Problems of digital transformation of education and their impact on scientific education

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Abstract: This article examines the main problems of digitalization, including infrastructural and international features, low level of digital literacy of teachers and students, as well as insufficient funding of educational projects. The analysis is based on the study of digital education technologies and educational outcomes in different regions of the country.

The results show that despite the successes in large cities, rural areas face serious challenges due to limited access to the Internet and digital tools. Digital technologies such as virtual laboratories have proven highly effective in improving the quality of science education, but require a consistent approach to teaching methods.

The article offers recommendations for developing employment, improving the qualifications of teachers, attracting investment and expanding cooperation with international organizations. Implementation of the proposed measures will create the basis for large-scale digitalization, improving the quality of scientific education and training competitive specialists.

Keywords: digital transformation, science education, digital literacy, infrastructure, problems of digitalization, distance learning, educational technologies.

1.Introduction

In the context of rapid technological development and global digitalization, education is becoming one of the key areas associated with transformation processes. Uzbekistan, being in the stage of active reform of the educational system, is faced with the need to use digital technologies to increase the competitiveness of its educational institutions and train personnel that meet the requirements of the modern economy.

Digital transformation in Uzbekistan is aimed at achieving several strategic goals: increasing the accessibility of education, modernizing classical programs, developing digital devices and integrating international standards. Particular attention is paid to reforms in the field of scientific education, which requires not only theoretical training, but also practical research, the use of laboratory equipment and access to modern information resources.

However, the introduction of digital technologies into the educational system of Uzbekistan is accompanied by a number of challenges. The country faces uneven levels of labor force development, insufficient training of teachers to work with digital tools, as well as limited access of students from the atmosphere to modern technologies. This is especially true for science education, which traditionally uses complex teaching methods that require large resources.

At the same time, Uzbekistan has the reserve potential to overcome these opportunities. The government of the country actively supports the introduction of information and communication technologies (ICT) in the educational process. For example, programs such as “Digital Uzbekistan – 2030” have been launched, aimed at modernizing all spheres of life, including education. Educational platforms are

being created, access to online courses and digital libraries is provided, virtual laboratories are being introduced, and advanced training programs are being organized.

This article presents the main problems of digital transformation of education in Uzbekistan and their impact on scientific education. The main emphasis is on identifying the obstacles and opportunities that can ensure sustainable development of scientific education.

2. Research methods

To study the problems of digital transformation of education in Uzbekistan and its professional scientific education, a comprehensive methodological approach was used, including both qualitative and quantitative research methods. Given the specifics of Uzbekistan, special attention is paid to studying the context of the national educational system, accessibility and monitoring of digital technologies of the national educational process.

The process used a mixed-method approach, combining quantitative and qualitative methods to obtain a multifaceted picture of the problems of digital transformation of education in Uzbekistan. The following were taken into account:

– socio-economic characteristics of the regions;
– definition between urban and rural entities;
– analysis of cultural factors, including the adoption of new technologies by teachers and students.

The strategy was divided into three stages:

1. Preparatory: secondary data collection and preliminary questionnaire.
2. Main: conducting field research and surveys.
3. Analytical: data processing and interpretation taking into account the specific features of the region.

The study focused on three key aspects:

1. *Infrastructure*: availability of equipment, high-speed internet, digital platforms and software in educational institutions.

2. *Personnel training:*the level of digital literacy of teachers and students, as well as additional programs to improve them.

3. *Efficiency of digital solutions:*intelligent technologies in educational processes with an emphasis on natural and engineering sciences.

Data collected from the following sources:

– analysis of the regulatory framework: programs and strategies being studied, such as “Digital Uzbekistan – 2030”, the Law “On Education” and the National Concept for the Development of Education until 2030;

– statistics: research of reports of the Ministry of Higher Education, Science and Innovation of the Republic of Uzbekistan, data of the State Statistics Committee and international organizations (UNESCO, World Bank) on the development of ICT in education;

– social surveys: surveys are conducted among teachers and students studying natural sciences;

– keywords and reports: Reviews demonstrate digital technologies in universities of Uzbekistan, including the use of an online platform (EDU.UZ) and virtual laboratories.

Observations were conducted during classes at universities (for example, Tashkent University of Applied Sciences). The use of electronic tools (projectors, virtual laboratories) and students’ enthusiasm for working with digital tasks were studied.

The following indicators were used for the analysis:

– the level of access to the Internet and digital devices in educational institutions;
– several students and teachers who have undergone digital skills training;
– availability and quality of digital educational resources, including local online platforms;
– the spread of digital technologies in natural science education (virtual laboratories, data analysis programs);
– Students' performance in science subjects before and after digital technology intervention.

Modern digital tools are used to collect and analyze data:

– Google Forms for survey;
– Excel for processing statistical data.

The methodology allows to correct the problems of digital transformations of education in Uzbekistan at the systemic level. A combination of typical and quantitative methods is used to apply a comprehensive

approach to the study of public digitalization of scientific education, regional specifics, infrastructure limitations and socio-cultural context. This approach allows to develop recommendations based on the needs and capabilities of the country's educational system.

3.Results and their discussion

The study revealed significant differences in the level of digitalization of educational institutions in Uzbekistan depending on the region and type of higher education institution. In cities, especially in Tashkent, Samarkand and Bukhara, educational institutions are provided with modern infrastructure. Many universities in Uzbekistan have a high degree of digitalization:

– online learning platforms are used (for example, moodle and ziyonet);

– virtual laboratories have been introduced for studying physics, chemistry and biology;

– However, in a number of regions, the digitalization of universities is limited due to closed equipment and lack of funds.

