Original Article

Teaching and learning informatization at the universities of physical culture

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Abstract
Problem Statement. The paper describes information technologies used for training students.
Approach. Computer-based training and supervisory systems improve the learning process. This research shows that the quality of computer-based training programs designed for dealing with databases in physical education and sports is insufficient.
Purpose. We introduce an algorithm of creating computer-based training and control programs. We have also designed an computer-based training program – *Sports & Physical Education Databases*.
Results. The experiment involved 240 students (n = 240). We have conducted a corresponding survey and got a 10/12 estimate after assessing the computer-based training program. The peer review has showed that respondents are equal of their opinions ($\rho = 0.35$; $p > 0.05$). Our computer-based program efficiency was tested by statistical hypotheses; its positive effect was proven by the Student's test – $t = 3.12$ on the back of the $t=1.98$ standard ($p > 0.01$).
Conclusion. We have analyzed the prospects of applying modern information tools in training and assessing knowledge of physical culture students. We have also identified research and development tools used to create information-based learning environments, as well as a wide range of computer training programs. This paper substantiates theoretical principles of learning based on computer training technologies. We have designed a computer-based training program for the *Sports & Physical Education Databases* Course that allows teaching based on the information technology.
Key words: training, control, computer, physical education, sports

Introduction

In the system of higher physical education, training students requires new approaches and tools. According to the European and world educational standards (Danielson, 2014; Maršíková, 2015), any student has to learn most of the training material independently using modern information systems. Advanced technologies of online (Wang, 2014; Klein, 2015) and in-class (Owston, 2011; Wengrowicz, 2014) computer-based training are applied in teaching by the leading universities worldwide. In Ukraine, informatization problem in physical education and sports was studied by a number of scholars, such as Ashanin V.S., (2015); Byshevets N.G., (2011); Dragnev Y.V. (2012); Kashuba V.O., Yukhno Y.O., Khmelnitska I.V. (2012); Svistelnyk I.R. (2015); Filenko L.V. (2007- 2015) and others.

These studies related to informatization at the universities of physical culture are relevant as there is a need in developing and using computer programs designed to improve the learning process (Milosevic & Milosevic, 2013). We have conducted our research whitin the framework of *Scientific and Methodological Foundations of Using Information Technology for Training Specialists in Physical Culture and Sports* (state registration number: 0113U001207).

Methods
Research methods
- observation (assessing the absence rate, developing content for *Sports & Physical Education Databases* Course);
- student-teacher poll about them using computer-based training and control programs;
- information modeling and programming (writing computer programs in Delphi);
- experiment (ascertaining basic knowledge and forming new knowledge in students);

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- mathematical statistics (statistical hypothesis testing, correlation and factor analysis, regression modeling).

Research Organization

This research was carried out at the Computer Science and Biomechanics Department of the Kharkiv State Academy of Physical Culture. Our research target ras the academic process at the universities of physical culture. Research subject: using learning and knowledge-control tools application techniques. The poll was up in January - February 2014. Generally, 240 respondents were interviewed. Equality degree of received opinions was determined through expert assessment. The experiment lasted two years (2014-2015). Students from the experimental groups (n = 180) were offered to use computer-based training and control programs. In the experimental group 1 (n = 90), innovations were introduced during classes under the supervision of teachers. Students from the experimental group 2 (n = 90) were provided with software for self-study and online learning. Students from control groups (n = 60) were taught by traditional methods. Academic record of students was fixed. Exams results (60-100 points) were used to calculate the average performance. At the beginning of the research (January 2014), the level of student knowledge (n = 240) with regard to sports & physical education databases was low (M = 61.5) at the standard deviation SD = 15.1 and varied from 60 to 68 points. Two years later (after the experiment) students were re-examined.

Participants.

The study was carried out among 240 students of the Kharkiv State Academy of Physical Culture: bachelors (4 academic years, n = 120) and masters (1 academic year, n = 120). Female-to-male proportion was 42% (n = 100) to 58% (n = 140). The age of students ranged from 20 to 58 years. The average age (M) was 22.6 at the standard deviation SD = 7.2. The level of student athletic performance was as follows: international masters of sports – 20 students; sub-master sportsmen – 43 students; first-class sportsmen – 75 students, second-class sportsmen – 26 students, third-class sportsmen – 22 students, students without sports training – 54 people. Table 1 provides data regarding the level of sports training and knowledge of students, who participated in the experiment (Table 1).

