig. 2. The electric diagram of the device

The obtained results of the analysis of time parameter verification are shown on the LCD display. In addition to displaying the results promptly, the device makes it possible to

save their values in internal memory or transfer them to the PC for additional analysis and visualisation.

Using the developed motion control device, a method for controlling students' coordination skills has been proposed. The method involves the location of mobile measuring units at a distance of 9 meters in a straight line. After the signal the student touches the first measuring block with their hand, begins to move along the trajectory towards the second mobile unit, upon touching which the student returns to the first block, touches with their hand and starts moving in the direction of the second mobile unit, touches it with their hand and returns to the first mobile unit. Digital informative signals received by the measuring mobile units are then registered by the stationary unit and communicated by infrared to the electronic computing device where the data is recorded and graphically visualised. After the student has finished the shuttle run, the result is displayed on the screen, presented in easy to read digital units.

The maximum effect from using ICT is achieved in an integrated approach when different information systems interact with each other [21]. It is this approach we have used in our project by developing the software infrastructure. In accordance with the developed structural scheme, the modelling of the main functional nodes and elements has been done with the Proteus software tool. With this specialized software, the functioning of the developed electronic system of the device was verified in real time, the basic operating modes were studied and the parameters of the elements of the scheme were selected.

Software enables quick processing of the obtained results using the methods of multidimensional mathematical analysis. At each current time of testing on the screen only those elements of measurement that are needed by the teaching staff are visible, and other graphic objects are hidden. Thus, the analysis of the obtained control results with the visual form of representation is synthesised. This provides a convenient review of the structure of the obtained results, their dynamics and the account of the summary information during the period of physical education, which significantly increases the information content of the monitoring.

The software forms an integrated database of tested coordination skills. The data is coherently replicated, processed and interactively analysed with the use of statistical and mathematical methods and algorithms. Thus, there is an accumulation, update, correction and multifaceted use of a large body of information during the physical education of students. The interface used for this provides a high level of ergonomic properties of the developed device and the possibility of effective work of specialists with the data of testing. Their subsequent archiving takes place in the infrastructure of the centre of data storage and processing in custom-tailored and accessible in text format for each student. Application of software enables simultaneous analysis of test results of a group of students without loss of information. Further, the device provides automatic retrieval of multiple test results in the form of an electronic protocol. It allows one to gather statistics of testing for each student in the course group for the entire period of them taking physical education classes.

The main indicators characterising the effectiveness of using the movement control device in testing students' coordination skills are:

- ease of use and compact size of the device; being ergonomically shaped, it performs a full set of necessary functions;
- the ease of conducting the test: the procedure does not require special training of the student;
- rapid testing process: continuous development of ICT enables an increase in the efficiency of processing and transmission of information;
- high sensitivity of the device, which captures the smallest deviations from the set parameters of the test task.

Thus, the results of the study supplement the data on pedagogical control in physical education of students [1], [5], [11]. We support scientific approaches to the ways to optimise control in physical education [6], [9], [13]. A. Krasnikov argues [10], that according to the theory of tests, the principle of obtaining the result forms the basis of the testing process. The effectiveness of physical education is estimated on the basis of results [1]. This is ensured by the accuracy, pertinence and expediency of the corrective actions of the teachers, which are determined by the quality of the monitored information [13]. The use of ICT for monitoring student coordination skills provides a speedy formative assessment, which consists of the time the information is received, the time of viewing the received data and analysing the results.

Our research corroborates the studies [4], [21] which postulate that the automation of the process for obtaining and processing information of testing can significantly improve the efficiency of obtaining and evaluating information in real time and significantly reduce time spent on conducting tests.

We fully support the findings [7], [22], [23] stressing the importance of the implementation of ICT in the educational process of higher education. It significantly affects the improvement of organisational forms of physical education [6]. In contrast to the traditional presentation of testing, the current presentation of results in the form of an electronic protocol allows significant expansion and increased range of representations, facilitates the search and interpretation of the results obtained during the course and ensures the preservation of information and convenient viewing of its dynamics. Therefore, the use of ICT in the testing ensures the accuracy of the presentation of the measurement information and the correspondence between the degree of scientific reliability and the practical value of the results. This corroborates our own scientific research results in the given domain [3], [24]. This way, permanent monitoring is implemented, a long-term observation with results updated after a predetermined time interval. This greatly increases the ability to operate with the results of monitoring, create a database and receive a test protocol immediately after its completion.

5. CONCLUSIONS

Application of the unique possibilities of ICT provides the contemporary level of didactics of intensification of educational process on physical education. The main idea of integration of ICT in testing the coordination abilities of students in their physical education is to intensify the pedagogical process of control, which greatly enhances its information capabilities. Being technological in content, the innovative modernisation of the control process provides automation of the acquisition and processing of information with the further formation of information bases.

The result of a scientific search aimed towards integrating ICT in the monitoring of the coordination skills of students is a device for tracking movement. Its function is to ensure the effectiveness of monitoring and assessing the status of coordination abilities. The use of a device developed on the basis of ICT in the monitoring of the coordination skills of students in the process of their physical education provides standardisation of the testing procedure, as a result of eliminating the influence of the human factor, which is a major impediment in the objectivity of monitoring.

