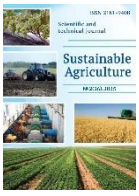
Sustainable Agriculture 2 (26) (2025) 68–71

Contents lists available at https://susagr.uz/index.php/ojs/issue/view/6

Sustainable Agriculture

journal homepage: https://susagr.uz/index.php/ojs



Virtualization of the Educational Process as a Tool for the Digital Transformation of Higher Education in Uzbekistan

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a R T i c L e i n f o

Keywords:
Digitalization of Uzbekistan, information resources, educational and laboratory complex, pedagogical technologies, virtual stand, minimization of the automatic Mile

a b s T R a c T

Digital transformation is one of the most important trends in the development of modern states, changing the appearance of virtually all spheres of the economy and the social sphere. The pandemic has hit many sectors of the economy, but has contributed to the accelerated development of the IT industry. It also showed the importance of introducing information and communication technologies and digital technologies into the work of state bodies, private enterprises, public organizations and educational institutions. One of the main tasks of the consistent socio-economic development of Uzbekistan is the widespread introduction of information, communication and digital technologies into education. This is exactly the area that represents an effective tool capable of ensuring high-quality reform of economic sectors and spheres of public life. The article examines the trends in the introduction of information technologies in various sectors of the economy in Uzbekistan, the issues of virtualization of the educational and laboratory complex of educational institutions of the country. As an example, the interactive virtual stand "Minimization of Mile automata" in the discipline "Theory of information processes and systems" is considered.

1. INTRODUCTION

The state is introducing digitization into all its industries. One of the main merits of the introduction of information and communication technologies is the reduction of bureaucracy and red tape in the registration of documents. ID cards and passports can be accessed online, where all data is stored and updated.

Today, the leadership of Uzbekistan is paying increasing attention to strengthening cooperation with foreign countries, in particular, in the direction of introducing innovations and advanced technologies. In this matter, it is impossible not to ignore the role and experience of the countries of the East, which demonstrate impressive growth rates of gross domestic product.

Such participants of the region as China, India, Vietnam and not only, today act as the locomotive of the global economy. Japan and South Korea maintain leadership in many areas of innovative and high-tech industries. Singapore, Malaysia and Thailand show exceptional achievements in exporting goods and services to global markets. And the United Arab Emirates, Qatar, and Saudi Arabia are making serious progress in the field of alternative energy [1-5].

All this is the result of a well-thought-out socio-economic policy. Strategic programs of measures for the integrated development of all aspects of the economy and public life are being developed and put into practice by governments. Also for Uzbekistan, which is currently engaged in solving similar tasks, the study of the experience of the eastern countries is of undoubted interest.

The last few years have become fundamental for the adoption of documents in Uzbekistan, which have laid the normative and legal foundations for further digital reforms. On April 28, 2020, a presidential decree "On measures for the broad introduction of the digital economy and e-government" was adopted. This document outlines the current issues related to the wide introduction of digital technologies in the work of domestic enterprises and public services, the training of IT specialists, comprehensive support for IT entrepreneurship and more.

The logical continuation of these works was the Presidential Decree "On the confirmation of the strategy "Digital Uzbekistan - 2030" and the measures for its effective implementation" of October 5, 2020. According to the document, all state duties and penalties are carried out using electronic payment systems online. In addition, over 400 information systems, electronic services and other software products are being introduced in various areas of socio-economic development of the regions.

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https://doi.org/10.5281/zenodo.16510860
Received 14 April 2025; Received in revised form 23 May 2025; Accepted 30 May 2025
Available online 1 July 2025
ISSN 2181-9408/© 2025 The Authors. Published by "TIIAME" NRU. The journal "Sustainable Agriculture" is registered in the Press Agency of Uzbekistan on the 12th of February in 2018 (license № 0957). In 2019, the journal is included in the list of recommended scientific publications by the Higher Attestation Commission of the Republic of Uzbekistan.

The strategy "Digital Uzbekistan - 2030" provides for the approval of two programs (on the digital transformation of regions and industries), as well as "roadmaps" for their implementation. This will undoubtedly ensure the most comprehensive coverage and effective implementation of the document, which includes such priorities as the development of digital infrastructure, e-government, and the national market for digital technologies, education and advanced training in the field [6-7].

It is also known that, according to the document on monitoring the state of digital transformation in the regions, an assessment method for the digital development of the territories has been developed, which allows for a preliminary diagnosis of digitization on the ground. The criteria include the use of the Internet in social institutions (universities, schools, and clinics), the introduction of educational and other systems and software products, the coverage of computer science teachers and students within the framework of the project "One million programmers" and the number of IT educational centers.

