

THE USE OF INNOVATIVE EDUCATIONAL TECHNOLOGIES IN ENGINEERING EDUCATION FOR INDUSTRY 4.0

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INTRODUCTION

With the development of digital technologies, humanity has entered a new period of its civilizational development – a network society that forms a new network culture of a person, network self-awareness, covering the spheres of spirituality, social interaction, and technology. Industry 4.0 (or the 4th industrial revolution, or Industry 4.0) is a consequence of the accelerating development of information technologies with their deep penetration into all spheres of human civilization. One of the characteristic features of this transformation is a change in the basic principles of the very organization of society: the hierarchical structures are being replaced by a global network that allows increasing the level of connectivity of all parts of society (both consumers and producers), ignoring the historically established spatial and temporal boundaries¹. In other words, the spread of information technologies leads to the formation of a new way of life, where society is a complex network structure.

The concept of «network society» appeared in 1991 in connection with the social, political, economic and cultural changes caused by the spread of digital technologies during the development of Industry 4.0. In our opinion, Industry 4.0 is the result of the merger of business, production and society with digital technologies. The uniqueness of Industry 4.0, in addition to its systemic nature, pace of development, and inclusiveness, lies in the growing harmonization and integration of a large number of different scientific disciplines and discoveries. The main feature of Industry 4.0 is digital transformation. The crisis of the COVID-19 pandemic has significantly changed the labor market. The values of the employee and the employer, the principles of labor organization have changed. The reasons for the changes are digitalization, accelerating technological progress, work automation and globalization. Many professions will be replaced by

¹ Industry 4.0 and the fourth industrial revolution explained. URL: <https://www.i-scoop.eu/industry-4-0/>

services, technologies and Internet platforms. All these digital technologies are rapidly developing today. Scientific and technological progress and meeting the needs of the network society of the 21st century is the main reason why some professions appear and others disappear. Inclusion in the digital economy requires not only the availability of physical infrastructure, but also the skills to use it.

