Малыженков П.В.

ИСПОЛЬЗОВАНИЕ ТЕХНОЛОГИЙ ИНДУСТРИИ 4.0 В ОБРАЗОВАНИИ

Аннотация: *в статье анализируются возможности применения технологических трендов концепции Индустрии 4.0 в образовании в рамках достижения Целей устойчивого развития. Задача, решаемая в работе, заключается в выявлении специфики и потенциальных возможностей цифровых технологий эпохи Индустрии 4.0 (как по отдельности, так и на основе их интеграции), которые становятся доступными образованию в контексте его цифровой трансформации и трансформируются в новую концепцию «Образование 4.0». Полученные результаты показывают, что не все цифровые технологии одинаково применимы в образовательной сфере.*

Ключевые слова: *Индустрия 4, вспомогательные технологии, цели устойчивого развития, образование, Образование 4.*

Pavel V. Malyzhenkov

THE USAGE OF INDUSTRY 4.0 ENABLING TECHNOLOGIES IN THE EDUCATION

Abstract: *this paper analyzes the possibilities of applying technological trends of the Industry 4.0 concept in education within the framework of achieving Sustainable Development Goals. The task addressed in this work involves identifying the specifics and potential opportunities of digital technologies in the era of Industry 4.0 (both individually and through their integration) that are made available to education in the context of its digital transformation and transform it in the new concept «Education 4.0». The results show that not all digital technologies are equally applicable in the educational sphere.*

Keywords: *Industry 4, enabling technologies, Sustainable Development Goals, education, Education 4.*

1. Introduction.

Education and upbringing of the younger generation, preparing competitive professionals, represent the only correct path toward creating a modern society in the 21st century. Enlightenment is truly a social and socially significant function of the state. Even in such a conservative field as education, progressive processes are taking place: the formation of new thinking, changes in the learning environment. It becomes evident that one of the primary tasks of enlightenment is the preparation of individuals who are carriers of modern knowledge and the corresponding technological base.

Many educational institutions, recognizing the necessity to integrate innovative methods into our daily lives and professional practice, are substantially revising student curricula and creating retraining programs for both teachers and IT specialists. Disciplines related to interactive and mobile education are being included. Education is becoming increasingly individualized.

Researchers and practitioners are increasingly considering sustainability in technological innovations during Industry 4.0 in general. Related to sustainability, numerous contributions in the literature aim to define the link and impact of Industry 4.0 in defining processes, with firms and society increasingly oriented towards sustainable development. The Sustainable Development Goals (SDG) tackle the educational issues in the Sustainable Development Goal 4 «Quality education» and in general the literature at the intersection of Industry 4.0 and sustainability concepts is rapidly evolving and growing to cover different areas (Piccarozzi et al., 2023; Li et al., 2020). The advantages and benefits of innovations in the economy and other spheres of life are undeniable. Indeed, development and economic growth and improved human well-being are some of the important societal goals achieved through technological innovation (Ghaffari et al., 2017). Today, innovations represent an opportunity for the society to gain and maintain a high level of meeting consumer demands related, in part, to the educational process. Scholars started to investigate the link between Industry 4.0 and sustainability from the perspective of its enabling technologies (Asif et al., 2022; Ramirez-Peña, 2020).

We apply a bibliography analysis for this study to answer the questions of the possible application of Industry 4.0 technologies to the educational process. We analyzed modern sources representing the trend of the Industry 4.0. Within this theoretical framework, we conducted searches of the relevant cases.

2. Research results and their discussion.

In (Vikhman, 2022) the following prospects of Industry 4.0 technologies applications to educational process are individuated:

2.1 Big Data: this technology is confidently penetrating education. Various aspects of its application are noted, such as in assessing and predicting the academic performance of students in educational institutions, including the use of Massive Open Online Courses (MOOCs) (Sinh, Muthu, 2015), or the belief that they 'can help determine the quality of teaching staff and students and consequently rank educational institutions'. The application of this technology in creating data repositories processed by educational institutions is aimed to enhance the institutional efficiency of the higher education system in addressing institution-related tasks for studying existing problems and identifying ways to solve them, as well as forecasting possible future outcomes. Furthermore, the active use of Big Data technology is documented for improving the educational process, enhancing the effectiveness of higher education institutions in the era of the Fourth Industrial Revolution. Besides, its usage in the field of learning analytics, which can enable academic institutions to better understand and actively address student needs in postgraduate education programs and as a new toolset for the next generation of researchers in the field of education and for incorporating these topics into researcher training programs is stressed.