Among the most important documents is also the resolution of the head of state "On Measures for the wide introduction of digital technologies in the city of Tashkent" of March 17, 2020. The comprehensive program "Digital Tashkent" approved by the document is aimed at the digital development of the capital of Uzbekistan.

The Development Strategy for the New Uzbekistan 2022-2026, adopted on January 28, 2022, includes seven reform priorities related to public administration, the rule of law, economic development, social policy, spiritual education, security, as well as a pragmatic and active foreign policy.

The development strategy defines the further digitization of a number of important areas, such as public and social services, law enforcement, traffic management and health systems, banking and agricultural sectors, education and others.

In addition, the improvement of the electronic Government of Uzbekistan and the introduction of the share of electronic public services to one hundred percent, the introduction of the mobile ID system for identifying the person in their provision, the projects "Digital Citizen Passport" and "Digital Authority" are envisaged.

The E-Government Project Management Center is working together with the Ministry of Information Technology and Communications on the implementation of the "Digital Citizen Passport" project.

As an experiment from July 15, 2022 to December 1, 2023, government agencies, banks and other organizations do not need paper ID cards. In the future, instead, you will be able to present your digital versions in a special OneID Mobile application, which legally correspond to their physical counterparts.

In addition to the passport or ID card of a citizen of the Republic of Uzbekistan, users of the service can manage digital documents such as driver's license, vehicle registration certificate, marriage and birth certificate, student ID card, etc.

The service also provides the ability to share digital copies, send a passport to a trusted person for a certain time, and share the document data with service providers and much more.

2. MATERIALS AND METHODS

Information resources of higher education institutions are becoming an important element of information provision. The priorities in this area are as follows:

- Modernization of technical learning tools.
- Development of advanced teaching methods and learning methods.
- Creation of conditions for the implementation of the system of open education.

In addition, each educational information source has a specific owner who, based on his "implicit" goals, which include the following points, spends money on his education and support:

- The need to implement a certain educational policy in accordance with modern social and cultural requirements.
- The opportunity to expand international cooperation in the promotion of cybernetic education.
- The possibility of launching certain educational products on the market, which are realized by expanding the range of potential users and the formation of the needs of the target audience of students.
- Opportunity to expand the range of paid educational services.

Erstellen eines virtuellen Stands.

The virtualization of the teaching and laboratory complex of universities is an important issue. And the next steps involve the creation of a library of modules, nodes and devices, which are generally a software product. The development of this type of resources intended for the learning process should include electronic texts of teaching aids, electronic images of graphic objects and a digital representation of audible information intended for listening [8].

The software, which was developed for the formation of virtual booths, is used everywhere in practice in the discipline "Computer science and information technology" and in other specialties of science and production, from technical project planning to organizational consulting [9-12].

The analysis of existing laboratory equipment and public software made it possible to determine the possibilities of the most efficient organization of the technical and methodological supply of laboratory lessons and the development of virtual laboratory stands using new pedagogical technologies in the organization of the learning process.

Modern pedagogical technologies involve the use of a set of measures for the formation of a virtual learning environment. Interactive technologies are a set of technical and software solutions aimed at achieving the pedagogical and cognitive goals of educational processes. Software means replacing people's activities with computers, hardware and software. This means that when automating workplaces, it is necessary to clarify from employees what degree of automation it is [13].

According to the degree of automation, learning technologies are divided into the following types:

- Learning technologies that are not automated.
- Learning technologies that are partially automated.
- Fully automated learning technologies.

The automation of pedagogical technologies involves the provision of the following possibilities:

- Exchange of teachers' activities (presentation of teaching materials, handouts, animation materials, control for adjusting the learning process, assessment of knowledge according to the assessment system).
- Provision of educational material (content).
- Implementation of types of learning activities (lectures, laboratory work, practical work, tests).
- Provision of teaching aids.
- Provision of training methods (detailed instructions on the use of methods, tools and methods of learning).

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Some didactic requirements must be imposed on automated pedagogical technologies, namely, the presence of operational feedback, virtuality, interactivity, visibility and scope of content. Information technologies should be considered as an effective means of acquiring learning material. Almost everything is determined by the quality of the organization of the cognitive process, the main element of which can be considered goal setting. The main task of pedagogical technologies is to define clear learning goals. A visual modeling system can be used as a tool environment. The possibility of further changes and extensions of the library (virtual laboratories, training programs and self-tests) should also be considered.

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 National Research University "TIIIMSH" at the Department of Automation and Process Control there is a bachelor's degree in Information Systems and Technologies. According to the curriculum of this direction, in the second year students take the discipline "Theory of information processes and systems".