The effectiveness of the proposed device in the testing is achieved through the following components: the ease of use and compactness of the device, the student-friendly testing procedure and the efficiency and reliability of control. Application of the developed device using ICT not only ensures the objectivity of control of coordination skills, but allows effective analysis and interpretation of the received large volumes of quantitative information.

Thus, it provides the modernisation and intensification of the test process in controlling the student's coordination skills, long-term observation with updating the results of processing.

As a toolkit for solving pedagogical tasks of control, ICT integration ensures a qualitatively new technological progress in methodology and didactics, organisation and practical implementation of monitoring coordination skills in the physical education of students.

The findings of our study complement those of earlier ones and provide valuable insights into the problem under research. But there is the evidence that further studies need to be carried out in order to validate the detailed insights into the further integration of ICT in the testing control in physical education [6], [9], [22].

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ЗАСТОСУВАННЯ ІКТ ДЛЯ ТЕСТОВОГО КОНТРОЛЮ КООРДИНАЦІЙНИХ ЗДІБНОСТЕЙ СТУДЕНТІВ У ФІЗИЧНОМУ ВИХОВАННІ

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Анотація. Установлено, що інформатизація сучасної освіти зумовлює потребу розроблення нової моделі фізичного виховання, заснованої на міждисциплінарних інтеграційних процесах застосування ІКТ. Розглянуто питання використання ІКТ у тестовому контролі координаційних здібностей у фізичному вихованні студентів. Основна ідея інтеграції ІКТ у фізичне виховання студентів полягає в інтенсифікації педагогічного процесу контролю задля посилення його інформаційних можливостей. *Мета статті* - обґрунтування та реалізація ІКТ у тестовому контролі координаційних здібностей студентів у процесі їхнього фізичного виховання. Стратегія дослідження зорієнтована на інтеграцію інформаційного ресурсу ІКТ задля ефективної реалізації контролю. *Результатом* наукового пошуку в напрямі інтеграції ІКТ у тестовий контроль координаційних здібностей студентів є розроблений пристрій переміщення. Його функція полягає в забезпеченні високого рівня контролю та оцінки стану координаційних здібностей студентів. Пристрій побудований на основі найновіших здобутків енергозберігаючих технологій, з використанням оптичних

сенсорів, багатофункціональних мікроконтролерних платформ, програмного забезпечення, розробленого в програмному середовищі Proteus. Програмна інфраструктура пристрою контролю переміщення забезпечує оперативну обробку отриманих результатів тестування із застосуванням методів багатовимірного математичного аналізу та формування інтегрованої бази даних контролю координаційних здібностей. Використаний для цього інтерфейс забезпечує високий рівень ергономічних властивостей розробленого пристрою та можливості ефективної роботи фахівців з даними тестового контролю. Ефективність використання запропонованого пристрою у тестуванні координаційних здібностей студентів досягається за рахунок: зручності у використанні та компактності пристрою, комфортності тестового процесу для студентів, оперативності та достовірності контролю. Реалізація унікальних можливостей ІКТ забезпечує сучасний рівень дидактики інтенсифікації процесу контролю у фізичному вихованні студентів.

Ключові слова: ІКТ; студент; контроль; тестування; фізичне виховання; пристрій; мікроконтролерна платформа; програмне забезпечення.

ПРИМЕНЕНИЕ ИКТ ДЛЯ ТЕСТОВОГО КОНТРОЛЯ КООРДИНАЦИОННЫХ СПОСОБНОСТЕЙ СТУДЕНТОВ В ФИЗИЧЕСКОМ ВОСПИТАНИИ

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Аннотация. Установлено, что информатизация современного образования обуславливает необходимость разработки новой модели физического воспитания, основанной на междисциплинарных интеграционных процессах применения ИКТ. Рассмотрены вопросы использования ИКТ в тестовом контроле координационных способностей в физическом воспитании студентов. Основная идея интеграции ИКТ в физическое воспитание студентов заключается в интенсификации педагогического процесса контроля для усиления его информационных возможностей. Цель статьи - обоснование и реализация ИКТ в тестовом контроле координационных способностей студентов в процессе их физического воспитания. Стратегия исследования ориентирована на интеграцию информационного ресурса ИКТ для эффективной реализации контроля. Результатом научного поиска в направлении интеграции ИКТ в тестовый контроль координационных способностей студентов является разработанное устройство перемещения. Его функция заключается в обеспечении высокого уровня контроля и оценки состояния координационных способностей студентов. Устройство построено на основе новейших достижений энергосберегающих технологий с использованием оптических сенсоров, многофункциональных микроконтроллерных платформ, программного обеспечения,

разработанного в программной среде Proteus. Программная инфраструктура системы контроля перемещения обеспечивает оперативную обработку полученных результатов тестирования с применением методов многомерного математического анализа и формирования интегрированной базы данных контроля координационных способностей. Использованный для этого интерфейс обеспечивает высокий уровень эргономических свойств разработанного устройства и возможности эффективной работы специалистов по данным тестового контроля. Эффективность использования предлагаемого устройства в процессе тестирования координационных способностей студентов достигается за счет: удобства в использовании и компактности устройства, комфортности тестового процесса для студентов, оперативности и достоверности контроля. Реализация уникальных возможностей ИКТ обеспечивает современный уровень дидактики интенсификации процесса контроля в физическом воспитании студентов.

Ключевые слова: студент; контроль; тестирование; физическое воспитание; ИКТ; устройство; микроконтроллерная платформа; программное обеспечение.



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