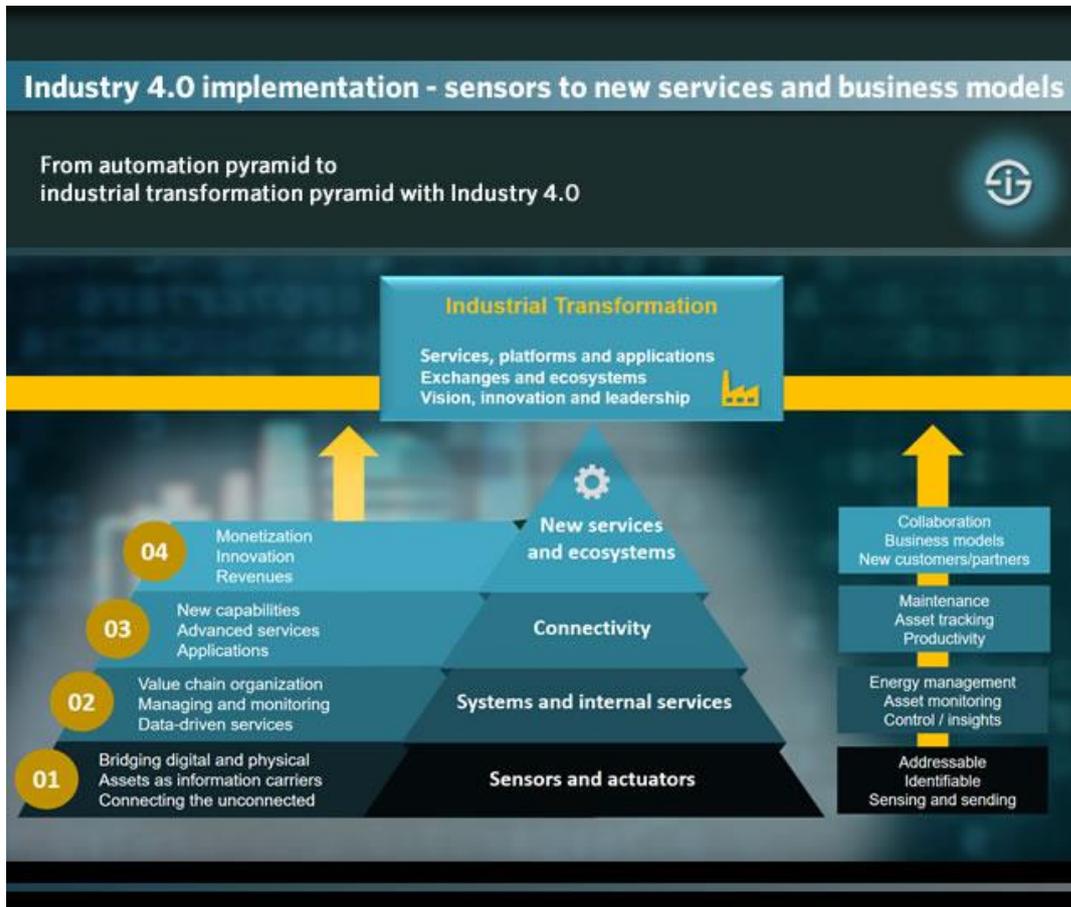


Fig. 1. From automation pyramid to industrial transformation with Industry 4.0

The advanced countries of the world are focused on the development of the «knowledge economy» or, as it is also called, the knowledge-based economy. The term itself was first introduced into use in 1962 by Fritz Machlupov, who understood it as just a sector of the economy. Now this term is used to define the type of economy where knowledge plays a decisive role, and the production of knowledge becomes a source of growth. The knowledge economy is the highest stage in the development of a post-industrial economy and an innovative economy, which is characterized by an information society or a knowledge society; it is also the next stage in

the great development of the economy and society of the advanced countries of the world. Knowledge is a product, on the one hand, a private one that can be appropriated, and on the other hand, a public product that belongs to everyone. Therefore, knowledge is measured by the cost of its production and by the market value of the sold knowledge. Costs include research and development, higher education, software. Enterprises face a difficult development challenge, which is compounded by the problem of aging staff and insufficient quantity and quality of offers in the labor market. Proven and experienced workers are being replaced by young and not yet so qualified graduates of professional and higher educational institutions. In this regard, one of the main elements of the sustainability of enterprises is the strategic work on the selection of employees with the necessary skills, knowledge and skills and the development of the organization's personnel. Moreover, many large corporations and enterprises create their own universities to train and retrain professional personnel².

Modern education is being transformed into a mobile and open system. The introduction of information and communication technologies, electronic educational resources into the educational process contributed to the formation of a new paradigm of education. The essence of the digital transformation of education is expressed in the achievement by each student of the necessary educational results through the personalization of the educational process based on the use of the growing potential of digital technologies, including the use of artificial intelligence methods, virtual reality tools; development of a digital educational environment in educational institutions; providing public broadband access to the Internet, working with big data.

1. Technologies of «Industry 4.0»

Technologies of «Industry 4.0» include features:

1. Digitization and consolidation of all interconnected value chains.
2. Digitization of finished goods and activities for their production.
3. Digital business projects and customer accessibility.

To realize these characteristics, appropriate digital technologies are used: cloud services, mobile devices, the Internet of Things, augmented reality/wearable gadgets, smart sensors, 3D printing, large-scale data analysis and advanced algorithms, real-time object tracking technologies,

² Powell, Walter W.; Snellman, Kaisa (2004). «The Knowledge Economy». *Annual Review of Sociology*. 30 (1): 199–220. doi:10.1146/annurev.soc.29.010202.100037.

modernized use of the graphical shell of the software and the operator, identification of the object and determination of the circumstances of the fraud, cooperation at different levels with the object and its personalization.

«Industry 4.0» is not «new production technologies», it is a different level of organization of production and innovative management of the cost chain and the creation of product value throughout the entire life cycle of production, that is, it is a concept for the development and integration of technologies and approaches to increase production efficiency. For the manufacturing sector, the implementation of the industrial (industrial) Internet of things (Industrial Internet of Things, IIoT), big data technology (Bigdata) and digital twin technology (Digitaltwin) is relevant.

2. Critical moments in the activities of traditional higher education institutions

In modern conditions, the skills and competencies that graduates should have come to the fore. The skills and competencies embedded in educational programs and professional standards today do not meet market requirements. Even now, the development of technologies and the acceleration of changes in business processes are taking place so quickly that we do not know and do not understand the profile of a person (manager) in a few years. And it turns out that professional standards already do not meet the requirements at the time of completion of the educational process. For higher education institutions, the skills and knowledge of graduates become reserves of competitiveness. And the one who correctly assesses these reserves and implements them in his educational process wins the fight. This is another reason for the creation of corporate universities. Here, companies form for their students exactly the skills and knowledge that their employees need.

