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Cross-cutting technologies in education

СКВОЗНЫЕ ТЕХНОЛОГИИ В ОБРАЗОВАНИИ

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Abstract

Purpose of the article: analysis of the experience of implementing end-to-end technologies in vocational education. Methodology: the article presents a study aimed at identifying the role of end-to-end technologies in the professional training of students. For this, a survey was conducted among students on the use of end-to-end technologies in the educational process in three age categories (junior, middle, senior). Students had to assess the importance of end-to-end technologies for the implementation of the educational process on a scale from 1 to 4. Results: Students note the significant role of end-to-end technologies in professional activities. This is a promising direction for the development of vocational education.

Key Words: end-to-end technologies, big data, professional education, digital economy, artificial intelligence, electronic technologies.

Аннотация

Цель статьи: анализ опыта реализации сквозных технологий в профессиональном образовании. Методология: в статье представлено исследование, направленное на выявление роли сквозных технологий в профессиональной подготовке студентов. Для этого среди обучающихся был проведен опрос о применении сквозных технологий в образовательном процессе в трех возрастных категориях (младшая, средняя, старшая). Обучающимся было необходимо оценить значимость сквозных технологий для реализации образовательного процесса по шкале от 1 до 4. Результаты: Студенты отмечают значимую роль сквозных технологий в профессиональной деятельности. Это перспективное направление развития профессионального образования.

Ключевые слова: сквозные технологии, большие данные, профессиональное образование, цифровая экономика, искусственный интеллект, электронные технологии.

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Introduction

The development of the digital economy has led to the emergence of radical changes in vocational education. The introduction of innovative technical means has become a prerequisite for the training of a highly qualified specialist.

The emphasis on technical teaching aids in most educational institutions serves to support the development of students in the field of programming, data analysis and competencies related to the communicative component of education, design and information technology; as the maintenance of student-centered learning, organized in conditions of open access to a large amount of information and the use of digital tools.

Today, there are several areas in which professional education is being improved from a digital point of view: big data, neurotechnology, artificial intelligence, distributed ledger systems (blockchain), quantum technologies, new production technologies, industrial Internet, robotics, sensorics, wireless communication, virtual and augmented reality. Scientists distinguish different directions, we will consider the main ones that are most related to vocational education. All these areas are denoted by the term end-to-end technologies.

End-to-end technologies are not associated with a specific product or field of activity, but are used and implemented by many industries and sectors of the economy, which determines their demand. The technologies under consideration are universal (Vaganova et al., 2019). Their development is carried out within the framework of the national program "Digital Economy of the Russian Federation" and the federal project "Digital Technologies". The goal of the project is to develop Russia's technological independence and ensure the competitiveness of the products being developed in the global market. Therefore, end-to-end technologies are actively being introduced into the educational process to train competitive specialists (Dobudko et al., 2019).

Multidisciplinarity increases their relevance (Tsarapkina et al., 2021). Cross-cutting technologies can be applied in various areas of student training (Aniskin et al., 2020).

High-tech areas of development have become a priority, including in vocational education to support Russian business and the economy as a whole (Shashlo et al., 2018).

Modern training of specialists includes more and more high-tech elements, therefore, constant monitoring of the development of the educational process with the use of end-to-end technologies is required.

Theoretical framework

Neurotechnology makes it possible to understand the work of the brain and higher nervous activity. In the process of professional education, neurotechnologies reveal the possibilities of individualization and personification of education.

Artificial intelligence is a complex of technological solutions that allows you to simulate human cognitive functions. The complex of technological solutions includes:

- information and communication infrastructure;
- software (machine learning methods, data processing and decision-making services) (Yarygin et al., 2019).

Among the main trends in the development of artificial intelligence are:

- the development of robotic services and the exclusion of humans from monotonous work processes through the development of appropriate software;
- maintaining communication between people;
- development of scientific methods of machine learning;
- widespread introduction of artificial intelligence (Shcherbakova & Shcherbakova, 2019).

