

# Digital economy in education: Perspectives and development perspectives

## Economía digital en educación: Perspectivas y desarrollo

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#### ABSTRACT:

The purpose of is to justify the promising areas of using digital technologies in education and training concepts that are adequate to modern world trends in the development of education. The study proved the need to reform the Russian education system through its transfer to digital technologies to form the competencies of graduates in demand in the modern labor market. The materials of the manuscript can be useful for educational organizations of all levels, forms and directions of training.

**Keywords:** digital economy, labor market, digital educational technologies, innovations training concepts

#### RESUMEN:

El objetivo es justificar las áreas prometedoras del uso de las tecnologías digitales en los conceptos de educación y capacitación que son adecuados a las tendencias mundiales modernas en el desarrollo de la educación. El estudio demostró la necesidad de reformar el sistema educativo ruso mediante su transferencia a las tecnologías digitales para formar las competencias de los graduados en la demanda en el mercado laboral moderno. Los materiales del manuscrito pueden ser útiles para organizaciones educativas de todos los niveles, formas y direcciones de entrenamiento.

**Palabras clave:** economía digital, mercado de trabajo, tecnologías educativas digitales, conceptos de capacitación sobre innovaciones

## 1. Introduction

The world community has entered a new, digital era of its development. It is expected that in the near future digital technologies will play a key role in all spheres of human and social life. But already now digital technologies change the structure of the economy and the labor market.

High-tech industries, innovative start-ups, large corporations, small and medium-sized

enterprises require workers of a new quality, with skills in the digital environment. Formation of such competencies and their use in practice is a necessary condition not only for the competitiveness of an employee, but also for the effective functioning of any national economy in the conditions of global competition.

For successful competition in the modern labor market in the digital economy, any specialist needs a deep knowledge of its capabilities and advantages, practical skills in using the resources of global information networks, protecting information security and their application in professional activities. In order to prepare such specialists, the content of education must meet the needs of the labor market, increase the amount of IT knowledge and skills in the learning process.

The lack of skills in the digital environment has become a global problem. Demand creates supply, and therefore the modern educational system must take into account the needs of the economy in specialists with a high level of competence in the field of digital technologies.

Rapid changes in the economic environment and the labor market actualize the need for educational reforms. In the conditions of the emerging digital economy, teaching methods cannot remain the same. In order for education to become competitive in the 21st century, educational institutions should use the latest technological developments and conduct training using digital technologies.

Like other countries in the world, Russia has begun to build a digital economy, Digital technologies are rapidly spreading in the government, social sphere, in all types of economic activity, especially in high-tech and knowledge-intensive (Mitin, 2017, Egozaryan, 2017; Kupriyanovskiy, 2016; Maymina and Puzynya 2017, Stelmakh, 2017, Klimenko and Maymina, 2017 and others).

The growing demand for personnel with new digital competencies requires the reform of the Russian education system, both in terms of its content and in terms of the educational technologies used.

The hypothesis of the present study was to prove the relevance of the digital reform of Russian education in order to ensure its conformity with the world trends and the needs of the modern labor market through the introduction of digital technologies in the educational process.

The aim of the study is to substantiate the perspective directions of using digital technologies in education and the concepts of teaching that are adequate to the current world trends in the development of education.

The objectives of the study, as per the goal, were as follows:

- To prove the leading role of education in solving the strategic task of building a digital economy;
- To define the basic directions of development of digital technologies in education and to characterize their content;
- To reveal the essence and advantages of innovative education concepts based on digital technologies;
- To summarize the prospects for the development of education under the influence of the digitalization of the economy.

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## **2. Literature review**

The introduction of "figures" in all spheres of human activity has caused a natural increase in the scientific interest of researchers in the development of the problems of digitalization. Over the past 15 years, a large number of works in this subject area of research have appeared in both foreign and domestic literature.

The essence of the digital economy, the features of its construction, its importance for the development of society are revealed (Chakvaroti & Chaturvedi, 2017; Kupriyanovskiy et al., 2016; Maymina and Puzynya, 2017; Ranger, 2018; Stelmakh, 2017). The manuscripts by O.I. Klimenko and E.V. Maymina (2017) focus on the analysis of the economic development

of organizations in the context of the task of increasing technological and scientific intensity, which cannot be solved a priori without the use of digital technologies.