Table 1
The initial performance of students with various sports training levels

Sports training level	Number of students, n	Average level of knowledge, M	Standard deviation, SD	Result variation interval, R
I – masters of sports	20	64.0	3.16	60-70
II – sub-master sportsmen	43	65.0	3.45	60-75
III – I class	75	63.2	3.63	60-78
IV – II class	26	63.4	3.48	60-76
V – III class	22	62.9	3.28	60-73
VI – students without sports training	54	64.3	3.42	60-75

Research tools.

We hace used computers in classrooms, research laboratory equipment, laptops and video projectors.

Background Paper

The Kharkiv State Academy of Physical Culture is one of the leading centers of computer-based training in the Ukrainian system of higher athletic education (Aghyppo & Shesterova, 2015). The Informatics and Biomechanics Department takes the lead in introducing information technologies to student training and knowledge control (Ashanin, 2015). Researchers (Cerkovnaya & Pyatisotskaya, 2015) have developed a comprehensive package of educational software intended to provide control and psychodiagnostic testing. Similar findings are also provided by another scholars studying the controlling methods applied in sport education and training (Ivashchenko et al., 2016; Osipov et al., 2016; Kretschmann, 2011). Scientists from Kyiv have developed an interactive complex called *Brainteaser* (Byshevets, 2011); hyper-media information environment was developed to explore the *Computer Technologies in Improving Physical Training* Course (Kashuba, Yukhno & Khmelnitska, 2012). Scientists from Lugansk have studied the basic principles of information training environment in the system of physical education and sports (Dragnev, 2012). Researchers from Lviv have presented an on-line information resource available at the websites of sports universities and developed a bibliography search engine (Svistelnyk, 2015). Researchers from Kharkiv (Petrenko & Filenko, 2015) have found that information technology was helpful in optimizing the learning process at the physical

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culture universities. The obtained results were helpful in terms of creating individual and group regression models that were further used to individualize teaching and learning through the computer software.

Chun-Yi Lin, Ya-Huei Lu, Mina Min (2015) from Japan and Hwang G.J., Chang H.F. (2011) from China argue that universities have to use multimedia technology for lectures, seminars, laboratory and self-study. Niva Wengrowicz, (2014) includes different types of tasks with multimedia learning. Lane Fischer, John HiltonIII, T.Jared Robinson, David A. Wiley (2015) believe that properly selected interactive learning tools can improve the quality of learning new material. Liesje De Backer, Hilde Van Keer, Martin Valcke (2015) consider that students can be provided with additional information while completing computer-based control tasks. According to Natalie Barker-Ruchti, Dean Barker, Steven B. Rynne & Jessica Lee (2016), computer training program is required for successful training of students and athletes since it provides strong performance.

Galushka S.V. (2014) and Dyrdyn E., (2013) have noted that computer training facilities should be based on the latest achievements made in various branches of science, education, psychology, information technology, physical education and sports. Karavanova T.P. (2012) has systematized types of computer use in learning and identified the educational software technique. Borysiuk A.B. (2013) has identified the major education problems to be solved by means of computer-based training programs. Pereyaslavskaya S. (2015) reveals the basic development stages for electronic textbooks and justifies their structure. Torubarova I.I. (2012) notes that at the current stage of education development, multimedia tools provide the possibility og combining text, sound, video, graphics and animation.

Russian scholars also emphase the individual capabilities and potential of graduates affiliated with the GPS of the MChS (State Fire Service of the Russian Ministry of Emergency Situations in the sphere of physical education and culture (Bolotin, 2015).

Literature analysis allows considering that applying information technologies during lectures, laboratory and practical classes allows finding optimal structure of learning at the universities of physical culture.

Results

Detailed analysis of research works, dedicated to the information tools application during training at the physical culture universities, indicates the presence of well-established learning environment and computer software with teaching and supervisory specific features. However, we have found that teaching database computerization issue was not highlighted.