Among the subtechnologies of artificial intelligence, there are:

- computer vision;
- natural language processing;
- speech recognition and synthesis (Vaganova et al., 2019);
- decision support systems (Nagovitsyn et al., 2020).

In a competitive environment, the one with the most accurate data has the advantage (Nagovitsyn et al., 2020). The use of artificial intelligence in professional education gives students an advantage in mastering educational programs and building professional competence.

Big data is structured and unstructured, diverse data in large volumes processed by databases and Business Intelligence solutions (Klimov et al., 2019). This phenomenon is associated with the emergence of technological opportunities and the

analysis of large data sets (Vaganova et al., 2020). According to experts, a comparative table was developed, which indicates the main differences between traditional databases and large databases (Pichugina et al., 2019).

Table 1.

Comparison of large and traditional databases (compiled by the authors based on the analysis of scientific research)

Characteristic	Big data databases	Traditional databases
Storage method	Centralized	Decentralized
Data structuredness	Structured	Mostly not structured
Data storage and processing model	Vertical model	Horizontal model
Data interconnection	Strong	Weak

Big data includes volume, which means that the amount of data is so large that new technologies are required to store it (Kharytonov et al., 2019); the concept of “speed” - the rate of accumulation is growing and the need to increase the speed of data processing is growing (Demidov et al., 2019); diversity - in big data systems structured, semi-structured and unstructured information can be processed; data reliability is an important task (Bulaeva, et al., 2018), implemented in big data systems; the value of the accumulated information - big data is of great benefit to business and the economy as a whole (Ivanova & Korostelev, 2019).

Augmented reality is a technology that allows you to integrate information presented by objects of the real world, texts, computer graphics, audio and video information. The technology enhances user interaction with the environment (Misakov et al., 2019).

Virtual and augmented reality technologies have received the most serious development in the marketing market, but this was one of the first steps in the development and implementation of these technologies (Kiseleva et al., 2019), (Arbeláez-Campillo, Dudareva & Rojas-Bahamón, 2019). Today, VR technologies are actively used in many areas, including in the field of vocational education, which contributes to the formation of new approaches to the learning process and improving the quality of education (Demidov & Tretyakov, 2016a).

The introduction of VR and AR technologies provides accessible tools for users and complements educational programs with interactive visual content. The spread of technologies in the educational segment will allow:

Virtual reality (VR) technology provides complete immersion in the computer environment through the use of special devices (VR-helmets). Virtual reality forms an artificial world that is transmitted through sensations:

- increase the effectiveness of online learning;
- to ensure the continuity of professional education;
- expand opportunities for improving the quality of education in the regions (Kidina, 2020).

- vision;
- hearing;
- touch;
- others (Pinkovetskaia et al., 2020).

VR and AR sub-technologies are: content and user experience; platform solutions for users; capture technology; feedback interfaces; graphical output; data optimization technologies (Aleshchanova et al., 2018).

The task of technology development is to achieve such a level at which it is impossible to distinguish visualization from the real situation.

Distributed ledger technologies are an approach to creating new databases, the peculiarity of which is the absence of a single control center. Blockchain is an implementation option for a distributed ledger network (Dronova, 2020). In this case, the data is structured in the form of a chain of related blocks of transactions (Smirnova, et al., 2020).

Blockchain in education allows you to create an infrastructure focused on scientific research, thanks to which the data on new publications is automatically recorded (Ponachugin & Lapygin, 2019).

The blockchain is a new technology that is breaking through in many fields, and also in the educational system. But it is not a specific technology which you can expect to improve a concrete situation: It is more a technology that allows registering events from an innovative form. And this can be translated into unsuspected changes. After presenting what Blockchain is and some examples of social uses, in the applications currently in use, there is an analysis of the problems to which the technology aims to answer. A review of the most outstanding experiences, all in an early phase of development, leads us to some critical conclusions about its viability (Bartolomé Pina & Lindin Soriano, 2018).