Scientific works that substantiate the prospects for switching to a "figure" in the most important sphere of society life: education which quality is a key factor in economic growth is of particular importance for this study (Frezzo, 2017, Makarina, 2018, Sakharov, 2017, Stelten, 2013 ; Callaway, 2012, et.al.).

In many studies, the opportunities and advantages of introducing digital technologies in the educational process are considered in the aspect of their interrelation with educational technologies, in particular, distance education (S. Bryant, J. Kahle & B. Schafer, 2005; A. Kan & L. Cheung, 2007), hybrid education (M. Jackson & M. Helms, 2008), online-education (C. Dykman & C. Davis, 2008a,b,c; A. Makeeva, 2017), etc.

Certain author's publications (V. Butenko, et.al., 2017; V. Mitin, 2017; S. Stelten, 2013), as well as editorial articles (The digital transformation of the global economy is generating unparalleled demand for innovative, tech-savvy people everywhere, 2015; The percentage of able Russian teachers to use computers is indicated, 2017; The Russians found mass incompetence, 2017) attention is drawn to the increased demands on the quality of training and the need to increase it for the conditions of the digital economy.

It is projected that by 2020 there will be 1.5 million new jobs using digital technologies in the world. Currently, 90% of organizations lack the competence of information technology professionals, while 75% of teachers and students believe that the training process does not provide an opportunity to fully create skills in the digital environment for graduates of educational institutions (D. Frezzo, 2017).

As estimated by S. Stelten (2013), OECD countries feature employment in the ICT field at the level more than 20% of total employment, with variation in the indicator for individual countries: Turkey - 11%, Portugal and Greece - 15%, Great Britain - 28%, Luxembourg - 35%. In the global list of the top ten jobs for which employers are most difficult to recruit, in 2012, IT specialists took the fifth place, and only three years ago they were not included in this list.

Researchers (E. Sakharova, 2017) prove that it is necessary to start the implementation of digital technologies from the earliest stages of education, from the preschool age. In eight to ten years, digital education will prevail: this is the need of the modern economy and the economy of Russia. The emphasis in all educational organizations will be made on digital education.

Obviously, in the near future about 90% of professions will require digital literacy.

As estimated by D. Frezzo (2017) at the World Economic Forum (May 2017), 65% of children entering primary school in the future will find themselves in those professions that currently do not exist.

The relevance of the problem of reforming the Russian education is convincingly confirmed by the results of the Boston Consulting Group study, in which companies from 22 industries with more than 3.5 million employees' participated (Russians demonstrated mass incompetence, 2017). It is stated that more than 80% of employable population of Russia does not have the skills and competencies to work in modern markets, and 35% of the population are engaged in low-skilled work that belongs to the category "skill" (repetitive typical or mechanical tasks, basic physical labor). Most often, the country's citizens work as drivers (7.1%), sellers (6.8%) and security guards (1.9%). And the total share of these professions in the structure of employment continues to grow over the past 15 years. Only 17% of the population is engaged in highly skilled work that belongs to the category of "knowledge" (intellectual work, creative and non-professional tasks). This is 1.5 times lower than in Japan or USA 1.7 times lower than in Germany; twice lower than Singapore and 2.6 times lower than in the UK.

Already only these examples, in our opinion, convince us that in the context of the globalization of economic processes, Russia cannot afford to remain in the past century, nor can it postpone the implementation of digital reforms in the education system.

The implementation of the concept of digital education makes it possible to modernize the entire educational system, make it more flexible and adaptive changes in employers' requests for personnel. Digital education opens up new opportunities and education perspectives, including simplifying the acquisition of knowledge, information and technology in remote access mode. Eventually, the IT skills gained in the training process increase the competitiveness of graduates in the labor market and provide them with the freedom to choose an employer.

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### **3. Materials and methods**

The main research methods in our study were a survey of the international experience of introducing digital technologies in education and assessing the possibilities of its adaptation to Russian practice. The informational basis for this was the resources of the Internet, including official websites of world leaders of education; scientific publications of researchers of educational issues recognized in the international educational environment; scientific works of domestic authors who carried out the development of the problem.