The studies allowed developing a training and control software. The program was written in Pascal and implemented in Delphi 7.0. We have applied *Uchebnik_BD.exe* to run the program. In the welcome window, one can choose the language (Ukrainian, Russian and English). The main window, shown in Figure 1, contains a cover page and a register file to be used by students. All information about student's training is recorded in files devedual for each student, which can be opened only by entering a password that protects personal data.
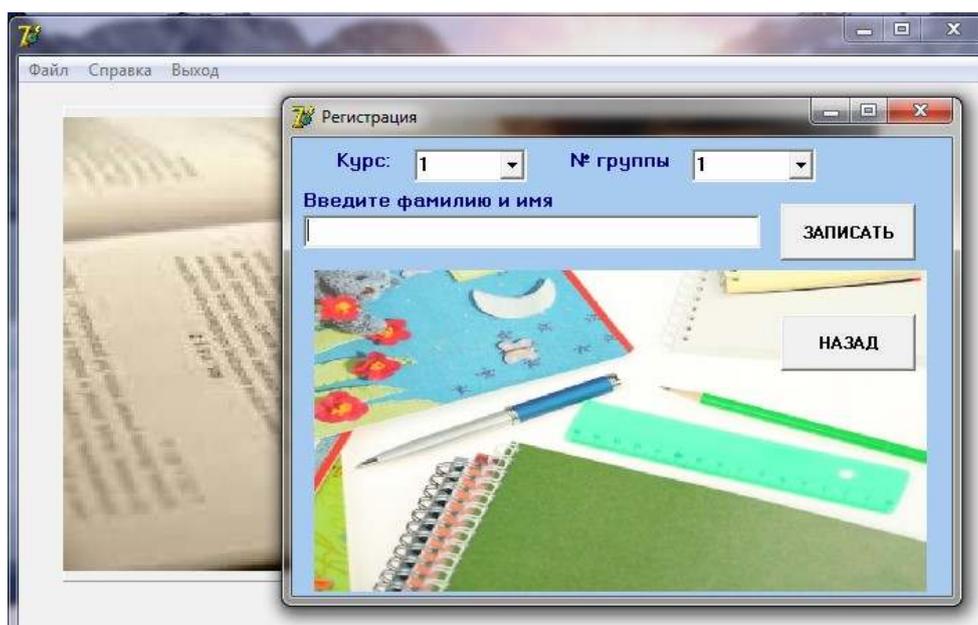

Figure 1. Main window of the training and control software

The training module is displayed as a one-step presentation of educational material using graphics, pictures, videos, animations, hyperlinks, glossaries. Educational materials were provided by *Sports & Physical Education Databases* course lecturers; imaging, audio and animations were designed by a creative group of students from the Computer Science and Biomechanics Department.

The control component is displayed as a computer test presented by three equivalent 30-item tasks. As the test is completed, the program provides information about the number of correct answers and grades (Figure 2).
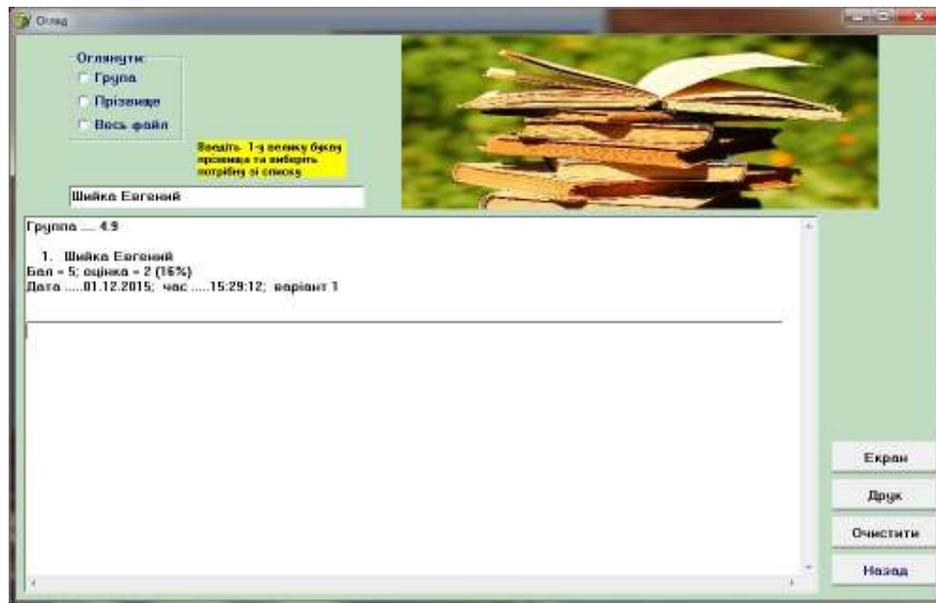
Figure 2. Test results window