Blockchains can allow for the accreditation of the path followed by each learner in an individualized learning process. The Edublocs project recovers already consolidated elements of educational design by creating a global learning ecosystem in which a University of Barcelona degree course is framed (Bartolomé Pina, 2020).

Among the subtechnologies of the distributed ledger, there are: technologies for ensuring consensus; application technologies; technologies for organizing and synchronizing data (Efremenko et al., 2020).

New production technologies are a combination of technologies that have high potential, but are not widely used in comparison with traditional technologies. This is a complex complex of multidisciplinary knowledge, a system of intellectual know-how.

Subtechnologies are smart production technologies, manipulation technologies.

The development of robotics and sensorics is based on various sciences (mechanics, electronics, mechatronics, and others). Technology is evolving to replace humans in routine jobs that require high precision and repeatability. The basis of interaction with people is human-machine interfaces.

Robotics in vocational education expands the opportunities for training students who are ready to carry out professional activities in a new reality.

Wireless communication technologies are a subclass of information technologies that allow information to be transmitted between multiple

points over a distance without a wired connection.

The technologies under consideration are being quickly introduced into the educational sphere, changing the training of students at a qualitative level.

Methodology

Students of higher educational institutions took part in the research in the amount of 452 people in three age categories (Minin Nizhny Novgorod State Pedagogical University, Russian State Agrarian University - Moscow Timiryazev Agricultural Academy, Volgograd State Socio-Pedagogical University, Military University of the Ministry of Defense of the Russian Federation).

The survey on the use of end-to-end technologies in the educational process was conducted in the age categories from 18 to 20, from 21 to 23, from 24 to 26 years old. Students had to assess the importance of end-to-end technologies for the implementation of the educational process on a scale from 1 to 4, where 1 is not significant, 2 is rather not significant than significant, 3 is more likely significant than not significant, 4 is significant.

Qualitative and quantitative processing of the survey results was carried out. The work was done in three stages: collecting information, analyzing the data obtained, summing up the results.

To process the data, the SPSS program was used, which makes it possible to identify numerical data with an interval level of measurement on a quantity scale.

The dynamics of growth in the implementation of end-to-end technologies were investigated for a three-year period from 2018 to 2020.

Based on representative information, reliable data, we presented in the work the dynamics of the implementation of end-to-end technologies.

Results and discussion

End-to-end technologies are actively used in Russia. The figure shows the areas where big data, neurotechnology, artificial intelligence, distributed ledger systems (blockchain), quantum technologies, new production technologies, industrial Internet, robotics, sensorics, wireless communications, virtual and augmented reality in professional educational institutions, including.

