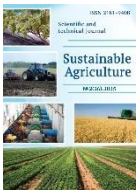
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Digital Transformation and Virtual Learning Resources in Higher Education in Uzbekistan: Experience in the Development and Application of Interactive Stands

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a r t i c l e i n f o

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a b s t r a c t

Information and communication technologies (ICT) have firmly entered the life of modern society in Uzbekistan, covering all key areas: economy, politics and social sphere. Digitalization is developing rapidly in the country, which has a positive impact on the education system. In particular, the expansion of distance learning opportunities contributes to improving the quality of education and making it more accessible to students, especially in rural areas. This provides access to high-quality educational resources in various formats (video, audio, and interactive platforms). Modern technologies and solutions such as online services, gamification, virtual libraries, online proctoring systems, and practical online classes are being actively implemented to optimize the educational process. Interactive learning based on the use of ICT is becoming an increasingly important element of the educational environment. Distance learning, while not replacing traditional attendance at educational institutions, effectively complements it by providing consolidation of knowledge and access to additional materials. Homework is often not enough for a deep understanding and assimilation of the subject, and in this case interactive resources play a key role. The Internet provides a wide range of such opportunities. Virtual interactive stands also contribute to the expansion of general and professional horizons, stimulating interest in learning through game elements. Teachers of the National Research University of Uzbekistan are actively developing and implementing such stands, including for distance learning purposes. In particular, a computer program has been created to study the section "Logical foundations of computing systems", covering the topics "Representation of functions by logic algebra", "Minimization of logical functions by Veitch diagrams" and "Minimization of logical functions by Quine method".

1. INTRODUCTION

Information technology and the Internet are rapidly changing the field of education, which plays a key role in the development of any country, ensuring its future prosperity. In the modern world, it is especially important to take into account new trends, which is why information technology is gaining great popularity in education. First of all, they provide unlimited access to information, going beyond traditional lectures and textbooks. Internet skills are becoming an integral part of the educational process. In addition, students have the opportunity to develop their creative abilities using a variety of tools such as presentations.

Of particular note is the emergence of completely new learning formats. Self-education: thanks to the huge amount of open information, it is now possible to study almost any discipline independently, without visiting archives and libraries, but having only a computer with Internet access. Distance learning: Higher education plays an important role, but is not always accessible to people who live far from educational institutions or have limited time. Remote completion of assignments, projects, and sessions is a great alternative to traditional learning.

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Online courses and seminars are also very popular, providing ample educational opportunities. The COVID-19 pandemic has pushed

teachers to actively develop and adapt open online courses for a large and diverse audience. Online communication with the teacher: tutors have the opportunity to conduct classes through various platforms, teaching languages and new professions.

The main advantages of using Internet technologies in education are as follows: automation of the learning process; improvement of the quality of education; the opportunity to study remotely, regardless of location. The use of graphic and sound elements makes the process of learning information more efficient, and the opportunity to learn from anywhere in the world significantly saves time.

Today, information technology is rapidly developing in Uzbekistan, which is reflected in the field of education. The relevance of the problem of introducing computer and information technologies into the educational process and ensuring wide access to the global Internet information system is recognized at the state level. The Hemis electronic platform for university teachers and students has been created in Uzbekistan. It provides students with access to educational materials (lectures, presentations, practical and laboratory work, videos, assignments, etc. etc.), class schedules and homework, as well as automatic generation of progress reports.

Hemis makes it easier for teachers to manage learning materials, set grades, and communicate with students by allowing them to post announcements, assignments, and reviews, as well as track student progress throughout the semester. The platform allows teachers to set homework, and students to send completed work electronically, without the need for printing and personal transfer. The service also provides access to other information related to the learning process, such as the number of hours allotted for studying the subject and a virtual version of the credit book.

Features of the Hemis platform: free use for students and university staff; designed for universities in Uzbekistan; up-to-date class schedule; virtual credit book; the ability to organize online training; interface in Uzbek; compatibility with current versions of operating systems; Remote receipt and delivery of homework.