Moreover, it should be noted that when retraining business managers or improving their qualifications, higher education institutions do not always evaluate the portrait of the consumer of the educational product. And this is a priority task in the development of curricula and courses, especially when it comes to professional training and advanced training of managers and managers of industrial enterprises. Most often, consumers of an educational product are focused on solving current operational problems, limited by existing standards, regulations, frameworks and rules. Among them, there is a low level of cross-functional interaction, industry focus and resistance to changes that modern educational technologies imply. Within the framework of the proposed model of professional competencies and the system of continuing professional education based on it, it is supposed to

expand the strategic vision of students, develop skills in working in an educational «project» office and build effective teamwork.

The second so-called critical point is program performance evaluation (NPS). In traditional higher education institutions, this assessment is practically not carried out. Consequently, universities deprive themselves of the opportunity to improve the educational process based on an objective assessment of the customer of the learning process.

And the third point is the lack of full-fledged interaction between the university and the customer of the educational process, primarily the employer. Most often, this interaction is limited to one-time joint events, excursions to enterprises, and the possibility of internships for students. There is no interaction with the employer at the stage of creating or updating educational educational complexes, which could increase the efficiency of the educational process.

3. Three main groups of professional competencies

There are three main groups of professional competencies that graduates need.

1. Corporate competencies:

- 1.1. Ensuring the implementation of the enterprise strategy;
- 1.2. Search and analysis of information;
- 1.3. Striving for excellence;
- 1.4. Ability to take responsibility;
- 1.5. Helping others to improve themselves;
- 1.6. Building trusting relationships.

2. Managerial competencies:

- 2.1. Understanding the business;
- 2.2. Organization and planning;
- 2.3. Impact and impact;
- 2.4. Team Leadership;
- 2.5. Performance management;
- 2.6. Change management.

3. Professional competencies (functional and technical knowledge and skills).

It should be noted that this set of competencies is necessary for all students, regardless of the direction and profile of education. Today, engineers need knowledge and skills about the mechanisms of presentations and negotiations, along with technical knowledge.

In order to increase the efficiency of the educational process of traditional higher education institutions, it is recommended to introduce

modern educational methodologies based on the principles of Agile, Scrum, Kanban, Lean, XP, etc.

Initially, the Agile methodology was applied in software development. Agile – manifesto describes the principles of «flexible» work methodology, in which the priority of the client's interests, openness to changes, mobile teams «customer – developer – user», consisting of specialists of various profiles and functionalities, come to the fore³.

Agile is 4 main ideas and 12 main principles of work, which are currently used not only in the field of IT, but also in project work, organization of business processes and education. From the point of view of education, this methodology can be applied both in the development of educational products and in the formation of an individual educational trajectory, as well as an effective pedagogical technology. For the first time, the Agile approach in education was applied by educators in the Dutch city of Alphen aan den Rijn. In addition, a special EduScrum fund has been created, which popularizes the mechanisms for applying this methodology in educational institutions. The EduScrum training system assumes the organization of the educational process in such a way that the responsibility for the educational process itself is transferred from the teacher to the students. The main thing in this approach is learning itself: learn «smarter», improve interaction with others, study yourself – these are the basic elements of this model. This approach gives students more responsibility, energizes them, increases interest and involvement in the learning process, develops personality, and also improves teamwork skills. This is precisely what is at the moment the key to the success of educational programs and the loyalty of applicants and students to higher educational institutions.

It should be noted that EduScrum is not a well-defined learning process or technique. This is a frame, a semantic frame within which you can apply various techniques and techniques⁴. It provides transparency in the educational process, clearly shows how effective the chosen curricula and approaches to work are, and helps students to constantly improve themselves and their methods. This concept involves the formation of teams, the assignment of certain roles, activities and artifacts, following certain rules. Each element of the concept serves a specific purpose and is an essential condition for the successful implementation of EduScrum.

³ Collier, Ken W. (2011). Agile Analytics: A Value-Driven Approach to Business Intelligence and Data Warehousing. Pearson Education. pp. 121 ff. ISBN 9780321669544.

⁴ David Parsons, Kathryn MacCallum «Agile and Lean Concepts for Teaching and Learning», 2018

Online courses, thematic educational groups in popular social networks are becoming more widespread. These technologies make it possible to ensure the continuity of the educational process and its availability for all categories of students.