The effectiveness of digital technologies in science education. During the COVID-19 pandemic, the introduction of distance learning helped maintain the educational process, but significant gaps were identified, such as in universities with developed infrastructure, students successfully implement technology programs.

The main obstacles to digital transformation:

– outdated equipment in the country's universities.

– shortage of specialists in the development and support of educational platforms.

– limited access to specialized courses for teachers, especially in the regions.

– insufficient funding for progressive educational activities.

– uneven distribution of funds between the capital and regional authorities.

Despite the difficulties, Uzbekistan has seen successful results in digitalization of education:

– creation of a national educational platform ZiyoNet, uniting resources for schoolchildren and students;

– implementation of teacher training programs through a platform such as EDU.UZ;

– developing partnerships with international organizations, including UNESCO and the World Bank, to finance digitalization projects.

The results of the study confirm that digital transformation in Uzbekistan has great potential, but its implementation faces systemic violations, lack of access to technology, lack of funding and low digital literacy.

To achieve the development of digital technologies in scientific education, a comprehensive approach is needed, including:

– increasing investment in digital infrastructure;

– expansion of teacher training programs;

– development of local solutions that observe the characteristics of atmospheric phenomena.

This will not only improve the quality of scientific education, but also increase the competitiveness of Uzbekistan in the international educational arena. The analysis showed that the main problems of digital transformation of education include:

1. Lack of work: Many technology institutions, especially in the regions, face problems of limited access to modern technologies and the Internet, which makes it difficult to use digital tools.

2. Low digital literacy among teachers and students: Despite the availability of modern technologies, many teachers and students do not have the skills to use them effectively.

3. Limited opportunities for hands-on learning: In science education, the hands-on component plays a key role. Virtual labs and simulations, although pseudonyms, cannot always replace real experiments.

4. Resistance to change: teachers and administrators of educational institutions are often not ready for radical changes and the transition to digitalization.

5. Inequality in access to education: Students from disadvantaged backgrounds face difficulties in accessing digital devices and the Internet, which leads to the formation of a form.

Digital transformation of education in Uzbekistan is a strategic direction within the framework of the state program "Digital - 2030". However, its products face a number of problems that have a significant impact on scientific education. This section discusses important aspects identified during the research, their causes and possible solutions.

In Uzbekistan, there is an imbalance in the level of digitalization between urban and rural educational institutions.

Reasons:

– limited availability of high-speed internet;

– insufficient funding of universities in different regions;

– migration of qualified teachers from rural areas to the city.

Recommendations:

– development of telecommunications infrastructure, including installation of basic methods and improvement of Internet coverage in regions with atmospheric influences;

– increasing motivation through financial support and providing opportunities for professional growth.

Political and financial aspects.

Digital transformation requires significant investments, which are decreasing unevenly. The reason is the limited state budget for modernization of education, as well as the concentration of funds in large universities of the capital region. As a result, there is a gap in the quality of educational services between regions and a decrease in the pace of digitalization in higher education.

It is recommended to pengage the private sector to finance educational technologies through public-private partnerships, and expand the participation of international partners and organizations in educational initiatives.

International experience and adaptation opportunities. Uzbekistan can adopt successful practices from other countries:

– Finland and Estonia: implementation of electronic devices even in remote areas;

– South Korea: use of interactive educational platforms with state support.

The application of such approaches in Uzbekistan is possible through the localization of experience, taking into account the country's characteristics.

Digital transformation of education in Uzbekistan is a promising but complex process that requires systemic access. To eliminate the identified problems, it is necessary to:

1. Develop infrastructure and ensure conditions for access to digital technologies in the context of variable and climate change.
2. To improve the level of digital literacy of teachers and students.
3. Strengthen state and international support for scientific education through digitalization.

These steps not only accelerate digital transformation, but also help create a competitive generation that can integrate into the global level of emergency knowledge.

4. Conclusion

The analysis demonstrates serious problems and predicts serious changes in education in Uzbekistan. The main findings confirm that, despite positive steps, digitalization of education faces systemic and regional barriers that must be overcome to achieve results.

Digital transformation can significantly improve the quality of scientific education in Uzbekistan by:

– expanding students' access to modern educational tools, including virtual laboratories and simulations;

– increasing the competitiveness of graduates of Uzbek universities in the international arena through mastering digital skills;

– accelerations are part of Uzbekistan's global educational ecosystem, which opens up new opportunities for scientific research and innovation.

Digitalization of education in Uzbekistan can become a catalyst for the country's development. However, this requires a systematic approach, including:

– support for the development of the proactive side from the state and business;

– taking into account the specific features of the region;

– creating an ecosystem in which digital technologies will become part of the educational process.

These measures will not only maintain current barriers, but will also ensure the development of a new generation of specialists capable of responding to global challenges, strengthening Uzbekistan's scientific and educational leadership in countries and on the international arena.

Digital transformation of education in Uzbekistan is a strategic task that requires long-term progress and concerted action. Despite the difficult situation, the measures already taken create preconditions for

progressive changes. Implementation of the recommendations proposed in this training will not only overcome current barriers, but also bring scientific education to a new level that meets the requirements of the 21st century.

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