The study implemented methods for identifying the essential differences in content and comparative analysis of digital educational technologies. To this end, we have formed an information array - scientific works and applied developments that reveal the technological aspect of digital education, and studied their contents in detail.

The implementation of the method of establishing key competencies formed through digitalization of education was based on our many years of experience in higher education, as well as on the analysis of information from employers who employ graduates of our educational organization, received in the "feedback".

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### **4. Results**

Based on the results of studying the works by different researchers, the authors' practical experience, trends analysis in the development of education under the influence of the digitalization process of the economy, as the main directions on which digital technologies should develop in education, the authors distinguish the following:

- Re-training of teachers;
- Online-education;
- Hybrid education;
- Network communication technology;
- Social networks management;
- "Makerspace" tools usage.

In order to justify the selected directions, the authors give the following arguments.

#### **4.1. Re-training of teachers**

Education, like any other field of activity, should be interconnected with the development of information technology. From this it follows that all spheres of education must be reformed. These reforms require the planning of educational management, including the implementation of retraining and advanced training of teachers, first of all, so that they can fully use the latest digital technologies to transfer their knowledge and skills to students.

Technically, modern educational infrastructure should include wireless technologies, switches and routers with remote access, as well as collaborative tools with students in an intelligent environment for real projects.

Particular attention should be paid to training teachers in the skills of digital technologies, the use of multimedia technologies as an innovative teaching tool and digital media elements for the presentation of teaching materials. This, in turn, will cause changes in the ways of contact work with students.

Practice shows that often students in the order of free interpersonal communication receive



Thanks to online learning and educational websites, students can quickly learn and master new digital technologies, try to apply them in practice, for example, to create a blog, use Photoshop to create a unique resume or even launch own company through social networks. Many students will come to understand that the practice and improvement of digital skills at an early stage will help them impress employers as soon as they begin to look for real work, demonstrate to employers the competences received in the educational process.

### **4.3. Hybrid education**

Hybrid (combined) education, which includes elements of both online and traditional forms of education, is also a promising direction for the digitization of higher education (Jackson & Kan, 2008).

For the transition to partial teaching of the material via the Internet, teachers should adapt the content of their lectures for a more convenient form of presentation of knowledge. A small online segment can be integrated into a traditional course. For example, a teacher may choose to use certain course management tools to facilitate out-of-class online forums.

On-line teaching, in this case, can be used for lectures and their discussion through online streams. Instead of useless waste of time for lecturing notes, students take a more active part in the discussion and independently learn the necessary teaching material with the help of homework, analysis of specific situations and group discussion in the online mode. These tools can also be used to facilitate the work of a small group, organize interaction through group communication and file sharing when performing group projects.

In hybrid training, special requirements are applied to the analysis of the progress of students and their satisfaction with such technology of instruction, and examinations and tests are taken in the classroom, with the personal contact of the teacher and student.

The advantages of the hybrid form of training are that students are involved in the so-called "active learning of subjects". This contributes to the fact that their knowledge within a particular discipline is more practical. In addition, online conferences and seminars allow more students to participate in the discussion.

In addition, the hybrid form of the organization of the educational process allows many busy people to get a quality education, since the constant presence of students in the classrooms is not required, which also serves as an advantage of the hybrid form of education.

### **4.4. Network communication technology**

The digital economy includes not only digital knowledge, but also the use of digital tools for networking, in particular, communication with professionals and experts. The practice of developing social networks shows that many professionals are open to mentoring and communicating with students, and online communication makes it convenient, both for their own intense schedules, and for the busy schedule of the student.

### **4.5. Social networks management**

Currently, social media is a large-scale digital resource for companies in various fields, used to expand the target audience and promote their own brands. Also, strongly social networks have entered the sphere of everyday communication between students, but teaching them to use social networks to build a career can create competitive advantages over other candidates for employment.

Management of social networks is one of the fastest growing industries. Many companies are looking for graduates who can take over the company's account management function in social networks, monitor product promotion and branding of the company.