Quite interesting from the point of view of the development of a continuous educational process is the use of gaming components and the so-called gamification of training courses. From our point of view, massively multiplayer online role-playing games (MMORPG) can contribute to the development of the educational process. Participants of such games in the course of performing various tasks and passing quests not only relax and develop communication skills, but can also gain new knowledge. Educational projects in the MMORPG world have been around for years. So, the British Council created an island for English teachers (British Council Isle) in the virtual world of Second Life, where everyone can communicate for free, learn English, attend presentations and complete tasks for which game awards are issued. Such play spaces can be created to develop almost any skill and knowledge⁵.

Back in 2006, Rodney Riegl and Wesley Matejka identified four main features of online educational spaces:

1. Reality. All participants in the game space must understand how they can apply the knowledge gained in this game to the real world.

2. Safety. Mistakes made during the course of the game should not pose a threat to the physical and emotional health of the players.

3. Control. The course of the game should be monitored by a teacher who will not allow violations of the established rules.

4. Efficiency. The game should provide understanding of the material to a greater extent than communication in the real world⁶.

When these elements are fully implemented, even an ordinary, non-educational online game can turn into a learning platform. A specially created educational game offers students situations in which they can simultaneously study several disciplines and develop different sets of competencies. Another important direction in the development of the education system as a whole is the introduction of project work into training

⁵ CMX: The Effects of an Educational MMORPG on Learning and Teaching Computer Programming IEEE Transactions on Learning Technologies. April-June 2017, pp. 219-235, vol. 10. DOI Bookmark: 10.1109/TLT.2016.2556666

⁶ Макаров В.С. Что можно ожидать от MMORPG в образовании? URL: <http://www.iedtech.ru/news1/mmorpg-ineducation/>

courses, namely team work on projects⁷. In modern conditions of the development of society, well-coordinated and effective teamwork is needed to develop business processes and increase the competitiveness of enterprises and sectors of the economy. These skills can and should be developed during the educational process. The following main components should be included in the basis of the project work:

1. Group work on projects under the guidance of a moderator;
2. Intermodular work and reflection;
3. Development of a roadmap for the project;
4. Development of team skills of interaction between players of different levels;
5. Analytical sessions with experts and plenary presentations;
6. Protection of projects in front of management and experts.

The general trend of updating training in engineering universities is an increase in the number of interdisciplinary programs that ensure the development of engineering and managerial competencies. Moreover, the priorities of their development are – compliance with global trends, in particular, the goals of achieving sustainable development, the principles of «lean production».

4. Prospects for the introduction of artificial intelligence technologies in higher education

The term «artificial intelligence» (artificial intelligence, AI) was introduced by the American computer scientist John McCarthy in 1956. Artificial intelligence (AI) is understood as the ability of intelligent systems and algorithms to perform creative functions traditionally performed by humans. The key task of AI is the intellectual modeling of achievable cognitive processes.

During the last decade, completely new classes and types of AI systems have emerged, such as⁸:

- «smart assistants» (agents), such as: Cortana from Microsoft, Siri from Apple, GoogleNow, Echo from Amazon, etc., which are able to

⁷ Казун А.П., Пастухова Л.С. Практики применения проектного метода обучения: опыт разных стран. *Образование и наука*. 2018. № 20(2). С. 32–59. <https://doi.org/10.17853/1994-5639-2018-2-32-59>

⁸ Bataev A.V., Bataeva K.I. Artificial intelligence technologies in higher education institutions: a model of adaptive education. Proceedings of 2019 XVIII Russian Scientific and Practical Conference on Planning and Teaching Engineering Staff for the Industrial and Economic Complex of the Region (PTES). 2019. pp. 28–31. URL: <https://journals.eco-vector.com/PTES/article/view/26294>. DOI: <https://doi.org/10.17816/PTES26294>

combine several «intelligent» functions and capabilities simultaneously: speech recognition, analysis of personal information about a specific user and the ability to interpret it at a certain basic level, help in Internet search and online shopping, and so on.

- AI and robotic systems equipped with special sensors and sensors that enable them to analyze and control and/or respond quickly to changes in various parameters and data of the surrounding physical world, such as temperature, air humidity, pressure, etc., online. e. A more sophisticated subclass of such systems are the various algorithms and technologies used in the development of unmanned/automated vehicles;

- self-learning AI systems that are able to provide answers to various questions that require knowledge of factual information. For example, IBM's Watson, which won the world's best player in the popular TV quiz game Jeopardy! in 2011, and Wolfram|Alpha, created by Wolfram Research, are a one-stop resource with a similar intellectual profile;

- gaming self-learning AI systems that have learned to win the winners of various intellectual games (chess, checkers, reversi, go, and even poker). For example, GoogleAlphaGo in 2016-2017. Won a top dan pro in a game of go.