2.2 Virtual and Augmented Reality in education: this technology permits to enhance the comprehensive sensory illusion of being present in another environment and so it's very promising in education. The following fundamental aspects of its application in education for learning may be highlighted: the students cyclically go through four different modes of learning like concrete experience, reflective observation, abstract conceptualization, and active experimentation, creating the theoretical foundation for didactic use of virtual reality technologies in schools by stressing the characteristics of these tools that

support a teaching approach that enhances sensorimotor activity in learning. Besides, the experimental teaching of sustainable innovations using a virtual chemical laboratory to influence academic performance may also be used (Su, 2019).

Different educational VR applications, utilize head-mounted displays (HMDs) or desktop displays and explore the potential of this technology, assessing the quality and quantity of information acquired by learners through virtual reality. The technology of VR and AR promises new teaching and learning models that better correspond to the needs of 21st-century learners, tends toward the use of integrated models for implementing the educational process, or design models for virtual reality learning environments (VRLEs). This technology can enable teachers and students to access specialized materials beyond time and space, improve spatial abilities, problem-solving, and student motivation and when incorporated into learning, students demonstrate a high level of satisfaction and a positive attitude toward its use.

2.3 Robotics and sensor technology in education: it has become the foundation for liberating humans from performing hazardous and monotonous activities, as well as for conducting precision measurements, encompassing many areas of development in automated technical systems and methods of controlling them, the development of sensory systems and methods for processing sensory information, interaction between technical systems and humans.

The range of areas where robotics finds its application varies from industrial production to the service sector. One of the most promising directions for the use of robots in the social sphere is the so-called social robots, which are understood as one type of cyber-physical system that is a social equivalent of the Industry 4.0 technology in applications involving humans, for example, in the service industry. Social robots have found extensive application in the educational context, where they are increasingly used to assist children with attention deficits, such as autism, or as mentors or classmates, educational agents focusing on the development of socio-psychological skills, and so forth (Pachidis, 2018, Mishra, 2021).

2.4 Artificial intelligence in education: a significant body of research is dedicated to the application of AI technology in education, such as the development of intelligent

learning systems designed for better lesson delivery and student self-learning (Panigrahi, 2020), analysis of the most common topics in an educational context that have been addressed using artificial intelligence and machine learning methods. AI technology when used in education, creates a personalized learning experience, enables achieving a level of flexibility and customization that was previously impossible and also allows for developing a personal learning plan based on individual interests and career paths.

3. Conclusions.

Information and communication technologies have become a working tool for modern youth. Generating fast and cost-effective ways of accumulating and transmitting knowledge to enhance their accessibility is the main task of IT solutions in the field of education in the coming years.

This includes, among other things:

1. Access to global knowledge resources and practical experience.

2. Development of global information systems for providing educational services.

3. Creation of new software products aimed at covering increasingly wider knowledge domains.

4. Use of cloud computing in distance learning.

5. Integration of social networks and e-learning.

6. Integration of language learning programs with GPS navigation (allowing immediate access to vocabulary related to the specific location where the user is at any given moment).

7. Cutting-edge learning formats, including expanding the capabilities of mobile communication.

The digital transformation of the existing sphere of education, based on the active application of digital technology capabilities, elevates it to a new level – Education 4.0. This not only formally corresponds to the era of Industry 4.0 but also has the potential to produce a new type of workforce oriented towards the digital reality, entering the market space.

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Малыженков Павел Валерьевич – канд. экон. наук, доцент, Нижегородский филиал ФГАОУ ВО «Национальный исследовательский университет «Высшая школа экономики», Россия, Нижний Новгород.

Malyzhenkov Pavel Valerievich – Ph.D. Associate Professor, National Research University Higher School of Economics, Russia, Nizhni Novgorod.