Hemis is a modern and user-friendly online educational platform with a variety of courses in business, technology, and healthcare. The dashboard provides students with access to course materials, communication with faculty, and progress tracking, helping them achieve their academic goals.

2. MATERIALS AND METHODS.

Resources providing information and communication technologies in the field of education play an important role in education. They can be divided into several categories:

- Databases and information: digital materials such as texts, images, and videos that teachers can use as teaching aids and illustrations, and students can use as information sources.

- Digital manuals: educational materials supplemented with up-to-date data (for example, videos) and easy navigation.

- Tools for practice: simulators and virtual laboratories that adapt to the level of training, goals and interests of students.

- Modeling tools: Simulators and expert systems that allow you to simulate the studied phenomena and change their parameters.

- Collaboration tools: Platforms for organizing interaction, networking, and communication between participants in the educational process.

There are many different tools available, from simple electronic textbooks to comprehensive distance learning platforms. The methods of using them also vary depending on the teacher. Modern pedagogy actively integrates ICT, relying on knowledge gained from pedagogical sciences. Interactive training programs are considered to be one of the most effective electronic resources for consolidating knowledge.

Interactive learning is a special approach to organizing the learning process in which students actively interact with each other, exchange information, solve problems together, model situations, evaluate actions and behavior, and immerse themselves in the atmosphere of business cooperation. The goal of interactive learning is to create a comfortable educational environment in which every student feels successful and valuable, which has a positive effect on learning outcomes.

In interactive learning, almost all students are involved in the learning process and have the opportunity to reflect on their knowledge and thoughts. A special feature of interactive methods is the high level of mutual activity of the participants and their emotional and spiritual unity.Unlike traditional forms of learning, the interactive approach changes the role of the teacher: he ceases to be the main source of information and becomes the organizer, creating conditions for independent activity of students.

Interactive teaching methods contribute to the development of critical thinking, the ability to solve complex problems, analyze information, evaluate alternative points of view, make informed decisions, participate in discussions and communicate effectively. Various forms of work are used for this purpose, such as pair and group assignments, research projects, role-playing games, document management, and creative assignments.

The student becomes an active participant in the educational process, and his experience serves as an important source of knowledge. The teacher does not provide ready-made answers, but guides students in their independent search.

Interactive forms of learning:

- Arouse the interest of students;

- Everyone's active participation in the learning process is encouraged;

- They appeal to the students' feelings;

- Contribute to the effective assimilation of educational material;

- They have a diverse impact on students;

- Provide feedback;

- Students' opinions and attitudes are shaped;

- They form life skills;

- They contribute to behavioral change.

It is important to note that the teacher's personal experience of participating in interactive classes is a key factor in their success.The basic principles of the organization of interactive learning:

- The principle of engagement: All participants should be actively involved in the work. To do this, special methods are used to include everyone in the discussion process.

- The principle of psychological preparation: It is necessary to take into account that not all participants are ready for active participation. Therefore, it is important to warm up, encourage activity and create opportunities for self-realization.

- The principle of optimal number of participants: The number of participants affects the quality of training. The recommended number is up to 25 people.

- The principle of space organization: The room should be organized in such a way that participants can easily move on to work in large and small groups.

- The principle of clear rules and regulations: It is necessary to establish rules and adhere to them. For example, respect for different points of view, freedom of speech and respect for the dignity of each participant.

- The principle of group formation: At the initial stage, it is better to form groups based on volunteerism, and then use the principle of random selection.

Mandatory conditions for the organization of interactive learning:

- Trusting and positive relationship between teacher and students;

- A democratic style of communication;

- Collaboration between the teacher and the students;

- Relying on students' personal experience, using vivid examples and images;

- A variety of forms and methods of information presentation;

- Support of internal and external motivation of students.

Interactive learning provides high motivation, the strength of knowledge, the development of creativity and imagination, sociability, an active lifestyle, team spirit, the value of individuality, freedom of

expression, activity, mutual respect and democracy.

3. RESULTS AND DISCUSSION.

Modern means of information support make it possible to create such programs in a multimedia format with maximum use of all means of visualization. Interactive training programs create motivation for the qualitative assimilation of educational information, the ability to apply it in practice and form the student's competence in a given section of the discipline.

