



# Digital Education in the Context of the Development of the Digital Economy: Technological Opportunities and Prospects

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**Abstract:** Digital education is education that primarily functions based on digital technologies, that is, electronic transactions that are implemented using the Internet. Digital education aims to professionalize and increase the mobility of those who study and at the present stage of ICT development, it can be considered as a technological basis for the fundamentalization of higher education. The purpose of the article is to analyze the technological capabilities of digital education on the example of the use of innovative classroom in the educational process. The article analyzes the advantages of the educational environment equipped with digital tools. Based on an expert survey, the main characteristics of the innovative classroom, as well as technological requirements for the innovative classroom, are determined and various models for the organization of the innovative classroom are presented.

**Keywords:** digital economy, digital education, educational environment, educational process, innovative classroom, innovative classroom model.

## I. INTRODUCTION

Today, the global trend of the world digital economy is entering an active phase of its development [1, 2]. The concept of Industry 4.0 and the development of digital technologies in the leading countries of the world both at the state and corporate levels have begun to be massively developed in government programs and strategies [3-5]. The practical aspect of solving these issues is quickly updated, which is a response to systemic challenges [6, 7].

The need to create a digital economy and society is recognized in Russia at the state level and digital

technologies are considered as one of the key drivers of sustainable development. At the same time, the development of the digital economy actualizes many public policy issues that need not only to be clearly set but also systematically addressed. One such issue is understanding the implications of the transition to digital education [8].

The digital economy transforms traditional types of social and economic activities (including education [9, 10]) and human lifestyle, as well as relationships in the digital world. It forms fundamentally new models of activities and is constantly improving, introducing cloud technologies, artificial intelligence, new virtual reality and Big Data, which has become the main resources of digital education [11].

The digitalization of education with the development of the digital economy is already changing the traditional education system in the direction of forming its new quality. This is manifested in the following: the number of virtual educational platforms is growing; one electronic resource can be used many times to provide different educational services; new technologies in education and digital educational platforms providing services are introduced [12].

The increasing speed and spread of broadband access to the Internet, as well as the spread of mobile devices and applications, are forming new types of educational services, which are called digital. Teachers widely use social media channels, such as Facebook, to communicate with other educational institutions and individuals who can help them adapt their teaching methods to make the most of digital tools. Students use digital technology to communicate with other students, not only in their country but also around the world, and to participate in self-study in areas related to their personal experiences and interests [13].

Today, most educational institutions have access to technology, from computers to tablets. At the same time, modern classrooms should provide teachers and students with easy and quick access to information and educational resources.

## II. LITERATURE REVIEW

The analysis of scientific literature [14-17] shows that digital education allows teachers to cover a larger number of students as compared to face-to-face courses. Teachers can spread new concepts, ideas and materials faster, connecting with more people and influencing their lives.

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Moreover, digital learning enables educators to bring "global conversations" to life, resulting in the acquisition and transfer of rich teaching experience. Digital learning helps educators create courses using the best content previously developed by other educators.

According to researchers [18], the use of the educational environment equipped with digital tools is a key factor for the long-term success of students. There are several reasons for this.

1. *Personalization.* Personalized learning helps modernize learning simply by adapting learning topics and methods to the needs, choices and interests of the student. Institutions that have adopted personalized learning strategies for their students find that the more students face personalized learning, the greater their achievements. Digital learning provides a new opportunity to receive an educational experience that is individual for each student [19].

2. *Accessibility.* Digital education solves many problems that arise in the field of education. By spreading digital devices and digital learning, educational institutions can not only connect to increase the level of exchange of experience and skills but also enable teachers to enjoy equal conditions because not all educational institutions have similar support. Accessibility is a vital condition for using technology and providing educational opportunities for all students around the world, including people with disabilities [20].

3. *Efficiency.* Digital assessment provides students with a quick response about their performance, allowing them and teachers to focus on the material that requires further understanding. Thus, with adaptive learning, it is possible to receive recommendations correcting incorrect answers in real-time [21].

According to scientists, the advantages of using digital tools in the educational process are as follows:

- multitasking (ability to change activities using digital tools);
- control of the learning situation (individualization of learning pace);
- support for collaborative learning [22].