A modern social media specialist must master the basics of the digital economy, within which

social media platforms operate. They should be able to analyze social media from the perspective of multi-faceted digital platforms and understand the distinctive features that serve the interests of a variety of stakeholders, including platform owners, users, advertisers and third parties.

Social media professionals should be able to:

- Analyze the technological, social and economic factors that make social media influential on the economy and society;
- Master methods of work in social networks;
- Critically assess the importance of social networks, while using the full range of services for both third parties and companies;
- Analyze the development of the Internet and assess the dominant role of social media in the formation of ways to promote the company and its products;
- Possess the skills of technical design and information architecture in the creation of communication services;
- Evaluate the importance of social interaction and participation in the Internet;
- Think creatively about the emerging digital economy, the availability of social networks and the types of services that they provide.

## **4.6. The “makerspace” concept**

“Makerspace” is a joint work space within an educational organization or library. The use of virtual reality to create a “new inner world” is achieved by loading data or information in 3D space. This leads to the expansion of information, creates new opportunities for learning that cannot be provided in any other way. Virtual reality uses computer simulators to “immerse” students in a particular situation in order to generate the sensory responses needed in that particular environment.

The creation of virtual reality zones has a special value for libraries, as it provides an opportunity to implement new ways of attracting the audience, modernizing information services for students, expanding the range of library services.

Technically, equipping a virtual zone requires the availability of digital equipment, such as robots, 3D printers and 3D applications for modeling parts and components. Using such equipment, it is possible to solve various creative tasks, carry out modeling of parts and components, implement creative and engineering concepts, and execute projects.

An alternative to the old methods of training is also using tablets and net-books, which allows writing notes directly on the screen, using special pens, which gives the learning process easier and more attractive.

Creation of an intellectual product by students can also take place in the classroom during project training or along with parallel learning technology through Hackathons.

A hackathon is a developer forum, during which specialists from different areas of software development (programmers, designers, managers) work together to solve a problem (What is Hackathon, and how it works, 2017).

Students simulate the networks they create in a simulator and a prototype with cloud technology. Instructors have the opportunity to use a customized learning management platform, collaborating with peer educators around the world.

The considered directions of digital technologies development in education can be implemented in practice by changing the conceptual approaches to learning. It is known that currently there are a large number of different learning concepts. In order to illustrate how science informs about digital improvement in learning, the authors will consider three concepts of learning.

1. Distributed cognition (dCoG): the theory introduced by E. Hutchins, who described how people, their environment and artifacts (or instruments) can be considered as one cognitive system (Frezzo, 2017). Teachers can view a person through the prism of distributed

consciousness to design digital skills that facilitate the interaction of people (for example, students, teachers, mentors), their interaction environment (e.g. classes, on-the-job training) and tools (e.g. practical exercises, simulators, games).

For example, Cisco Networking Academy uses this training concept to develop IT skills and career development, develop strategies, create and test digital solutions within a single learning platform. Cisco Networking Academy is a program of professional and career development in the field of IT, accessible to educational institutions and students around the world. Since 1997, more than 6 million people have joined the Network Academy, which have become the driving force behind changes in the digital economy.

During the training, students learn the latest network, cloud and security technologies, develop their knowledge in the laboratory and with the help of modeling tools.

Cisco Networking Academy offers a large number of different training courses. Here are some of them:

The Introduction to Packet Tracer course is intended for beginners who do not have knowledge of network technologies. This self-study course describes the basic operations of the Cisco Packet Tracer, a robust modeling tool that is used to visualize networks. A number of practical exercises are based on real-world situations. Upon completion of this course, students receive valuable advice and best practices for using the Cisco Packet Tracer.

The Networking Essentials course provides practical networking skills and an understanding of the role that networks play in society. The course introduces students to the opportunities for professional development and career development in the field of networks and prepares them for further training. Trainees gain practical knowledge of troubleshooting on the network and network connections, gain the skills to configure standard Internet applications, exchange data between computers and basic IP services, and consolidate the acquired skills in laboratory exercises and in the Cisco Packet Tracer simulator.