Borland Delphi allowed developing a complex software product built according to the algorithm shown in Figure 3. According to the software methodology, this computer training program can be used in class as evident demonstration of educational material – both separately and as part of presentation (data visualization). At practical exercise lessons, teacher records each student, tests knowledge of the subject, chooses topics individually for each student (computer-based training individualization).
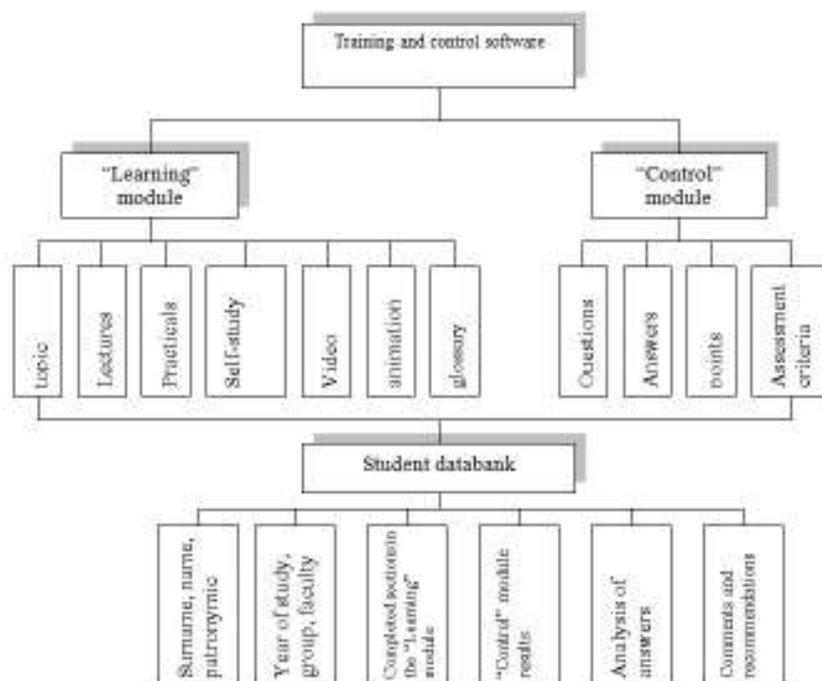

Figure 3. Algorithm diagram for *Sports & Physical Education Databases* software

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At group practical study, teacher uses program elements to verify knowledge of particular parts of teaching material (differentiated computer-based training). At self-study, student chooses the topic at his/her own option and swithes between the modules by using hyperlinks (independent computer-based training management). Training material control can be preliminary, current and final. It varies in relation to complexity of questions, their number, validity and assessment criteria. Control can be used both in a separate class within the test module or exam and during the current class. All information referring to the student's learning activity is recorded in his/her personal file; only the user or administrator has access to this file. The teacher can see the main mistakes made by the student, identify the most difficult material, set the amount of time to study each topic using the resource list administration menu. This allows adjusting the learning process and provides students with relevant material for self-study. The developed software can be used in distance learning.

The poll with a 12-point grading scale was used to identify attitudes to our computer program. We have interviewed 240 respondents and each 20 people got "3", "4", "7", "8" and "12" points for their answers. The largest number of respondents scored 10 points – 40%, 25% of students graded the program with 9 points. There was another important factor in the expert assessment – identifying the program components that have received positive feedback. Program design was positively assessed by 168 respondents (70%), educational material design – by 132 students (55%), and computer-based test structure – by 60 students (25%); 96 students (40%) liked the training material. In general, 24 respondents (10%) liked nothing. The obtained data reveal the strongest components of the program (training material design and presentation) and the weak ones (animation and visualization). The general opinion of teachers regarding the compliance of software information with the syllabus of the *Sports & Physical Education Databases* Course shows that 65% of respondents considered it as sufficient, 30% - insufficient, and 5% indicated the presence of excessive and distracting information.

The final question touched upon the overall awareness on using sports and physical education databases. The poll has revealed that 84% of respondents were interested in databases and could work with them; 16% - were not familiar with databases. This demonstrates the reliability of contingent presented by the sample that reflects both advanced users and those, who do not have knowledge of databases. Based on the survey, we have found positive and negative aspects of our software and upgraded it with due regard to the expressed opinions.

In order to establish the reliability of opinions provided by respondents, who had their own subjective attitude to information, we have used Spearman correlation analysis, which allowed finding rank-order correlation coefficient regarding the compliance of computer program assessment determined by the respondent, and his/her familiarity with other similar developments, $\rho = 0.35$. This figure indicates the relationship ($p < 0.05$), which, in turn, indicates the equality degree.

The value of the correlation coefficient indicating attitudes of respondents to the training material and their assessment of this program, $\rho = 0.53$ shows the relationship between these parameters ($p < 0.01$) and can be interpreted as one of the main assessment factors of our software designed for the *Sports & Physical Education Databases* Course.

