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PROBLEMS OF ENSURING OF THE EDUCATIONAL PROCESS IN ARCHITECTURE, ENGINEERING AND CONSTRUCTION BY ELECTRONIC RESOURCES PEDAGOGICAL PURPOSE

Abstract. The article deals with the stage of digitalization of education, which requires the development of information and educational environment (IEE) of universities (including architectural and construction profile), which is understood as a set of conditions for the interaction of all categories of users (students, teachers, parents, administration of educational institutions, the public concerned) with information and methodological support of the educational process on the basis of the information system of the educational organization. The main component of IEE is new electronic resources for educational purposes. The approach within which these resources will be developed by students — future programmers within interdisciplinary design under the leadership of the skilled teachers and the methodologists who are a part of interdepartmental scientific collectives is offered. The proposed approach is aimed at improving students' professional competencies in the field of programming, the development of information and educational environment of the University, which is declared by the state regulations, as well as the implementation of the social order of the society on the formation of information and communication competence of the modern user in any sphere of public production and private life.

Keywords: information and educational environment (IEE), digitalization of education, electronic resource, methodological support

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ПРОБЛЕМЫ ОБЕСПЕЧЕНИЯ ОБРАЗОВАТЕЛЬНОГО ПРОЦЕССА В АРХИТЕКТУРЕ, ИНЖЕНЕРНОМ ДЕЛЕ И СТРОИТЕЛЬСТВЕ ЭЛЕКТРОННЫМИ РЕСУРСАМИ ПЕДАГОГИЧЕСКОГО НАЗНАЧЕНИЯ

Аннотация. В статье рассматривается этап цифровизации образования, требующий развития информационно-образовательной среды (ИОС) вузов (в том числе архитектурно-строительного профиля), под которой понимается совокупность условий взаимодействия всех категорий пользователей (студентов, преподавателей, родителей, администрации образовательных учреждений, заинтересованной общественности) с информационно-методическим обеспечением образовательного процесса на базе информационной системы образовательной организации. Основной составляющей ИОС являются новые электронные ресурсы для образовательных целей. Предложен подход, в рамках которого эти ресурсы будут разрабатываться студентами — будущими программистами в рамках междисциплинарного проектирования под руководством опытных преподавателей и методистов, входящих в состав межкафедральных научных коллективов. Предлагаемый подход направлен на совершенствование профессиональных компетенций студентов в области программирования, развитие информационно-образовательной среды вуза, что декларируется государственными нормативными актами, а также реализацию социального заказа общества на формирование информационно-коммуникационной компетентности современного пользователя в любой сфере общественного производства и частной жизни.

Ключевые слова: цифровизация образования, информационно-образовательная среда (ИОС), электронный ресурс, методическое обеспечение

The system of higher education in Russia has gone through 2 stages: the stage of computerization (1970–1980s of the last century), the stage of informatization (from 1980s of the last century to the present time). In 2019, in accordance with the normative documents [1–3], the third stage began — digitalization, the purpose of which in the field of vocational education is to ensure broad access to information and digital resources and the use of digital technologies in the educational process [3, 4].

The analysis of the content essence of stages 1 and 2 showed that, according to the research of Robert I. V. [5], the main pedagogical purposes of the use of modern information technologies in education at any level are:

1) intensification of all levels of the educational process through the use of modern information technology tools by improving the efficiency and quality of the learning process, increasing the activity of cognitive activity, deepening interdisciplinary connections, increasing the volume and optimizing the search for the necessary information;
2) development of the student's personality, preparation of the individual for a comfortable life in the information society through the development of different types of thinking, development of communication skills, formation of skills to make the best decision or offer solutions in a difficult situation, aesthetic education through the use of computer graphics, multimedia technology, formation of information culture, the ability to process information, the development of skills to model a task or situation, formation of skills to carry out experimental research activities based on ICT;
3) work on implementation of the social order of society on preparation of the information competent person.

Robert I. V. [5], considering the process of Informatization as a whole, highlights in the concept of Informatization of education signs corresponding to specific stages of this process.

Stage 1 is characterized by the following features:

1) the beginning of mass introduction of new information technologies and, first of all, computers;
2) research work on pedagogical development of means of computer equipment is carried out and there is a search of ways of its application for intensification of process of training;
3) the society is on the way of understanding the essence and necessity of Informatization processes;

Stage 2 is characterized by the following features:

1) active development and fragmentary introduction of new information technologies (NIT) in traditional disciplines;
2) development of new methods and organizational forms of work with the use of computer technology by teachers;
3) active development and the beginning of the development of teachers of educational and methodological support;
4) formulation of the problem of revision.

