EDUCATION AND RESEARCH IN THE ERA OF DIGITAL TRANSFORMATION

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Abstract: This article provides a brief overview of education and research in the era of digital transformation, encompassing what digital transformation entails, the integration of technology into education and science, along with concepts such as online platforms and artificial intelligence-based learning. Furthermore, it provides a brief explanation of how modern technologies should be utilized in each form of education. Additionally, the digitalization processes in Uzbekistan, existing challenges, and ways to address them are analyzed.

Keywords: Digital transformation, education system, scientific research, artificial intelligence (AI), Big Data, Data Science, cloud technologies, virtual laboratories, distance education, online learning, digital educational resources, electronic textbooks.

Introduction

One of the main characteristics of the 21st century is the rapid development of digital transformation processes in all spheres of society. Digital technologies are deeply penetrating the education system and scientific research activities, replacing traditional methods with modern, interactive, and effective forms. In today's globalization context, the convenience of acquiring knowledge, broad access to scientific information, and rapid

information exchange are ensured through the digital environment. Therefore, the digitalization of education and science has become not only a development requirement but also a necessity of the times. Moreover, as a result of these changes, the relationship between teacher and student in the educational process is taking on a new form, and the process of knowledge acquisition is becoming individual, adaptive, and more efficient. The rapid development of digital technologies has become an important factor in enhancing the competitiveness of countries, turning education and science into the strategic center of innovative development.

What is Digital Transformation?

Digital transformation is the process of automating processes through digital technologies, expanding data analysis capabilities, improving service quality, and achieving efficiency. Its main directions are recognized as:

1. Artificial Intelligence (AI)
2. Big Data
3. Cloud Computing
4. Internet of Things (IoT)
5. Blockchain technologies

These technologies elevate education and scientific research to a new level, ensuring global competitiveness.

Artificial Intelligence is the ability of computers and software systems to perform tasks that typically require human intelligence. It typically performs tasks such as:

1. Data analysis
2. Learning (Machine Learning)
3. Speech recognition (e.g., Siri, Google Assistant)
4. Image recognition (camera facial recognition)
5. Text generation (like ChatGPT)
6. Providing recommendations (YouTube, Netflix recommendations)

7. Automatic translation (Google Translate)

Big Data is a collection of data that is very large in volume, rapidly changing, and diverse in form. It should be noted that ordinary computers or traditional programs cannot process this data, which is why special technologies and algorithms are required.

Cloud Technology is a system that allows using files and programs via the internet without installing them on a computer. With its help, it is possible and easy to store data on the internet (in the cloud), access data from anywhere, use programs without installation, perform large-scale calculations on servers, and rent servers and infrastructure for companies.

Internet of Things (IoT – Internet of Things) is a system that ensures the mutual exchange of information and independent operation of internet-connected devices, sensors, equipment, and objects. Devices communicate with each other, sensors collect and transmit data, processes are automatically controlled, and remote monitoring and management are implemented.

For example: the air conditioner automatically turning on before you enter the house or a water leak sensor sending a notification to your phone about a malfunction — these are results of IoT.

Blockchain is a digital ledger (accounting book) where data is connected in chains in the form of blocks, stored on millions of computers, and cannot be corrupted. Its functions consist of the following:

1. Data is placed in blocks, i.e., each block contains transactions (data)
2. Each block is connected to the previous block, and this connection is accomplished through a cryptographic code (hash)
3. The system is decentralized, i.e., data is stored not on one server but on thousands of computers
4. Blocks cannot be modified, i.e., any change breaks the chain, which is why data is considered very reliable

Digital Transformation in Education

In recent years, the widespread implementation of online education platforms has increased the adaptability of the learning process. Platforms such as Moodle, Google Classroom, Zoom, and Microsoft Teams enable teachers to deliver lesson materials electronically, check online assignments, and communicate with students remotely. This proved its effectiveness especially during the pandemic period. Additionally, for the purpose of developing educational resources, electronic textbooks, video lessons, and virtual laboratories are creating an even more convenient and rapid learning environment for pupils and students. Virtual laboratories provide the opportunity to conduct experiments in subjects such as physics, chemistry, and biology safely and without restrictions. Furthermore, systems developed based on artificial intelligence ensure a personalized approach to education. With the help of AI, several opportunities are being created, such as automatically determining students' knowledge levels, creating adaptive lesson plans, automatic assessment of tests, and monitoring the learning process. In today's labor market, skills such as digital literacy, programming, cybersecurity, and data analysis are among the most important skills. Therefore, educational institutions are updating curricula based on modern requirements.

Digital Transformation in Scientific Research

The need to work with large volumes of data in scientific research is increasing. Data Science methods provide the following opportunities:

1. Statistical analysis
2. Creating predictive models
3. Modeling complex processes

Artificial intelligence, one of the AI technologies, is making significant changes in directions such as biology, medicine, ecology, and social sciences. For example, analyzing medical images, studying genomics data, and creating models on climate change are performed much faster and more accurately with the help of AI.

Many scientific investigations are carried out in the digital environment. Computer simulation allows the study of physical, chemical, and economic processes without real experiments. This saves time and resources. We can also confidently say that digital platforms, including resources such as Google Scholar, Scopus, ResearchGate, and Academia, are creating broad access to scientific articles. This plays a major role in strengthening scientific collaboration and global scientific integration.

Advantages of Digital Transformation

Based on several studies, we can say that digital transformation has advantages both in education and in scientific research. For example, the following advantages exist in education:

1. Free access to quality educational resources
2. Transparency and adaptability of the educational process
3. Innovative pedagogical approaches
4. Effective communication between teachers and students

In scientific research:

1. Increased speed of investigations
2. Ability to analyze large and complex data
3. Expansion of global scientific collaboration
4. Reduction of errors and increased accuracy of results

Challenges and Solutions

The use of these technologies brings several problems:

1. Insufficient internet infrastructure
2. Low digital skills of teachers
3. Increased cybersecurity risks
4. Students' lack of technical equipment

The solution to these problems consists of: increasing media literacy, developing internet infrastructure, strengthening information security strategies, and gradually implementing modern IT technologies.

Digital Transformation in Uzbekistan

The "Digital Uzbekistan-2030" strategy adopted by the Republic of Uzbekistan has outlined the main directions for digitalizing education and scientific research. Electronic journals and diaries, online platforms, and digital laboratories are being implemented in schools and higher education institutions. Conducting scientific research based on ICT in higher education institutions, and establishing artificial intelligence centers and digital technoparks are underway.

Conclusion

From this article, we can conclude that digital transformation is bringing new opportunities to the education and scientific research process, similar to many conveniences in our daily lives. For example, if students living in remote areas were previously forced to travel long distances to receive lessons from good teachers, today they can freely access quality education through Zoom or Google Classroom. Similar changes are observed in scientific research: whereas previously expensive equipment was required to conduct laboratory experiments, today students and researchers can test complex processes on computers with the help of virtual laboratories. Additionally, translation tools operating based on artificial intelligence are facilitating the study of foreign sources, and cloud storage services enable teachers to share educational materials at any time. As a result, pupils, students, and scientists can actively learn and conduct research regardless of time and place. Overall, the implementation of digital technologies in education and scientific research has practical significance proven through many real-life examples, significantly increasing the intellectual development of modern society, the convenience of the learning process, and the effectiveness of scientific investigations.

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