At the Department of Automation and Control of Technological Processes of the «Tashkent institute of irrigation and agricultural mechanization engineers» National Research University, together with teachers of the Tashkent State Pedagogical University, active work is underway to introduce virtual interactive educational stands into the educational process, including distance education.

The computer program provides for the implementation of training lessons in the section "Logical foundations of computing systems", namely "Representation of functions of the algebra of logic", "Minimization of logical functions by Veitch diagrams (Carnot maps)", "Minimization of logical functions by the Quine method".

When launching the program, the user is provided with an interface that indicates the names of the course and section offered for study (fig.1).

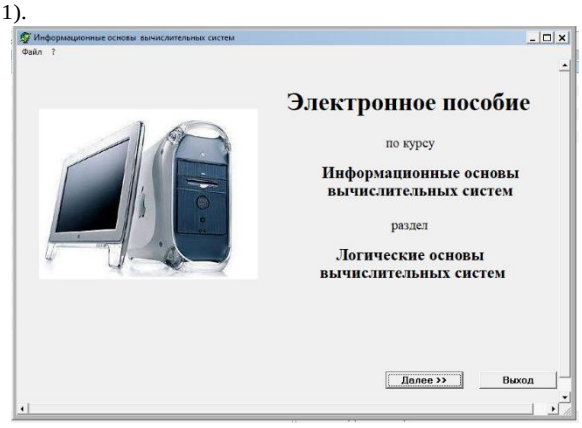


Figure 1. The main window and interface of the interactive stand.

To continue working in the system, the user must log in to the system, to do this, enter the user name (login) and password. For users who are working in the system for the first time, it is necessary to register. After the user has logged in to the system, the user is prompted to select a lesson (fig.2).

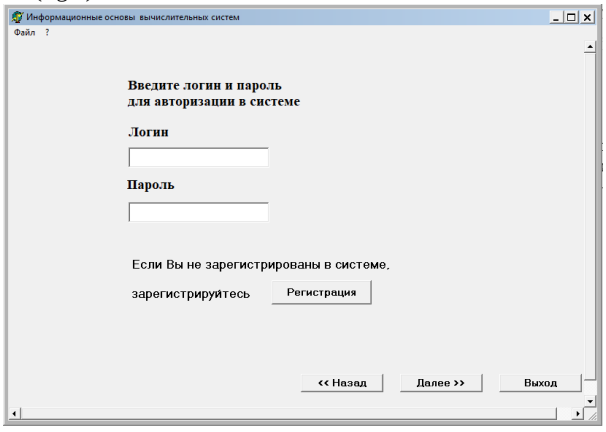


Figure 2. Authorization in the system.

Let's consider the work of the program using the example of one of the modules of the lesson program "Minimizing logical functions. The method of minimizing Carnot maps".

The user needs to find the minimum disjunctive form of a logical function. In the lesson window, the initial data is offered - a function of the algebra of logic, set digitally and using a truth table. The user must fill in the Carnot card correctly according to the specified truth table. The value "0" is changed to the value "1" by double-clicking the mouse. You can check the correctness of the filling by clicking on the "Check" button. If the user filled out the Carnot card incorrectly, then when clicking on this button, the program will display an error message (fig.3).

After the Carnot card is filled, the user needs to select the minimum cover of all "1". In this program, the blocks are highlighted in red. After clicking the "Check" button, the cells that are supposed to be combined are selected. The selection is made by clicking on the desired cell.

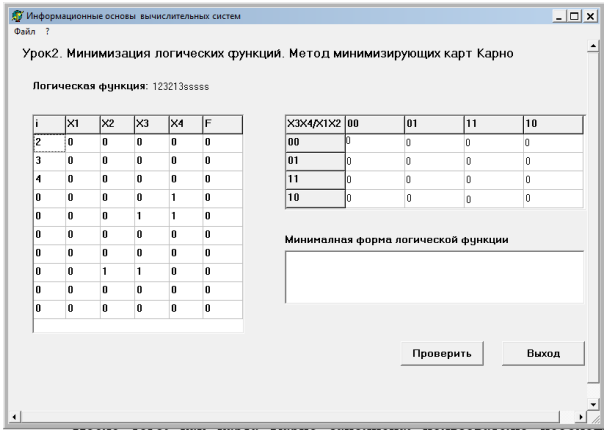


Figure 3. Interactive stand module - minimization of logical functions

If you are gluing units that cannot be glued together (for example, non-adjacent and non-opposite cells, or "0"), the program will display an error message. As a result of the correct selection in the lower field of the window, we get the minimum disjunctive form of the logical function.