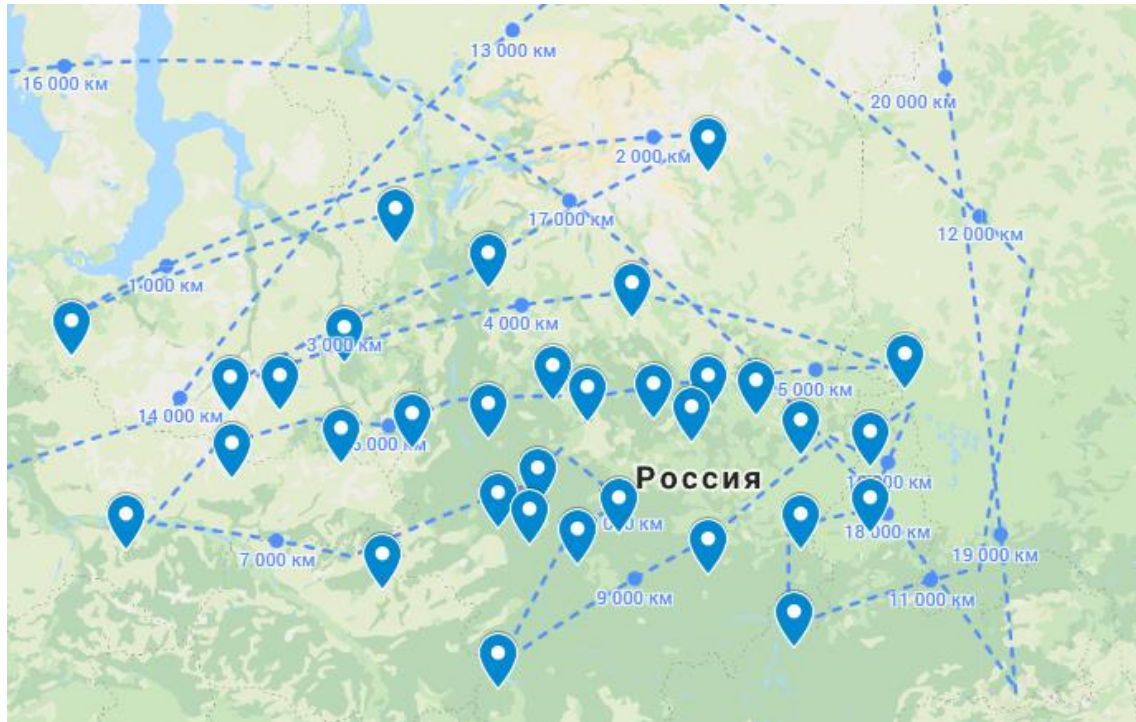


Fig. 1. End-to-end technology implementation map (compiled by the authors based on the analysis of scientific research)

A fragment of the map shows that the spread of end-to-end technologies is growing. Many vocational schools use them in their activities.

The figure shows the results of a survey of students of three groups of students (in the age categories from 18 to 20, from 21 to 23, from 24 to 26) of higher educational institutions on the

use of end-to-end technologies in the educational process. The students had to assess the importance of end-to-end technologies for the implementation of the educational process on a scale from 1 to 4, where 1 is not significant, 2 is rather not significant than significant, 3 is more likely significant than not significant, 4 is significant.

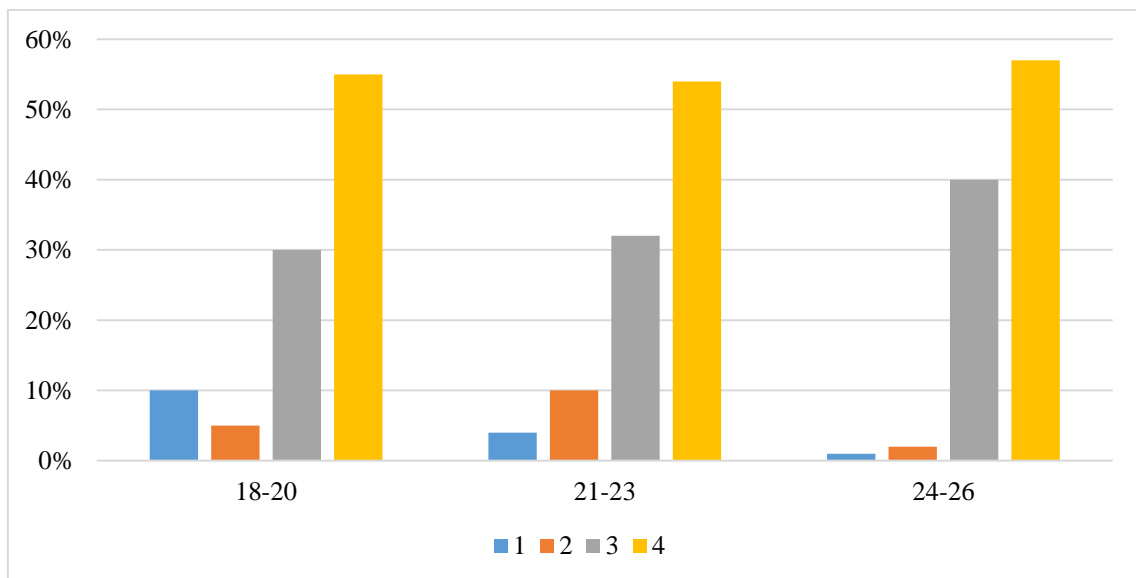


Fig. 2. Results of a survey of students on the implementation of end-to-end technologies in educational activities (Onw authorship)

The majority of respondents believe that the use of various end-to-end technologies has a positive impact on the educational process and training in general. In the third (older) age category, this is most pronounced, since they have sufficient

experience of interacting with such technologies and can more adequately assess their impact.

