THE RESEARCH AND ELABORATION OF ACTUAL ASPECTS IN THE SUBJECT AREA OF INFORMATION TECHNOLOGIES FOR COMPUTERIZED TRAINING USING THE METHODOLOGY OF EXPERT SYSTEMS OF ARTIFICIAL INTELLIGENCE

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Abstract. The purpose of the article is to find ways to solve the actual problem of the perfecting processes and improving results in the practical application of information technologies for the computer-aided training through the intellectualization of approaches to their selection and integration on the basis of the criterion of the full functionality and compatibility of tools. The research`s methods. The methodological basis of researches is the means and methods of the information theory, information systems and technologies, computer systems, the computerized training, expert systems of the artificial intelligence. The main research`s results. The actual aspects in the subject sub-branch of information technologies for computerized distance training are analyzed, as a result of which their specifics and problematic issues are detected. A conceptual model of the generalized structural composition for the knowledge base in the expert system of the artificial intelligence, assigned for the selection and integration of information technologies for the computerized distance training, has been developed. The research of actual aspects in the subject sub-branch of information technologies for the optimization of the user`s interaction with electronic resources of computerized training systems is carried out, as a result of which, their features and problem moments are outlined. The approaches to the conceptual modeling in the generalized
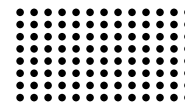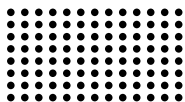
structure for the knowledge base of the expert system of the artificial intelligence, aimed at the supporting in the formation of high-performance information technologies for the optimizing of the user`s interaction with electronic resources of computer-based training systems, are developed. The scientific novelty. The new approaches to the conceptual modeling of information technologies for the computerized distance training and for the optimization of the user`s interaction with electronic resources of computerized training systems, based on elements of the theory in knowledge bases of expert systems of the artificial intelligence, allowing to the increase of the efficiency for these information technologies, are created. The practical significance. The practical use of the obtained theoretical approaches allows you to increase of the efficiency for the computer-based training by a few percent on the basis of the working with more appropriate information technologies.

Keywords: *information technology, computerized system, training, artificial intelligence system, expert system.*

Problem`s statement. The computer-based training more widely and more deeply covers all educational processes without exception, including [1]:

– training processes at all levels of the training and retraining for specialists carried out within educational institutions;

– various processes of self-education (self-training, self-study, etc.), which are carried out outside of educational institutions.

Educational processes in general and, in particular, the processes of computer-based learning, in their main essence, are mainly informational in nature, characterized by: the active transmission and reception for sufficiently significant amounts of the information; the dynamic information interaction with feedback and correction of information influences, etc. [2-3].

Therefore, when trying to improve approaches to the implementation of the computer-based training, first of all it should be taken into account that one of the most crucial roles for its successful implementation is played by the effectiveness of information technologies underlying it.

Namely, successful concepts of the development, selection and integration of information technologies for computer-based training directly contribute to the ensuring of the high productivity in the functioning of those information objects, processes and environments that are its components.

One of the most actual directions for the implementation of educational processes is computerized distance training [4].

This educational technology covers many different segments of the population, for which the main and extremely critical factor was the availability of the organizational opportunity to implement the training in conditions of the territorial distance from certain educational institutions, teachers, target groups of students and more.

The practice has shown not only the theoretical possibility, but also the real feasibility of such situations, when it becomes extremely necessary to cover by the computerized distance training not only taken separately categories on students of educational courses, but also the one hundred percent of all those studying in educational institutions for a long time and in conditions of significant territorial and time constraints, increased psychological tension, etc.

The providing of the highly productive computerized distance training with its significant duration, mass and in conditions of force majeure social and economic circumstances requires the significant addition, strengthening, and development of existing approaches to its organization.

Based on the above, the urgent question is the research and elaboration of actual aspects in the subject sub-branch of information technology for computerized distance training in order to find efficient and powerful reserves for their improvement.

Both within the distance training and in general, for modern high-intensity educational processes, which are characterized by rather strict time limits, the optimality in the information interaction of users with numerous electronic resources of computer-based training systems has become the quite critical.