The program provides a database with job options, the modification and addition and removal of which are included in the functions of the administrator. Each time the program is restarted, the user works with a new task option, that is, the selection of options is performed randomly.

The program was implemented in the Delphi 7 environment. As you know, this system is well suited for the development of multi-window user applications, the creation of multifunctional general-purpose systems, the design of databases of any complexity and database management tools, the creation of single and multi-user interfaces, the development of text, graphics, video and sound processing systems, writing programs using the Internet.

The debugging process is an integral part of creating any program. The program was tested throughout the development of the system.

4. CONCLUSIONS.

The integration of information and communication technologies (ICT) is significantly transforming the educational landscape in Uzbekistan. The development of platforms such as Hemis and the creation of interactive learning tools demonstrate a commitment to modernize teaching and learning methods. These initiatives aim to increase access to quality education, especially for students in remote areas, by expanding distance learning opportunities. Providing students and teachers with a wider range of resources, including multimedia materials, virtual labs, and online collaboration tools, promotes active learning and engagement through interactive methods, simulations, and gamification. Administrative processes such as managing student accounts, assignments, and grades are being optimized. The focus is on interactive learning and the development of virtual educational stands.

The program of studying the logical foundations of computer systems reflects a shift towards more student-oriented and attractive pedagogical approaches. These efforts are expected to improve learning outcomes, instill critical thinking skills, and prepare students for success in the digital age.

REFERENCES

[1] S. Ubaydullayeva, G. Tadjiyeva, D. Ubaydullayeva, N. Kadirova, Z. Gulyamova and D. Subanova, "The Specifics of the Organization of Independent Work of Students in the System of Secondary Vocational Education In Uzbekistan in the Context of the Transition to a Digital Economy," 2023 3rd International Conference on Technology Enhanced Learning in Higher Education (TELE), Lipetsk, Russian Federation, 2023, pp. 287-290, doi: 10.1109/TELE58910.2023.10184330.

[2] S. Ubaydullayeva, Z. Gulyamova, G. Tadjiyeva, N. Kadirova and U. Kusanova, "The Use of Virtual Interactive Stands in the Educational Process in Higher Education," 2024 4th International Conference on Technology Enhanced Learning in Higher Education (TELE), Lipetsk, Russian Federation, 2024, pp. 39-44, doi: 10.1109/TELE62556.2024.10605705.

[3] K. Tulenova, S. Ubaydullayeva, R. Gaziyeva, U. Mamayusupov, M. Mamadjonova and E. Turdikulova, "The Introduction of Information Technologies Into Educational and Laboratory Complexes is an Important Step Towards the Digitalization of Uzbekistan," 2024 4th International Conference on Technology Enhanced Learning in Higher Education (TELE), Lipetsk, Russian Federation, 2024, pp. 48-53, doi: 10.1109/TELE62556.2024.10605665.

[4] J. MacLeod and H. H. Yang, "Life-Cycle Efficacy for Educational Technology: Best-Practices for Leading Schools," 2016 International Conference on Educational Innovation through Technology (EITT), Tainan, Taiwan, 2016, pp. 139-142, doi: 10.1109/EITT.2016.34.

[5] M. Qian, B. Zhao and Y. Gao, "Exploring the Training Path of Design Thinking of Students in Educational Technology," 2019 IEEE International Conference on Computer Science and Educational Informatization (CSEI), Kunming, China, 2019, pp. 315-319, doi: 10.1109/CSEI47661.2019.8938895.

[6] C. Buiu, "Hybrid Educational Strategy for a Laboratory Course on Cognitive Robotics," in IEEE Transactions on Education, vol. 51, no. 1, pp. 100-107, Feb. 2008, doi: 10.1109/TE.2007.906605.