At the same time, researchers note that modern students, unlike previous generations, live in a truly global reality. They are more united than ever and have more power to influence the world. They will need skills that were not required by previous generations in order to be effective citizens of the digital society and actors of the digital economy [23].

However, as researchers note, only ultramodern auditoriums, so-called "innovative classrooms" (ICR), provided with the right tools, services and experience of teachers can prepare students for this reality. Prepared and coordinated actions of teachers and the involvement of special resources aimed to create and organize activities in the newest classrooms can help students solve real-life problems. Technology provides students with new opportunities and engages them in exploring the environment, in which they find themselves. It prepares

students for a future that will be driven by digital skills and brings people together. Technology unites students with each other, with teachers and with the whole world. Integrated technologies can serve both to attract students to educational activities, to motivate them and to prepare them for the real world. In particular, the use of technology makes learning interesting and students benefit from knowledge related to technology [24, 25].

*Research hypothesis:* The use of the ICR will make it possible to improve the quality of educational services, especially in the context of modernization of the content of higher pedagogical education

## III. PROPOSED METHODOLOGY

### A. General description

The theoretical study was based on the analysis of scientific literature on the problem of the research.

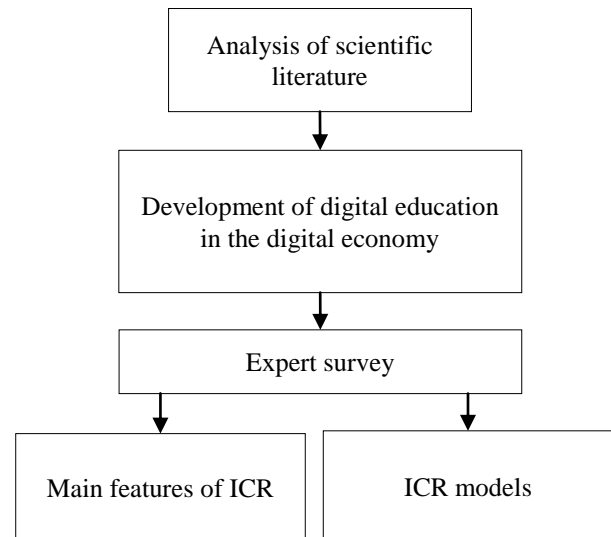
An online expert survey was conducted to determine the main characteristics and technological capabilities of various models of the ICR, in which 26 experts, teachers, IT employees and administrative employees of technical and pedagogical universities took part.

### B. Algorithm

The analysis of scientific literature on the problem of the development of digital education in the digital economy was carried out at the first stage of the study.

The expert survey concerning the use of ICR as a means of improving the quality of educational services was conducted at the second stage of the study.

### C. Flow chart



## IV. RESULT ANALYSIS

The use of the latest digital technologies in the ICR provides several advantages. In particular, the main characteristics of ICR are as follows (Table 1).

**Table 1: Main features of the ICR**

Characteristic	% of mentions	Rank	Expert explanation
Reflection	92,3%	1	Working in the ICR allows students to engage in constant reflection. In the ICR, students always ask themselves: "What should I do?". They are not satisfied with the status quo and insist on the fact that it is necessary to always learn more. It is important to encourage students to ask as many questions as possible.
Continuous training	84,6%	2	Every event in the ICR is seen as a learning moment, with students benefiting from a fast-paced and ever-changing environment.
Creativity	80,8%	3	The ICR not only offers unique solutions to everyday problems but also develops the answers needed to solve future problems. A creative classroom promotes innovation by encouraging students to think creatively.
Principles and procedures	76,9%	4	In the ICR, participants in the educational process must work based on sound principles and procedures. Clear instructions are needed to guide the class. The educator in the ICR should be encouraged to establish clear guidelines on how activities are carried out.
Problem identification	73,1%	5-6	The ICR does not wait for problems to appear; it actively looks for problems in the classroom, school and world. Innovation starts with a question, not an answer. New technologies and understanding can only be developed when students start asking "why?" and "how?".
Collaboration	73,1%	5-6	Collaborative activities in the ICR encourage innovation by engaging students in cooperation with others. Collaboration in the ICR encourages discussion, which is the foundation of all innovation.
Variations	69,2%	7-8	One should not rely on one teaching or learning method. The ICR includes learning strategies that are always different from each other and evolve daily.
Goal-setting	69,2%	7-8	Students set goals and achieve them in the ICR. These goals, being small or large or, ideally, contain aspects of both types, guide students towards innovation.
Possibility of making changes	65,4%	9	Students consider risks and recognize that nothing is perfect in the ICR. As a result, the ICR is sustainable and pushes students and teachers to constantly change, adapt and improve. Students reflect in order to better analyze every aspect of their activity in the ICR.