The problem is largely due to the coincidence of the factors that the choice of these electronic resources is almost endless, the possibilities are very diverse, and the limitations of actual practical use are not always clearly defined and fully understood at first view.

Accordingly, another actual direction of the research and development is the elaboration of actual aspects in
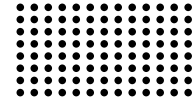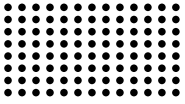
the subject sub-branch of information technologies to optimize the interaction of users with electronic resources of computer-based training systems.

The recent research`s and publication`s analysis. Methodological foundations for the subject sub-branches of information technologies in the computer-based distance training and in the optimization of the user interaction with electronic resources of computer-based training systems studied in this consideration, take their origins from a number of fundamental branches of knowledge, are currently relevant and have a progressive development.

First and foremost, to specified areas of knowledge include information theory, information systems and technologies, software engineering, computer science, computer systems and networks, artificial intelligence, information security, technical means for training, information and communication technologies, pedagogy, psychology, physiology, and others [5-7].

However, we cannot say that the above subject subsectors only elaboration (subjected to monitoring, accumulate, analyze and integrate etc.) achievements in other branches of knowledge [8].

Subject subsectors of information technologies for the computer-based distance training and for the optimization of the user interaction with the electronic resources of computer-based training systems can be safely called as fully independent directions of the research and development, where the desired result is not always possible to achieve by a simple collecting together of the separate achievements.

To the least researched and tested aspects of a specified subject subsectors belong those questions that lie at the intersection of the sciences that are their subsoil, and require the careful mutual coordination [9].

In particular, it should be noted that the issues related to the following aspects have been insufficiently studied [10]:

– the conceptualization of environments, phenomena, states, objects, properties, mechanisms of the functioning, totalities of the key data, processes, flows, and interactions of key elements in the subject subsector;

– information components of objects, processes, flows, and relationships of the subject subsector;

– significant amounts of the information congestion, saturation, density, redundancy;

– the insufficient completeness, exhaustiveness, accuracy, clarity, and reliability in the definition of the information;

– manifestations in the essences of the subject subsector with the high dynamics of changes and their uneven distribution in the space and time;

– the complexity of the systems in the subject subsector, their elements, components, relationships, and external influences;

– the interaction of elements, components and systems in the subject subsector with the environment and its separate components;

– the control of complex systems in the subject subsector, their components and interaction.

Based on the above, the research and elaboration on actual aspects in the subject subsectors of information technologies for the computerized distance training and for the optimization of user interaction with electronic resources of computerized training systems should be carried out using the methodology of expert systems of artificial intelligence.

The study`s objective. The defining goal of the work is to solve the actual problem on finding approaches to strengthening the effectiveness of information technologies for the computerized distance training and for the optimize of user interaction with electronic resources of computerized training systems based on the application of methodological elements in expert systems of the artificial intelligence.

The research`s findings. Let's start with the issue on the research and elaboration of actual aspects in the subject sub-branch of information technologies for computerized distance teaching using the methodology of expert systems of artificial intelligence.

The main feature of modern information technologies of computerized distance training is that, taken as a whole, they provide enough powerful, universal, convenient, and easy to master functional opportunities, tools, and organizational approaches to the implementation of the highly efficient distance education.

At the same time, if we study the advantages and features separately for each of the representatives in the totality of existing information technologies for computerized distance training, the results of such consideration will show now the far from ideal state of affairs.

First of all, there is takes place an insufficient full functionality for each of the taken separately representatives of these information technologies in relation to the set of functions that is actually objectively necessary.
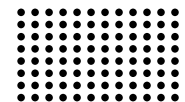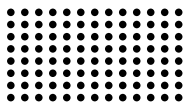
This is accompanied by a high degree of the specificity for each of the representatives of the researched information technologies and their narrow specialization in certain types of educational tasks.

Both theoretical and practical solutions to the above problem should be sought through the integration of separate information technologies for computerized distance training into all-in-one fully functional systems.

We have that fact that ready-made ideal and universal integrated solutions do not currently exist, and the implementation of integration processes is not a simple and unambiguous success case. It is largely due to the need for successful adaptive linking of these solutions to the practice of organization and operation of each computerized distance training system.