Stage 3 is characterized by the following features:

1) widespread use of modern it tools in training;
2) restructuring of the content of all stages of continuing education on the basis of its Informatization;
3) change of methodical basis of training and mastering by each teacher of a wide range of methods and organizational forms of training supported by appropriate means of modern information technologies (completion of Informatization stage).

The analysis of the stages of Informatization of education allows us to conclude that the process of Informatization of society in general, and education in particular, is the result of technological progress, an objective reality in which we will live and work in the future. The term "digitalization" does not seem to be the most successful, as at the stage of computerization, and at the stage of Informatization, all the information stored in the computer and processed it is represented in digital (discrete form as a set of zeros and ones), and not in analog (continuous) form.

The current stage of digitalization is a logical development of this process, the purpose of which in the field of vocational education is to ensure broad access to information and digital resources and the use of digital technologies in the educational process. All these steps involve the introduction and use of modern digital technologies (from virtual reality and robotics, to smart things in professional activities and in everyday life of modern man), which will continue to work on the implementation of the social order of society to form the information and communication competence of the modern user in any sphere of public production and private life.

During the stage of digitalization, the management of any educational organization should focus not only on the automation of certain processes occurring in the subordinate organization (this was the task of the stage of Informatization, to date, not solved in all educational organizations), but on the redistribution of resources in the real and virtual environment of the organization, in order to achieve more effective results from the automation of processes.

In this regard, it is possible to formulate the tasks of digitalization of education, which should be set before the educational organization of any level:

- further training and professional development of the teaching staff on the use of digital technologies in educational activities;
- further implementation of digital technologies in the educational process;
- provision of digital resources for collective use and access to them through cloud resources;
- increasing the level of motivation for the professional use of digital technologies by the teaching staff and students;

- creation of innovative conditions for the development of educational organization on the basis of further introduction of digital technologies;
- provision of information and consulting services on the use of digital and cloud technologies by all interested users;
- accumulation, systematization and dissemination of information on the use of digital and cloud technologies of educational organizations.

The solution of these problems of digitalization of education requires the improvement of information and educational environment (IEE) of any educational organization (EO). Under IEE it is understood, in accordance with the studies by Robert I.V., Kozlov O.A., Serdyukov V.I., Castronova V.A. etc. [6–9], based on the psychological and pedagogical approach, as well as taking into account the requirements of normative documents of the Ministry of education and science of the Russian Federation, the set of conditions for the interaction of all categories of users (students, teachers, parents, administration of educational institutions, the public concerned) with information and methodological support of the educational process on the basis of the information system of the educational organization.

This definition is based on the fact that the EO information system is a technical and technological basis, the structure of which includes electronic resources for educational purposes and services that ensure the automation of processes occurring in the EO, and the IEE is an add-on over this basis and provides conditions for the interaction of all its users with the electronic resources and services available to them.

At the same time, terminologically, the concept of "information and educational environment" and "digital educational environment" are identical, since in both cases we are talking about the components of the environment that operate on the basis of digital (not analog) technologies.

Thus, within the framework of digitalization of education, it is necessary to develop the educational organization's IEE by means of development and implementation of electronic resources for educational purposes in the educational process. This equally applies to the IEE of any University that trains modern graduates, including for the architectural and construction industry. There is a natural question: where to take electronic resources of pedagogical appointment?

Analysis of research Lapenok M.V., Nass O.V. [10, 11], related to the theoretical foundations of the development of electronic educational resources (EER), allowed to identify two areas. According to the first of them, EER create teams of developers of domestic and foreign companies, including specialists in the subject areas. At the same time, the eras created by them have sufficiently positive technological characteristics, but do not, as a rule, have competent methodological solutions.

According to the second direction, EER develop enthusiastic teachers to use them in the implementation of their own methods of teaching disciplines [11–14]. These eras, implementing the author's methods in various subject areas, having high-quality methodological solutions based on the personal pedagogical experience of the teacher-developer of eras, have rather low technological characteristics. Both these directions of development of the EER have certain disadvantages, however, the problem of development of IEE, the universities should be solved.

One of the ways to solve it is proposed as follows. Will consider higher education, where the preparation of graduates who, in varying degrees, studying programming, and such directions of preparation as "Mathematical Software and Administration of Information Systems", "Applied Informatics", "Business Informatics", "Applied Mathematics and Informatics", "Informatics and Computer Engineering", "Informational Systems and Technologies", "Fundamental Mathematics and Mechanics", "Fundamental Informatics and Information Technologies", "Software Engineering", "Information Security", etc. Training of students in these areas should be focused on the formation and improvement of programming knowledge and skills in solving various kinds of applied problems (mathematical, economic, engineering, etc.). As a rule, students are not taught to solve pedagogical problems associated with the development of electronic educational resources in these areas of training. However, the potential of students studying in the field of programming allows them to solve pedagogical problems.