At the Department of Automation and Control of Technological Processes, together with teachers of the Tashkent Pedagogical University named after Nizami, a set of virtual stands has been developed to perform practical work on the module "Theory of automata" of this discipline.

Consider one of these virtual stands - "Minimizing fully defined automata. Minimizing automatic Miles."

The development of the modules of this virtual stand is based on the π-partitioning method.

Consider the steps of this method.

1. In the transition/exit table, column groups with the same output response are highlighted (in the following example, the group columns are marked with *,+). The states corresponding to the equally marked columns form an equivalence class. The resulting equivalence classes form the initial division of class π1.

2. For further partitioning attempts, the original table is rewritten. The states are grouped by belonging to the equivalence class. The contents of the cells are now the equivalence classes found that correspond to the states located there. For this, the source table is analyzed. For example, in the column for status 1, the following is written: A2 A1, since 3 has reached the status to class A2, and 5 has reached the status to class A1.

3. In the resulting table, an attempt is made to map the corresponding classes again. The assignment of new classes is also determined by comparing the column contents within the same class. The new equivalence classes found form a division of class π2.

4. The group changes 1 and 2 are compared, if they are the same, i.e. the same composition of the equality classes, the group change is considered complete, otherwise the attempts to create a new group change will continue .

5. When the partitioning is complete, a minimized automata table is created. From each class of the last partitioning, Ci is selected according to a state and they are redefined in Si terms. These states form a new automaton, the column of input letters is rewritten, status columns are added, based on the number of Si states obtained.

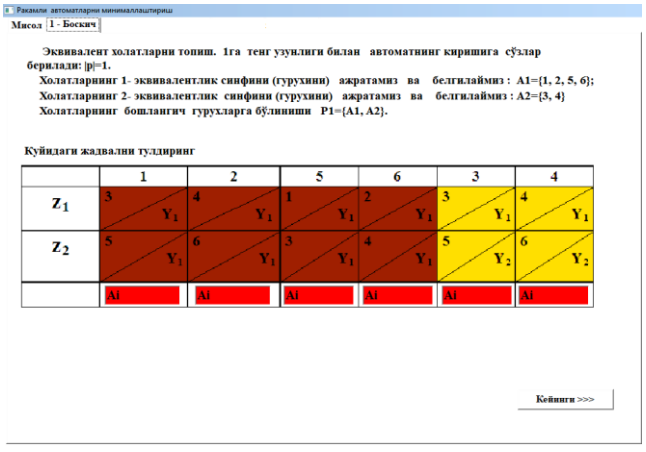


Figure 1. The 1st stage of automata minimization. Definition of equivalent states.

The cells of the new table are filled in as follows: the next Si state is taken, it is determined which states of the original table are equivalent to it. The output reactions contained in the corresponding columns of the original table are recorded in the new table. To record states, it is analyzed which equivalence class belongs to the state recorded in the corresponding cell of the source table. Then, which new state corresponds to the same equivalence class and it is written to the new table in the corresponding cell.

The created virtual booth consists of the following windows:

- the cover page of the virtual stand,
- the main window of the virtual booth, in which the following buttons are located,
- a button to open the interactive tutorial window,
- a button to go to the window of theoretical materials (the algorithm of the pi-partitioning method),
- a button to go to the examples window.

Let's look at the first window of the interactive training program.

1. In the interactive tutorial window, the user is asked to minimize the automaton specified by the combined table of transitions/outputs.

When you click the button to go to the next window, we see a table in which the states for which homogeneous equivalence classes have been introduced have already been grouped using the program (Fig.1). The transition/exit table highlights groups of columns that have the same output response. The states corresponding to identically labeled columns constitute one equivalence class. The resulting equivalence classes make up the initial partition π1. The user must fill in the cells of the bottom row of the table himself, comparing the output reactions of Yi.

If the user incorrectly fills in the last row of the table, the program displays an error message. If the table is filled in correctly, the user goes to the next window, otherwise he is given the opportunity to correct the error.

2. The next window shows the 2nd stage of solving the problem.

Classes A1 and A2 are analyzed for their splitting when submitting words of length 2: |p|=2. Using the pi-partitioning method, new groups are defined - B1, B2, B3.

At this stage, also, if the user incorrectly fills in the last row of the table, the program issues an error message. If the table is filled in correctly, the user goes to the next window, otherwise he is given the opportunity to correct the error (fig.2).