[7] G. Y. Maruyama, A. A. De Castro Junior, A. C. De Lima and M. P. Vilhanueva, "Asimov: A Remote Laboratory for Experimentation in Educational Robotics," 2024 Brazilian Symposium on Robotics (SBR) and 2024 Workshop on Robotics in Education (WRE), Goiania, Brazil, 2024, pp. 313-318, doi: 10.1109/SBR/WRE63066.2024.10838153.

[8] C. S. Tzafestas, N. Palaiologou and M. Alifragis, "Virtual and remote robotic laboratory: comparative experimental evaluation," in IEEE Transactions on Education, vol. 49, no. 3, pp. 360-369, Aug. 2006, doi: 10.1109/TE.2006.879255.

[9] V. Djalic, P. Maric, D. Kosic, D. Samuelsen, B. Thyberg and O. Graven, "Remote laboratory for robotics and automation as a tool for remote access to learning content," 2012 15th International Conference on Interactive Collaborative Learning (ICL), Villach, Austria, 2012, pp. 1-3, doi: 10.1109/ICL.2012.6402174.

[10] F. Martell-Chavez, J. M. López-Téllez, C. A. Paredes-Orta and R. Espinosa-Luna, "Virtual laboratories for teaching automation, robotics, and optomechatronics," 2023 IEEE World Engineering Education Conference (EDUNINE), Bogota, Colombia, 2023, pp. 1-4, doi: 10.1109/EDUNINE57531.2023.10102906.

[11] A. Kerem Erdoğmuş and U. Yayan, "Virtual Robotic Laboratory Compatible Mobile Robots for Education and Research," 2021 International Conference on INnovations in Intelligent SysTems and Applications (INISTA), Kocaeli, Turkey, 2021, pp. 1-6, doi: 10.1109/INISTA52262.2021.9548503.

[12] C. Gonzalez-Espinoza, A. Venzor-Mendoza, O. Lasso-Lopez and C. Lozoya, "Educative impact of a remote laboratory to experience industrial robotics," 2023 IEEE International Conference on Teaching, Assessment and Learning for Engineering (TALE), Auckland, New Zealand, 2023, pp. 1-5, doi: 10.1109/TALE56641.2023.10398333.

[13] B. Hokanson, "Creativity and Educational Technology," 2017 International Conference of Educational Innovation through Technology (EITT), Osaka, Japan, 2017, pp. 229-233, doi: 10.1109/EITT.2017.62.

[14] S. R. Ubaydullayeva, D. R. Kadirova and D. R. Ubaydullayeva, "Graph Modeling and Automated Control of Complex Irrigation Systems," 2020 International Russian Automation Conference (RusAutoCon), Sochi, Russia, 2020, pp. 464-469, doi: 10.1109/RusAutoCon49822.2020.9208076.

[15] S. R. Ubaydulayeva and A. M. Nigmatov, "Development of a Graph Model and Algorithm to Analyze the Dynamics of a Linear System with Delay," 2020 International Conference on Industrial Engineering, Applications and Manufacturing (ICIEAM), Sochi, Russia, 2020, pp. 1-6, doi: 10.1109/ICIEAM48468.2020.9111939.

[16] S. R. Ubaydullayeva, S. Yunusova and Y. Barno, "Study of Dynamic Processes in Nonlinear Discrete Systems with Delay Based on Graph Models," 2022 International Conference on Industrial Engineering, Applications and Manufacturing (ICIEAM), Sochi, Russian Federation, 2022, pp. 919-925, doi: 10.1109/ICIEAM54945.2022.9787277.

[17] S. Ubaydullayeva, D. Ubaydullayeva, R. Gaziyeva, Z. Gulyamova, G. Tadjiyeva and N. Kadirova, "Model of Organizing Online Learning for Students in Agricultural Area," 2022 2nd International Conference on Technology Enhanced Learning in Higher Education (TELE), Lipetsk, Russian Federation, 2022, pp. 317-320, doi: 10.1109/TELE55498.2022.9800945.