Figure 3 shows the dynamics of growth in the implementation of end-to-end technologies over a three-year period.

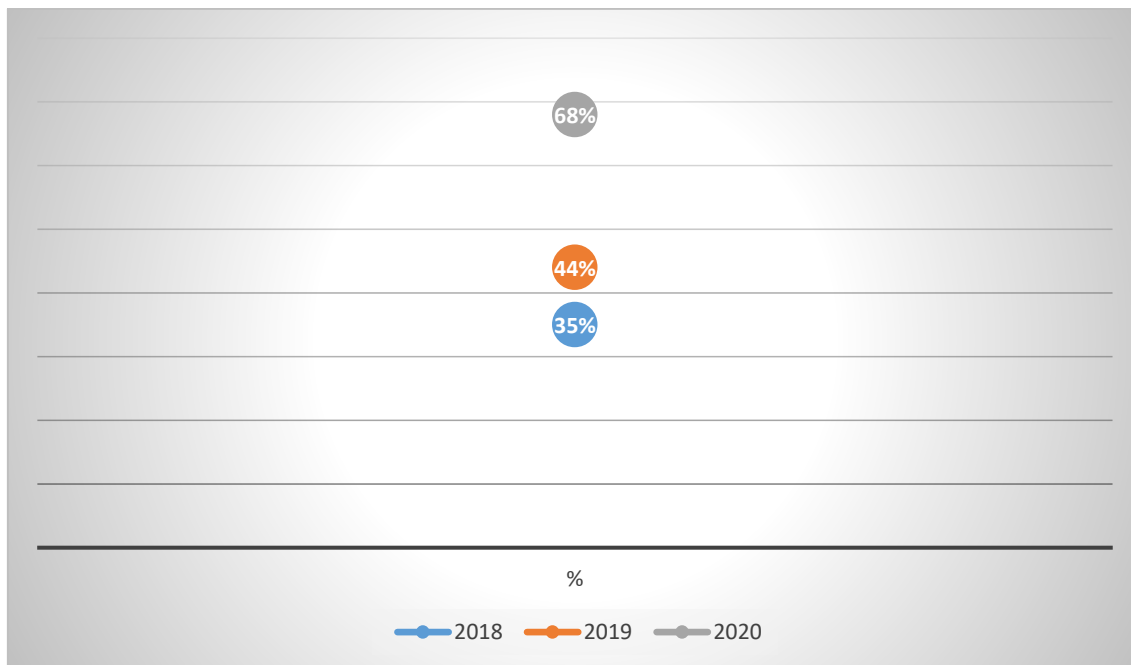


Fig. 3. Dynamics of growth in the implementation of end-to-end technologies over a three-year period (Owm authorship)

By 2020, end-to-end technologies are starting to be used in 68% of the cases studied. Universities are interested in the further implementation of technologies in the educational process.

Conclusions

The prospects for the digital transformation of vocational education are directly related to the implementation of end-to-end technologies that contribute to the training of highly qualified competitive specialists, and, therefore, allow us to move to a new level of technological sustainable development on the way to leadership in global markets.

The potential of digital solutions motivates students to engage in independent research, joint activities, and participation in projects. The introduction of end-to-end technologies contribute to the formation and promotion of the competencies of the future, the formation of critical thinking, creativity, the need for constant self-improvement.

The use of end-to-end technologies contributes to the organization of student-centered learning, making each student significant, thereby allowing him to form his professional competence.

The study made it possible to reveal the high dynamics of growth in the implementation of end-to-end technologies in vocational education. Most students consider the use of end-to-end technologies to be a promising direction in the development of the educational process and emphasize a significant role in the formation of professional competence.

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