According to the experts, the use of the ICR allows applying the following in the educational process:

- innovative teaching methods;
- comprehensive training and approach to the implementation of competency-based STEAM education;
- digital tools to support various student activities;
- forms of work in small groups;
- research projects with the main research stages;
- formation of the assessment technology;
- question-based learning;
- virtual and augmented reality software;
- formation of methods and techniques associated with critical thinking;
- various digital means of forming vital digital competencies.

## V. DISCUSSION

According to the experts, the technological requirements for the ICR depend on the implemented ICR model. During the discussion, the experts suggested four ICR models (depending on specialization), each of which has free access to the Internet (Wi-Fi).

According to the first model, the ICR (engineering, robotics) includes four learning zones:

- The creative training zone (ICR1) should contain multimedia equipment, computer gadgets and transformable furniture. This allows designing different types of individual and group learning activities: presentations, workshops, brainstorming sessions, teamwork, preparation of project works for practical implementation in other areas, public

defense of performed works;

- The 3D modeling zone (ICR2) should contain the main and auxiliary equipment for the practical implementation of projects in the field of 3D modeling, additional calculation work, as well as work with ready-made engineering solutions and models using portable computer equipment, server and network solutions;

- The engineering creativity and robotics zone (ICR3) is designed for practical work with robots and other educational equipment used for engineering creativity;

- The independent work zone (ICR IW) is a unifying zone designed for independent work with information content.

A room for the server equipment – server room – is separately allocated.

All areas except for ICR IW, if necessary, can be transformed in accordance with the educational objectives of learning and teaching.

Moreover, the positioning of a coffee machine, additional tables for coffee breaks, etc. is possible in the ICR IW zone if the organization and conduct of significant educational events are necessary (meetings, seminars and conferences).

Presentation of new educational material and its primary assimilation, as well as preparation, discussion and development of models and projects, including their preliminary testing, are conducted in ICR1 with the help of new pedagogical technologies. After the initial approval of projects, students move to ICR2 and ICR3, where they perform practical work and implement their models. Presentation of results, their discussion and evaluation take place in ICR1.



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According to the second model, the ICR (engineering, robotics) includes four learning zones:

- Learning Area (LA) contains multimedia equipment, including an interactive smart board with a projector used for lectures, presentations in various educational areas, as well as publication and distribution of educational materials. In this zone, students acquire theoretical knowledge, after which they are given practical tasks to solve;

- Brainstorm Area (BA) is used to discuss ways to solve a problem, exchange views and feedback, as well as brainstorming.

In this zone, audio and video playback devices (video camera, TV, projector, tablet) are used;

- Working Area (WA) provides for the use of mobile devices and tablets for access to educational resources, the study of electronic educational tools for learning and teaching (including in English), the creation of content in the classroom and beyond. It is equipped with robotic kits to conduct innovative classes in robotics and programming, a drilling machine – to create models and parts for robotics; console devices – for laboratory classes and creative educational projects for experienced students; soldering stations – to create models and parts for robotics; illuminated magnifiers, transistor testers and digital multimeters – for laboratory work in robotics;

- Production Area (PA) is designed to accommodate 3D printers, CNC machines, soldering stations and servers.