Accordingly, there is an urgent need to the create of such methods and tools that, based on the initial data about the features of specific computerized distance training systems,

and about the characteristics of existing information technologies for computerized distance training, will be able to consult, issue recommendations and decide on approaches to the choice of specific representatives of these technologies and approaches to their integration.

Therefore, it seems an appropriate to propose the use of the methodology in expert systems of the artificial intelligence.

Namely, first of all, it is necessary to carry out the conceptual modeling for bases of facts and rules, within the framework of creating the knowledge base for the expert system in the selection and integration of information technologies for computerized distance training.

The main categories of facts and rules for the knowledge base of the expert system that will support the intelligent choice and integration of information technologies for computerized distance training should reflect the conceptual approach presented in Tables 1-2.

Table 1 – The generalized structural composition for the initial prototype of the facts base as part of the knowledge base in the expert system for the selection and integration of information technologies for the computerized distance training

№	The semantic filling for predicates of the facts base as a part of the knowledge base in the developed expert system	The available information sources with which the arguments and meanings of the predicates for the facts base as part of the knowledge base for the developed expert system must be agreed (the state of their order)
1	The presenting by the facts in the knowledge base of the determining information about the existing information technologies for the computerized distance training	The lists of names and addresses for information resources with descriptions of characteristics on existing information technologies for the computerized distance training (require the prior systematization)
2	The presentation of the key information on the tools of existing information technologies for the computerized distance training using the facts of the knowledge base	The lists of names and addresses for information resources with descriptions of characteristics for tools on existing information technologies for the computerized distance training (require the prior systematization)
3	The presentation of the basic information about the functionality of existing information technologies for computerized distance training using the facts of the knowledge base	The lists of names and addresses for information resources with descriptions of functional possibilities of existing information technologies for the computerized distance training (require the prior systematization)
4	The presentation as facts in the knowledge base of the existent correspondences between the names, tools and functionality of existing information technologies for the computerized distance training	The lists of names and addresses for information resources with descriptions of correspondences between elements and components of existing information technologies for the computerized distance training (require the prior systematization)
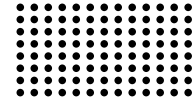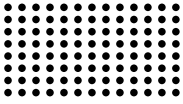
Table 2 – The generalized structural composition for the initial prototype of the rules base as part of the knowledge base in the expert system for the selection and integration of information technologies for the computerized distance training

№	The semantic filling for predicates of the rules base as a part of the knowledge base in the developed expert system	The available information sources with which the arguments, meanings, and logical constructions of the predicates for the rules base as part of the knowledge base for the developed expert system must be agreed (the state of their order)
1	The presenting by the rules in the knowledge base of the ways to choose of certain information technologies in order to form on their basis of the full-fledged system of tools and functional possibilities for the implementation of the computerized distance training	The lists of names and addresses for information resources with descriptions of conceptual approaches to choose of existing information technologies for the computerized distance training (require the prior systematization)
2	The presenting by the rules in the knowledge base of the ways for the integration of certain information technologies into the holistic system in order to ensure proper opportunities for their communication in the process on the implementation of the computerized distance training	The lists of names and addresses for information resources with descriptions of conceptual approaches on integration of existing information technologies for the computerized distance training (require the prior systematization)

We will move on to consider of the question about the research and elaboration in actual aspects of the subject sub-branch of information technologies to optimize of the user`s interaction with electronic resources for computer-based training systems using of the methodology in expert systems of the artificial intelligence.

On the one hand, we have a variety of opportunities and benefits in the using of electronic resources for the computer-based training systems and interaction with them, as well as the relevant information technologies for the implementation of the optimal interaction.

On the other hand, there are take place:

– the specifics of the use, in the process of the information communication with users, electronic resources of computer-based training systems as a means of purely artificial origin;

– features of those information environments in which the specified resources are applied;

– the specifics of those information objects with which these resources are used.

It is because of the large number for alternatives and specific features, often decisions about the feasibility, resource consumption and efficiency of the use and information communication with each of the many types of electronic resources for computerized training systems and complexes of these resources cannot be made on the basis of simple unambiguous considerations and need of optimization approaches.