Since EER is usually developed for two or more subject areas, it is advisable to use the project approach [15–18] in the context of interdisciplinarity [19–21], which stimulates the development of close interaction between representatives of different disciplines (including natural sciences: physics, chemistry, biology, etc.) and IT-specialists.

The development of interdisciplinary projects in vocational education is considered in many studies [22–26], in which it is noted that in the process of developing an interdisciplinary project, specialists of different disciplines and professions are involved, who are stakeholders in the course of joint work.

Organizational issues related to the development of interdisciplinary projects are proposed to be solved in the framework of the creation of interdepartmental research teams (IDRT), which include representatives of the Executive Department (Department engaged in the training of future programmers) and representatives of customer departments, which are various departments of the University.

As a result of the implementation of the proposed approach, students-future programmers are formed:

- knowledge of the basics of design for the implementation of EER necessary teaching methods (oversees the teacher of the Executive

Department and the leading subject teacher of the Department-customer);

- ability to apply programming skills in combination with modern programming technologies (supervised by the teacher of the Department-performer); to determine the compliance of the developed EER pedagogical and technological requirements for the organization of the educational process (supervised by the leading teacher-subject of the Department-customer);
- experience in determining the pedagogical purpose of using EER in the educational process; development of the training scenario (oversees by the leading subject teacher of the Department-customer); design of EER content (oversees by the teacher of the Department-contractor, leading subject teacher of the Department of the customer); development of applications for the implementation of content and technological components of the content and interface of EER in accordance with the technical task of the Department-customer (oversees by the teacher of the Department-contractor).

The knowledge, skills and experience gained during the development of EER are components of competence in the development of electronic resources for pedagogical purposes, which simultaneously enriches the authors-developers in a professional way, and the information and educational environment of the University with new electronic educational resources, which in turn allows you to continue to work on the implementation of the social order of society to form the information and communication competence of the modern user in any sphere of public production and private life.

References

1. *Federal Law of 29 December 2012 No. 273-FZ* "*On education in the Russian Federation*". Available at: https://base.garant.EN/70291362/4c3e49295da6f4511a0f5d18289c6432/#friends. (In Russ.).

2. *State program of the Russian Federation "Development of education" for 2013–2020.* Available at: http://new.volsu.ru/upload/medialibrary/809/Proektirovanie education2013–2020.pdf. (In Russ.).

3. *Program* "*Digital economy of the Russian Federation*" *of the Government of the Russian Federation from 28.07.2017 No. 1632-p*. Available at: https://www.sudact.ru/law/rasporiazhenie-pravitelstva-rf-ot-28072017-n-1632-r/programma-tsifrovaia-ekonomika-rossiiskoi-federatsii/. (In Russ.).

4. Meleshko V. Glavnyy trend rossiyskogo obrazovaniya — tsifrovizatsiya [The Main trend of Russian education — digitalization. From an interview with Yaroslav Kuzminov rector of the Higher school of Economics]. *Teacher's newspaper*. 23.01.2018. Available at: http://www.ug.ru/article/1029. (In Russ.).

5. Robert I.V. *Sovremennyye informatsionnyye tekhnologii v obrazovanii: didakticheskiye problemy; perspektivy ispol'zovaniya* [Modern information technologies in education: didactic problems; prospects of use]. Moscow, School Press, 1994. 205 p. (In Russ.).

6. Robert I.V. Fundamental'nyye issledovaniya v oblasti informatizatsii natsional'nogo obrazovaniya [Fundamental research in the field of Informatization of national education]. *Pedagogical Informatics*, 2014, vol. 3, pp. 8–19. (In Russ.).

7. Kozlov O.A., Borodin S.G. Nauchno-pedagogicheskiye osnovy professional'noy deyatel'nosti operatorov slozhnykh tekhnicheskikh sistem [Scientific and pedagogical bases of professional activity of operators of complex technical systems]. *Problems and priorities of development of science in the 21st century*. Smolensk, 2017, pp. 100–109. (In Russ.).

8. Serdyukov V.I., Serdyukova N.A., Slepov V.A. Formalization of knowledge system on basis of system approach. *Smart Innovation, Systems and Technologies*, 2015, vol. 41, pp. 371–381.

9. Kastornova V.A., Dmitriev D.A. Informatsionno-obrazovatel'naya sreda kak osnova obrazovatel'nogo prostranstva [Information and educational environment as the basis of educational space]. *Vestnik of Samara state technical University. Series Psychological and pedagogical Sciences*, 2012, vol. 2, pp. 83–90. (In Russ.).

10. Lapenok M.V. *Nauchno-pedagogicheskiye osnovy sozdaniya i ispol'zovaniya elektronnykh obrazovatel'nykh resursov informatsionnoy sredy distantsionnogo obucheniya* [Scientific and pedagogical bases of creation and use of electronic educational resources of information environment of distance learning. Dr. Sci. (Pedagogy) thesis]. Moscow, 2014. 43 p. (In Russ.).