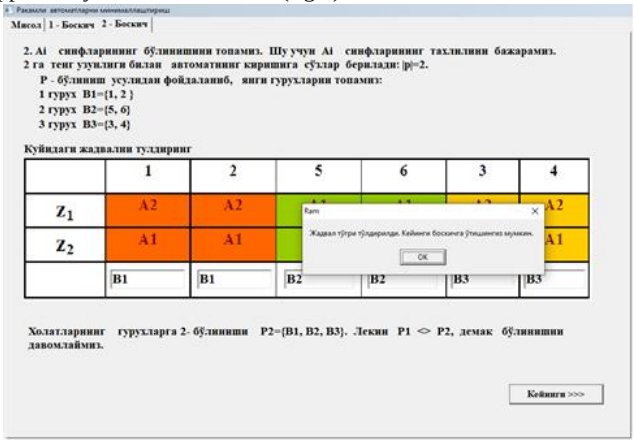


Figure 2. The 2nd stage of solving the problem of minimizing automata. definition of equivalence classes Bi.

At the 3rd stage of solving the problem, the Bi classes are divided. To do this, Bi classes are analyzed. Classes B1, B2 and B3 are analyzed for their splitting when submitting words of length 3: |p|=3. Using the π-partitioning method, the user defines new groups - C1, C2, C3. At this stage of solving the problem, π1=π2, therefore, the partitioning is considered completed.

If the 3rd stage of the task is solved correctly, the transition to the next window is performed. From each class of the last Ci partition, the user selects one state, and they are denoted in terms of Si. These states will make up a new automaton, columns of states are added, according

to the number of Si states received.

At the last, 6th stage of solving the problem, the program outputs the original graph of the Mile automaton and the graph of the minimized Mile automaton (Fig.3).

As a verification of the correctness of the minimization, the combination X1 X2 X2 X1 is applied to the input.

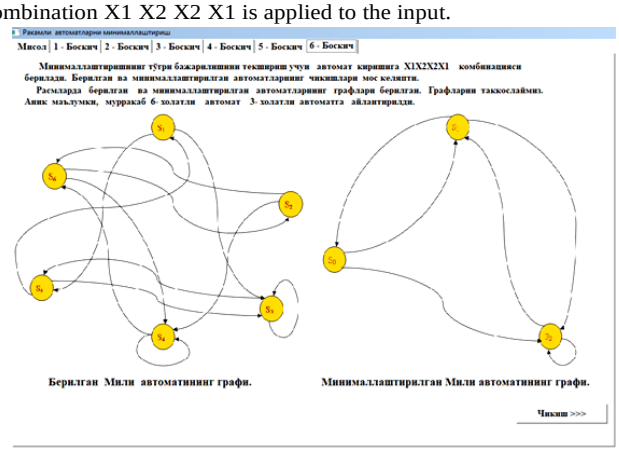


Figure 3. The window of the 6th stage of solving the problem. Graphs of the original and minimized Mile automaton.

The output reactions in the initial and minimized automata coincide. Thus, the student user is given the opportunity to independently solve the problem of minimizing the automaton.

4. CONCLUSIONS

The development of the IT sector and the digital economy in Uzbekistan is among the main tasks. Due attention is also paid to the improvement of the sphere producing high-tech goods and services. In addition, in conditions of fierce competition in world markets, information and communication technologies can safely act as a locomotive for further sustainable development and diversification of the national economy, increasing its competitiveness [14-17].

The range of tasks of each educational institution should be determined by the social order of society. In the presence of market relations, the problems of economic and social integration are particularly acute. But the needs of information and communication technologies cannot always be met due to a lack of practical skills.

In a virtual classroom, teachers can more easily approach each student and individually involve them in classes in a virtual classroom according to their needs. Because in e-learning, teachers use new technologies to facilitate communication and expand learning opportunities. Students will actively participate in the learning process, and thus knowledge gaps will be prevented. The lecturer - teacher can directly share his on-screen content with the group through screen sharing. Teachers and students can access, edit and comment on all materials. This stimulates discussions and makes it easy to inform all students.

Another advantage of the virtual classroom is that it allows both students and teachers to attend online courses from anywhere. A virtual classroom creates a learning environment in which everyone participates in learning at the same time. Compared to traditional learning methods such as face-to-face learning, e-learning offers more convenience and tools. Using various graphical tools, you can perform interactive exercises and solve visual tasks.

In the modern and virtual working world, it is important to think "outside the box". With the transition to digital technologies, it has become possible to conduct virtual courses, retraining or further education in a virtual classroom. Don't forget – learning in a virtual classroom, by the way, strengthens your own digital skills, which are so important today. All these points make the virtual classroom very effective and demonstrate the advantages of a virtual classroom over a traditional one.

REFERENCES

[1] 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.

[2] 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.

[3] 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.