In the future, employees of various companies will have to be more creative and able to solve non-standard tasks faster.

The use of AI can lead to significant changes in the field of education, creating new opportunities to reshape the work of the entire industry. The introduction of AI technologies in the field of education will increase the efficiency of the educational process, the resources spent on its organization. The artificial intelligence system of the educational process should include the following elements:

- a search information system that provides the formation of a database of the educational process from various sources;

- automatically updated library of electronic textbooks, manuals and guidelines;

- a system for monitoring the level of knowledge of students, which includes a subsystem for continuous monitoring of their progress, activity and results;

- a library of control tasks, automatically adjusted to the level of preparation of each student, depending on his results;

- automated system for scheduling and distribution of teaching load;

- a service system that provides communication between the student and the educational organization.

The use of AI technologies in education can play an important role in human learning and development throughout life. As advanced technologies of Industry 4.0 in the content and means of modern education, we can distinguish:

- Internet of things (remote access training laboratories; remote laboratory stands);
- additive manufacturing (3D printers in educational workshops; 3D modeling (in the disciplines of computer science, mathematics); manufacturing of robot parts, technical devices in additional education for students);
- AI, machine learning and robotics (the use of avatars and chatbots in the educational process for consulting, testing and designing individual educational routes for students; the use of presence robots in distance learning);
- big data, blockchain and cloud computing (creating a secure portfolio of students and teachers; fixing the formation of educational and professional competencies; using cloud technologies in the educational process);
- virtual and augmented reality (use of simulation laboratory stands and laboratory installations with elements of augmented reality in the educational process).

Universities are not only carriers of the academic tradition and system-wide efficiency, but also have an incredible potential for innovation and innovative initiatives. Only by recognizing this truth can one realize the potential for transformation that exists in the higher education system. The use of AI technologies by universities facilitates the process of providing educational services and improves their quality. AI allows you to create an individual educational trajectory for each student for successful study at a university and further professional growth. Let us present some promising areas for the use of AI.

Adaptive and personalized learning implies the selection of the necessary educational content for the needs of each student with different levels of performance, with the ability to track progress in learning and change its trajectory depending on the results.

The automatic assessment system makes it possible to carry out an automated impartial assessment of the level of knowledge of students, analyze information about learning outcomes, make recommendations, and develop effective individual training plans.

Intermediate learning – a specialized computer program allows the student to consolidate the material covered, determines when he can forget it and gives recommendations for repetition.

The possibility of learning in a game form (gamification) is expressed in the use of gaming technologies and training simulators in the educational process.

A proctoring system is also promising, which is capable of analyzing the behavior of a student taking an exam remotely: the frequency of looking away from the monitor, an attempt to change the tab in the browser, the presence of unauthorized persons or voices, etc. It should be noted that the above can, on the one hand, be objective when assessing, but on the other hand, in case of imperfection of the system, it can in some cases lead to inaccuracies. For example, there may be noise in the room that is not related to passing an exam, which the system can fix as a violation; or, for example, there may be difficulties in passing the exam by persons with visual impairments (strabismus), etc.

Smart Campus – the project will allow you to quickly answer various questions from students: class schedule; search for classrooms in which classes are held; feedback from the university, teacher; access to video lectures, audio materials, presentations, etc.; receiving control tasks; registration for various educational programs, courses; availability of necessary literature in the library; the availability of free space in the hostel, the possibility of choosing a place; search for a free parking space, etc.

It should be noted that promising areas for the use of artificial intelligence in the field of higher education are not limited to the above. In our opinion, AI is not at all a competitor to the teaching staff either in teaching or in assessing students' knowledge. AI is an auxiliary but valuable tool that can perform and improve a large number of different operations carried out at the university, help organize an effective educational process and build the necessary communications.

The creation and development of the necessary digital educational environment helps to increase the level of digital competence of all participants in the educational process.

5. The use of immersion in modern education

Immersive learning is a method of learning by which students are immersed in virtual dialogue.