Our program was intended for training within the *Sports & Physical Education Databases* Course. Students were randomly divided into control ($n = 60$) and experimental ($n = 180$) groups, no significant differences between their level of database knowledge were observed at the beginning of their studies ($p < 0.05$). This makes the samples identical and allows further research.

The teaching experiment lasted during November 2015; students from experimental groups were given training material through thr computer training program. At the Computer Science and Biomechanics Department, teachers used the software to demonstrate theoretical material during lecture classes and laboratories in order to develop skills of working with databases in students for their self-study on sports database design and creation and to control their knowledge. This software was placed on the platform of Moodle distant learning courses.

As the students completed the *Sports & Physical Education Databases* Course, we conducted comprehensive knowledge testing in the control and experimental groups. Tests showed significant differences in performance values ($p > 0.05$). Students from the control group got an average score of 68.5 points while the students from the experimental group – 76.3 points. This confirmes that our computer program is effective when it comes to training sports students. Table 2 shows the analysis of indicators by Student's test that proves the statistical hypothesis regarding the reliability of differences between the two studied samples.

Table 2.

Results of statistical hypothesis checks for significant differences between the studied samples: control and experimental groups

	CG (n=60) $\overline{X} \pm m$	EG (n=180) $\overline{X} \pm m$	tsta	tгран	p
41			3.98	1.98	<0.01
42	65.3±0.98	78.6±1.21	3.41	1.98	<0.01
43	71.9±1.23	82.1±1.56	2.28	1.98	<0.05
44	68.5±1.23	69.5±0.78	2.78	1.98	<0.01
$\overline{X} \pm m$	68.2±1.56	75.1±1.15	3.12	1.98	<0.01
	68.5±1.25	76.3±1.82			

Figures from each group show high reliability in resulted differences. This proves our assumptions regarding the possible optimization and improvement of training through modern information technology at the physical culture universities.

Both the quantitative assessment of academic progress, expressed in points (60-100 points), and its quality are the important factors of student assessment. At the proportion between variations of quality attributes, one can argue about their relationship. Therefore, we have used a number of indicators. Based on the fact that studied objects were classified by several nominal attributes, research results of training quality assessment were presented in tables. In Table 3, lines indicate attendance (Y) or non-attendance ($\overline{Y}$) of classes where the training software was applied; columns indicate the learning outcomes (passed – X, not passed – $\overline{X}$). This table allows stressing two factors related to the same phenomenon.

Table 3.

Dichotomic table presenting association and contingency coefficients

Training type	Result	
	Passed (X)	Not passed ($\overline{X}$)
Computer-based training (Y)	a=112	b=8
Non-computer training ($\overline{Y}$)	c=97	d=23

The relationship between the studied factors *X* and *Y* can be assessed by the contingency coefficient (C_k=φ):

$$\varphi = \frac{ad - bc}{\sqrt{(a + b)(c + d)(a + c)(b + d)}} = 0.19 \; ; \tag{1}$$

as well as by the association coefficient (C_a=ζ):

$$\zeta = \frac{ad - bc}{ad + bc} = 0.54 . \tag{2}$$

The contingency coefficient (C_k=φ=0.19) is lower than the the association coefficient (C_a=ζ=0.54). This indicates the interdependence between the two education quality factors: training type and academic progress.

Research results indicate the possibility of further implementing computer technologies in the teaching and lerning process. The positive impact of information tools and academic progress have improved the training quality. Subsequent research may focus on other sports disciplines. Computer training programs allow improving the level of presented educational material, as well as the sportsmanship level of students at the physical culture universities.

Conclusions

We have analyzed the prospects of applying modern information tools for teaching and knowledge control at the universities of physical culture, identified research and development tools used to create information-based learning environments, as well as a wide range of computer training programs. This paper substantiates theoretical principles of learning based on computer training technologies.

We have designed a computer training program for the *Sports & Physical Education Databases* Course that allowa teaching based on the information technology. This program was designed in Pascal and implemented in Delphi 7.0; it contains the *Training* and *Control* modules.

The survey has showed a highly positive assessment of the designed software: 10 points, according to the 12-point grading scale (40%). This research has revealed both positive and negative aspects of the software. We have upgraded the program. Thus, it can be further implemented and used in the learning process.

The computer teaching and control programs experimentally introduced into the learning process of physical culture universities proved to be effective both during laboratory classes held under the supervision of a teacher and during online training. The growth rate of student knowledge has reached 7.6% under computer-based learning versus traditional teaching methods.

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