It should be noted that now especially acute appear of following questions that relate to the effective information communication and information technologies for optimal user`s interaction with the electronic resources of computer-based training systems:

– the adequate ergonomics of resources and communication with them (moreover, their safety from the point of view of standards on the life safety and labor protection);

– the comprehensive availability of resources (informational, physical, time, cost, etc.);

– the warranty of the acceptable time for the user`s access to resources with the aim of the informational interaction with them;

– the easy in study of technologies for the information interaction with the resources;

– the comfort in the implementation of the information communication with resources;

– the efficiency of the information consumption and assimilation in the process of the interaction with the resources;

– the accuracy and stability in functioning of resources.

Based on the analysis was performed, there is a need, similar to the first of the above tasks, relating to the creating
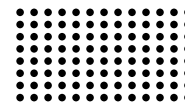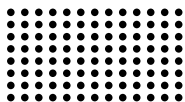
and maintaining of the appropriate knowledge base for the expert system of the artificial intelligence.

First, it is actually to create of a facts base what will reflect of the key knowledge on:

– electronic resources of computer-based training systems;

– information technologies of the interaction with these resources;

– concepts and models of the optimization of this interaction.

Secondly, it is the development required of a rules base that will reflect of concepts and methods:

– to develop of effective strategies for the interaction with electronic resources of computer-based training systems;

– the formation of information technologies for the optimization of user`s interaction with these electronic resources.

In particular, one of the most important roles is played by intelligent rules for the reasonable choice of information technologies to optimize of the user`s interaction with electronic resources of the computer-based training systems, which are based on time criteria that take into account the average time limits of the interaction with resources and possible deviations from the specified limits what are inherent and acceptable in these systems (initially, in the course of work, upon completion of activities) for certain training scenarios and types of information resources.

The research`s conclusions. The topical issue of improving the approaches to the application of information technologies for the computer-based training on the basis of the intellectualization of their choice and integration by the criterion of completeness in functionality and compatibility of tools is investigated. The analysis of specifics and problems for actual aspects in subject sub-branches of information technologies of computerized distance training and optimization of user`s interaction with electronic resources of computerized training systems is carried out. The conceptual models of the generalized structural composition for knowledge bases of expert systems of artificial intelligence intended for the realization of the expedient choice and integration for information technologies of computerized distance training, and also for the formation of highly effective information technologies for the optimization of the user`s interaction with electronic resources of computerized training systems are developed. The proposed new approaches to the conceptual modeling of information technologies for the computerized distance training and for the optimization of the user`s interaction with electronic resources of computerized training systems can enhance the effectiveness of these information technologies. The practical use of the obtained developments allows increase the efficiency of the computer-based training by a several percent on the basis of working with more appropriate information technologies.

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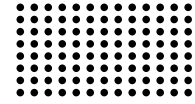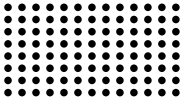
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ДОСЛІДЖЕННЯ Й ОПРАЦЬОВУВАННЯ АКТУАЛЬНИХ АСПЕКТІВ ПРЕДМЕТНОЇ ГАЛУЗІ ІНФОРМАЦІЙНИХ ТЕХНОЛОГІЙ КОМП'ЮТЕРИЗОВАНОГО НАВЧАННЯ З ВИКОРИСТАННЯМ МЕТОДОЛОГІЇ ЕКСПЕРТНИХ СИСТЕМ ШТУЧНОГО ІНТЕЛЕКТУ