According to the third model, the ICR (pedagogical) includes five learning zones:

- STEAM-Lab contains multimedia equipment, transformable furniture, electronic flipchart complete with mobile stand, as well as LEGO education construction kits. This allows using innovative electronic resources to develop constructive skills of students (future teachers), stimulate motivation to study, popularize STEAM education and develop partnership interaction skills, teamwork, as well as various forms of individual and group practical activities. Portable round tables placed in this area allow using interactive methods of working with students in the process of problem-based learning;

- IT-Space is equipped with computers, laptops and an electronic flipchart complete with a mobile stand, as well as an interactive smart board with a projector. This zone can be used for online education, application of innovative electronic methods of teaching and learning in online research environments, development of media literacy, analysis of application possibilities, creation of educational games and simulations, etc.;

- Mobile Learning Space provides for the use of mobile devices and tablets to access educational resources, the study of electronic educational tools for learning and teaching (including in English) and the creation of content in the classroom and beyond. This space also provides for flipped learning and the use of short videos (microlearning). Mobile technologies can be used in the educational process both separately and in conjunction with other ICT. Portable devices can be used in different learning zones, depending on the specifics and tasks of teaching (learning). In this area, a TV and safety trolley with trays for charging and synchronizing tablets should also be placed. This allows demonstrating individual fragments of an educational

problem for its subsequent solution using the mobile learning technique (working individually, in pairs and groups);

- Presentation Space is designed for the organization of various forms of individual and group educational activities: presentations, workshops, project work, brainstorming, teamwork, defense of performed work and its evaluation, etc. It must be equipped with an interactive display and a computer.

In this case, two dedicated spaces – Presentation Space and Mobile Learning Space – if necessary, can be combined into a Conference Space for the organization and conduct of educational events (including online), meetings, seminars, etc. for teachers and students of the university, as well as guests from other institutions, including international. At the same time, Conference Space can be used to present individual modular creative projects and thematic training videos, as well as for student scientific Internet conferences (webinars), etc. The experts also recommend using this area to improve the methodology for using short videos (microlearning) in the educational process (students present fragments of lessons in primary or secondary school using the best European practices).

- Reflection Space is provided for use in the process of individual independent work of participants of the educational process to generate new ideas and reflect on problem situations (here, if necessary, mobile devices can be used), as well as for the development of critical thinking, "reset", etc. According to the experts, this space should be equipped with two soft sofas; if necessary, it can be supplemented with mobile tables or transformable chairs.

According to the fourth model, the ICR (pedagogical) includes four interconnected zones:

- The training zone should contain multimedia equipment, computer gadgets and transformable furniture, which will allow conducting individual and group training sessions. This zone allows organizing online training, mixed training, "inverted" training and online research training, as well as conducting classes in the traditional form.

- The research zone should contain computer gadgets, photo/video cameras, multifunctional devices for printing, as well as methodological and didactic materials developed by students, which allow students to perform individual and group studies. This zone can be used during the organization of different forms of educational activities: creation and presentation of educational projects, thematic training videos for students to generate new ideas, etc. If necessary, this zone can be supplemented with portable tables-transformers.

- The creative zone should contain a 3D printer, computer gadgets, a trolley-safe with trays for charging and synchronization of tablets and a metal trolley for storing didactic materials, which enable students to generate new ideas, developments, etc. The zone is related to the development of critical thinking and creative skills through the use of mobile and other devices. This zone promotes the use of innovative techniques and technologies for the development of constructive and creative skills of students.

- The zone for students' personal space should be equipped with computer gadgets, a trolley-safe with trays for charging and synchronizing tablets and two soft sofas with tables and, if necessary, can be supplemented with mobile transformable furniture. This zone is intended mainly for individual independent work of participants in the educational process.

The experts emphasize that zones should be determined in such a way that, if necessary, the student can move individual learning tools from one zone to another. The experts specify that in the presented models, allocated zones should be multifunctional so that, if necessary, they can be transformed in accordance with the educational objectives of learning and teaching.

## VI. CONCLUSIONS

The results of the study confirm the hypothesis that the use of the ICR makes it possible to improve the quality of educational services, especially in the context of modernization of the content of higher pedagogical education.

The essence of the pedagogical aspects of the ICR is to improve the efficiency of the educational process, which ensures the readiness of the specialist for future professional activity, as well as their competitiveness. The use of the ICR contributes to the implementation of innovative educational forms and methods, such as seminars, masterclasses, webinars, problem-based learning, online learning, e-learning, etc.

The use of modern ICR equipment allows improving the quality of educational services, primarily in the context of modernizing the content of higher pedagogical education. The organization of the ICR, as well as its open nature, contribute to the development of innovative activities at university, forming a team of change agents in the modern Russian higher school, aiming at training graduate and undergraduate students, conducting masterclasses and training for university teachers and improving the quality of teaching disciplines of various specialties.

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