11. Nass O.V. *Teoretiko-metodicheskiye osnovy formirovaniya kompetentnosti uchiteley v oblasti sozdaniya elektronnykh obrazovatel'nykh resursov (na osnove adaptivnykh instrumental'nykh kompleksov)* [Theoretical and methodical bases of formation of competence of teachers in the field of creation of electronic educational resources (based on adaptive instrumental complexes). Dr. Sci. (Pedagogy) thesis]. Moscow, 2013. 42 p. (In Russ.).

12. Bogomaz I.V. *Nauchno-metodicheskiye osnovy bazovoy podgotovki studentov inzhenerno-stroitel'nykh spetsial'nostey v usloviyakh proyektivno-informatsionnogo podkhoda* [Scientific and methodical bases of basic training of students of engineering and construction specialties in the conditions of projective-information approach. Dr. Sci. (Pedagogy) thesis]. Moscow, 2012. 313 p. (In Russ.).

13. Tarabrin O.A. *Kompleksnoye ispol'zovaniye informatsionno-kommunikatsionnykh tekhnologiy v protsesse nepreryvnogo obucheniya inzhenerno-upravlencheskogo personala: na primere podgotovki spetsialistov dlya otrasley mashinostroyeniya* [Complex use of information and communication technologies in the process of continuous training of engineering and management personnel: on the example of training of specialists for the branches of mechanical engineering. Dr. Sci. (Pedagogy) thesis]. Moscow, 2006. 45 p. (In Russ.).

14. Polyakov V.P. Razvitiye informatsionnoy podgotovki v kontekste strategii natsional'noy bezopasnosti Rossiyskoy Federatsii [Development of information training in the context of the national security strategy of the Russian Federation]. *Science City: science production society*, 2016, vol. 2, pp. 46–51. (In Russ.).

15. Gromyko Yu., Davydov V.V. Kontseptsiya i proyekt v teorii razvivayushchego obucheniya [Concept and project in the theory of developmental education]. *Izvestiya RAO*, 2000, vol. 2, pp. 36–43. (In Russ.).

16. Kilpatrick W.H. *The project Method. Application of the target setting in the pedagogical process.* Leningrad, Brockhaus Efron Publ., 1925. 43 p.

17. Dewey J. *Pedagogical encyclopedic dictionary*. Moscow, 2003. 356 p.

18. Polat E. S. Metod proyektov na urokakh inostrannogo yazyka [Method of projects at foreign language lessons]. *Foreign languages at school*, 2000, vol. 2, pp. 3–10. (In Russ.).

19. Franks D., Dale P., Hindmarsh R., Fellows C., Buckridge M., Cybinski P. Interdisciplinary foundations: Reflecting on interdisciplinarity and three decades of teaching and research at Griffith University, Australia. *Studies in Higher Education*, 2007, vol. 32 (2), pp. 167–185.

20. García L. M., Roblin N. P. Innovation, research and professional development in higher education: Learning from our own experience. *Teaching and Teacher Education*, 2008, vol. 24, pp. 104–116.

21. Rabb R., Rogers J., Chang D. Course development in interdisciplinary controls and mechatronics. *Proc. of 38th ASEE/IEEE Frontiers in Education Conference.* Saratoga Springs, 2008, pp. T3F11-T3F15.

22. Stozhko N. Y., Tchernysheva A. V., Mironova L. I. Education Computer assisted learning system for studying analytical chemistry. *Chemistry: Bulgarian Journal of Science*, 2014, vol. 23, pp. 607–613.

23. Gendjova A., Yordanova B. Proektno obuchenie po prirodni nauki v amerikanskiya kolezh v sofiya [Project-Based Learning in Science at the American College of Sofia]. *Chemistry*, 2009, Vol. 18 (4), pp. 255–267. (In Bulg.).

24. Kong S. C., Chan T. W., Griffin P., Hoppe U., Huang R., Kinshuk Looi C. K., Milrad M., Norris C., Nussbaum M., Sharples M., So W. M. W., Soloway E., Yu S. E-learning in School Education in the Coming 10 Years for developing 21st Century Skills Critical Research Issues and Policy Implications. *Educational Technology & Society*, 2014, vol. 17 (1), pp. 70–78.

25. Sampson D. G., Ifenthaler D., Isaias P., Spector J. M. Editorial: Digital systems supporting cognition and exploratory learning in 21st century. *Knowledge Management and E-Learning*, 2014, vol. 6 (2), pp. 98–102.

26. Chu H. C., Hwang G. J., Tsai C. C. A knowledge engineering approach to developing mind tools for context-aware ubiquitous learning. *Computers and Education*, 2010, vol. 54, pp. 289–297.