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Анотація. Мета статті полягає у пошуку шляхів вирішення актуального завдання вдосконалювання процесів і покращення результатів практичного застосування інформаційних технологій комп'ютеризованого навчання на основі інтелектуалізації підходів до їхнього вибору й інтеграції за критерієм повноти функціональних можливостей і сумісності інструментарію. Методи дослідження. Методологічним підґрунтям досліджень є засоби та методи теорії інформації, інформаційних систем і технологій, комп'ютерних систем, комп'ютеризованого навчання, експертних систем штучного інтелекту. Основні результати дослідження. Проаналізовано актуальні аспекти предметної підгалузі інформаційних технологій комп'ютеризованого дистанційного навчання, у підсумку чого, виявлено їхню специфіку та проблематику. Розроблено концептуальну модель узагальненого структурного складу бази знань експертної системи штучного інтелекту, призначеної для вибору й інтеграції інформаційних технологій комп'ютеризованого дистанційного навчання. Здійснене дослідження актуальних аспектів предметної підгалузі інформаційних технологій оптимізації взаємодії користувачів із електронними ресурсами систем комп'ютеризованого навчання, за результатами якого, окреслено їхні особливості та проблемні моменти. Розроблено підходи до концептуального моделювання узагальненої структури бази знань експертної системи штучного інтелекту, спрямованої на підтримку формування високо результативних інформаційних технологій оптимізації взаємодії користувачів із електронними ресурсами систем комп'ютеризованого навчання. Наукова новизна. Створено нові підходи до концептуального моделювання інформаційних технологій комп'ютеризованого дистанційного навчання й оптимізації взаємодії користувачів із електронними ресурсами систем комп'ютеризованого навчання, основані на елементах теорії баз знань експертних систем штучного інтелекту, що дозволяють посилити дієвість зазначених інформаційних технологій. Практична значимість. Практичне використання отриманих теоретичних підходів дозволяє на декілька відсотків підвищувати ефективність комп'ютеризованого навчання на основі роботи з більш доцільними інформаційними технологіями.

Ключові слова: *інформаційна технологія, комп'ютеризована система, навчання, система штучного інтелекту, експертна система.*
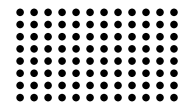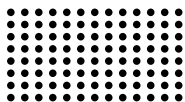
ИССЛЕДОВАНИЕ И ПРОРАБОТКА АКТУАЛЬНЫХ АСПЕКТОВ ПРЕДМЕТНОЙ ОБЛАСТИ ИНФОРМАЦИОННЫХ ТЕХНОЛОГИЙ КОМПЬЮТЕРИЗИРОВАННОГО ОБУЧЕНИЯ С ИСПОЛЬЗОВАНИЕМ МЕТОДОЛОГИИ ЭКСПЕРТНЫХ СИСТЕМ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА

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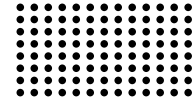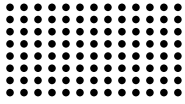e-mail: aleksandra.krtk@gmail.com; ORCID ID: 0000-0001-6819-6263

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Аннотация. Цель статьи заключается в поиске путей решения актуальной задачи по совершенствованию процессов и улучшению результатов практического применения информационных технологий компьютеризированного обучения на основе интеллектуализации подходов к их выбору и интеграции по критерию полноты функциональных возможностей и совместимости инструментария. Методы исследования. Методологическим основанием исследований есть средства и методы теории информации, информационных систем и технологий, компьютерных систем, компьютеризированного обучения, экспертных систем искусственного интеллекта. Основные результаты исследования. Проанализированы актуальные аспекты предметной подотрасли информационных технологий компьютеризированного дистанционного обучения, в итоге чего, выявлено их специфику и проблематику. Разработана концептуальная модель обобщенного структурного состава базы знаний экспертной системы искусственного интеллекта, предназначенной для выбора и интеграции информационных технологий компьютеризированного дистанционного обучения. Осуществлено исследование актуальных аспектов предметной подотрасли информационных технологий оптимизации взаимодействия пользователей с электронными ресурсами систем компьютеризированного обучения, по результатам которого, определены их особенности и проблемные моменты. Разработаны подходы к концептуальному моделированию обобщенной структуры базы знаний экспертной системы искусственного интеллекта, направленной на поддержку формирования высоко результативных информационных технологий оптимизации взаимодействия пользователей с электронными ресурсами систем компьютеризированного обучения. Научная новизна. Созданы новые подходы к концептуальному моделированию информационных технологий компьютеризированного дистанционного обучения и оптимизации взаимодействия пользователей с электронными ресурсами систем компьютеризированного обучения, основанные на элементах теории баз знаний экспертных систем искусственного интеллекта, которые позволяют усилить действенность указанных информационных технологий. Практическая значимость. Практическое использование полученных теоретических подходов позволяет на несколько процентов повышать эффективность компьютеризированного обучения на основе работы с более целесообразными информационными технологиями.

Ключевые слова: *информационная технология, компьютеризированная система, обучение, система искусственного интеллекта, экспертная система.*

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