The CCNA Routing and Switching curriculum is the path to entry-level positions in the field of network technologies and further careers in IT. It comprises of four courses: Introduction to Networks, Routing and Switching Essentials, Scaling Networks, and Connecting Networks. The first two courses prepare students for the Cisco CCENT certification or the CCNA Security course. Before passing the Cisco CCNA Routing and Switching certification exam, it is recommended to pass all four courses. Students get practical knowledge of routing, switching, network applications, protocols and services, are trained under the guidance of an instructor and gain access to expert materials online at any time. Students work through the acquired knowledge on this equipment, and also with the Cisco Packet Tracer configuration tool.

The CCNP Routing and Switching course, which is based on the CCNA curriculum, offers in-depth study of the routing and switching of converged networks for voice, video and data communications. The CCNP Routing and Switching Curriculum consist of three courses: ROUTE, SWITCH, and TSHOOT. Students learn the theory in detail and expand their knowledge in the field of routing and switching, under the guidance of the instructor they get access to expert materials online at any time.

Within the framework of the course Introduction to Cybersecurity, issues of information security, enterprise protection from cyberattacks are considered. Students learn how to protect their personal data and ensure privacy on the Internet and social networks, learn what cybersecurity is and what it means both in personal and professional terms. Students will be able to protect themselves on the Internet by studying the most common types of threats, attacks and vulnerabilities.

In addition, through hackathons and practical tasks of the laboratory, students of network academies will be able to cooperate, create and solve problems in real time.

2. The concept of the proximal development zone (PDZ) is the basis of Scaffolding technology in teaching science that allows for a discrepancy between the level of actual development (when the student can independently solve a learning problem) and the level of potential development (which the learner can achieve only with the help of a teacher or in cooperation with other students).



The essence of technology is as follows: the teacher with the help of special problem-search assignments helps and directs the learner to discover new knowledge, relying on his experience, and this support can in practice be expressed in various forms, for example, as a flowchart, algorithm, key or leading questions, recommendations, etc.

When using the Scaffolding technology, the student adapts to the zone of the nearest development, i.e. the student's ability to learn new material is sharpened and optimized, and a balance is maintained between his current ability and the level of potential development. Adding digital tools extends the scope and reach of personalized learning assignments.

3. The concept of formative evaluation emphasizes how people learn through activity, through the use of frequent formative assessments-formal and informal practices with continuous and feedback in real time. Navy's Digital Tutor system demonstrates how digital solutions lead to a scalable educational environment that has created IT experts for months rather than years.

In the framework of the pilot project Education Dominance, Navy's Digital Tutor in the United States developed a system of training based on artificial intelligence to reproduce the behavior of exceptional educators. Simulation technology and practical laboratories manage this system in accordance with the results of students' equivalent to or superior to those used by the teacher. The platform is also scaled in such a way that personal tutors are not provided.

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## 5. Discussion

Thus, reforming Russian education on a digital basis in the areas of retraining of educators, online learning, hybrid education, technology of network communication, management of social networks, use of "makerspace" tools allows ensuring the effectiveness of ongoing reforms, improve the quality of training, satisfying the requirements of the digital economy. This aim will be promoted by changing the conceptual approaches to learning, in particular, the concepts of distributed knowledge, proximal development zones, and formative evaluation zones.

The directions of developing digital technologies in education and the innovative concepts of education substantiated in the manuscript do not conflict with the work of other researchers.

In this manuscript, directions and concepts are outlined in the production plan, and therefore the authors plan to continue scientific research in the field of digitalization of the Russian education system.

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## 6. Conclusion

The modern labor market requires the personnel of a new formation with digital knowledge, aptitude and skills to use them in professional activities.

In order to provide the emerging digital economy with highly qualified personnel, the Russian education system shall develop in world trends that open opportunities and prospects for the use of digital technologies in the educational process.

This manuscript justifies the feasibility study for the development of digital technologies in the areas of teacher retraining, online learning, hybrid education, network communication technology, management of social networks, and the use of "makerspace" tools. As a conceptual basis for the digitalization of education, the advantages of distributed cognition concepts, proximal development zones and formative evaluation zones are revealed.

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