The transformation of education and the development of the necessary strategy for its development today require the identification of significant reasons and trends. To do this, it is necessary to make an attempt to

determine the prospects that will form the basis of the future paradigm of education. According to many scientists, the current stage can be positioned as a transitional, and the active introduction of e-learning, digitalization of the educational process dictate other requirements for approaches and technologies. A number of modern educational technologies (inverted classroom, blended learning, adaptive learning and microlearning) are based on human-computer interaction (HCI). However, most often devices for control and output of information (including visual) are limited to a standard set (keyboard, mouse, monitor, etc.). To learn about the world around us, man was created to use a number of different functions of the body: movement in space, interaction with objects with the help of hands and feet, rotation of the head, and others. But today in the digital age, these mechanisms have found a completely different format, which depends on the controls of computers and other technical devices. Interaction with the user interface has made learning habitual by pressing keys and waiting for the result in the form of visual images on the monitor. This reduces all human-machine interactions to «finger» manipulations, which is not inherent in man by nature⁹.

It's about virtual reality technology. Virtual reality is a new artificial world constructed by technological devices, which is transmitted to man through his senses. It is based on the concept of using a human-machine interface to create the effect of a three-dimensional environment in which the user interacts interactively with virtual objects, rather than with images of these objects. Virtual reality technologies are gaining momentum, and the decline in the cost of such equipment and, consequently, its mass availability determine the key positions in the near future, especially in education. Here, human-machine interaction is familiar to human nature: the movement of arms and legs to interact with the virtual environment, the rotation of the head, the movement of the whole body in space, receiving a completely different feedback. This approach radically changes the way multimodal interaction with the user interface and virtual environments in general.

The study of virtual environments, as well as their use as a tool to influence the learner is the work of foreign authors: Mikropoulos TA, Natsis A., Warburton S., Dede C., Blascovich J., Loomis J., Beall AC, Swinth KR, Hoyt CL, Bailenson JN, Sanchez-Vives MV, Slater M. [5-6]. The use of immersive technologies in education is considered by the authors: Freitas S. d., Neumann T., Hew KF, Cheung WS, Dunleavy M.,

⁹ Sherman, William R.; Craig, Alan B. (2018). Understanding virtual reality : interface, application, and design (2 ed.). Morgan Kaufmann. ISBN 978-0128010389.

Dede C., Mitchell R., Cummings JJ, Bailenson JN, Potkonjak V., Gardner M., Callaghan V., Mattila P., Guetl C., Petrovic VM, Jovanovic K.

Immersion is literally understood as «immersion», «presence effect». It allows a qualitatively different look at the application of modern immersion technologies, in particular virtual reality technologies, expanding and deepening it. Thus, it is possible to observe the development of immersion from the effect of telepresence to complete immersion with interactivity. Immersion is seen as a set of human sensations in an artificially created three-dimensional world, in which he can change the point of view, zoom in and out objects, etc. That is, we are talking about interaction in such environments as opposed to passive observation.

The immersive approach in education is understood as a strategy of cognition, as well as a set of techniques, ways of interactive productive interaction of the subjects of the educational process to develop and self-develop the student's personality in an artificial virtual environment that can comprehensively affect its sensory modalities.

The immersive approach is partly related to other approaches in education (activity, contextual, informational), deepening their significance. From the standpoint of activity approach, which provides a set of ways to form and develop student subjectivity, aimed at self-improvement, we can identify productive interaction between teacher and students, the development of motivation for future professional activities in the future. From the standpoint of the contextual approach as a holistic integrated model of organization and functioning of the educational system common points of view are seen in the student's desire for self-knowledge, self-development and self-realization, as well as ensuring its self-actualization in the living space (context). The information approach is most deeply integrated with the immersive, as in the study of any object, process or phenomenon in nature and society in the first place identify and analyze the most characteristic informational aspects that determine their functioning and development. Thus, the information approach reveals the study of the representation and processing of visual sensory information, which is based on the use of artificial intelligence and computer technology in general.

The immersive approach implies a number of key points on which the principle of clarity in education is implemented. Thus, the principle of immersion does not deny, but rather expands and complements it, taking into account current trends and opportunities. Immersive technologies in education enhance the importance of visual aids in the process of learning through deep immersion in the virtual environment. Their role in enriching

students with complex sensory cognitive experience necessary for comprehensive mastery of abstract concepts is very important.

To increase the effectiveness of training, the principle of immersion requires, above all, the use of immersion tools, based on visual modality. The principle of complexity in the immersive approach involves the impact on all human senses to the perception of educational material. Jan Amos Comenius laid down this principle in his «Golden Rule», which states the following: to taste – taste, accessible to the touch – by touch. If any object can be perceived by several senses at once, let them be grasped by several senses at once. Unfortunately, technically today there are still no examples of mass production of technological solutions that allow to fully implement this rule by means of modern available devices. However, even today there is reason to believe that the immersive approach claims to be one of the key in the coming horizons of transformation of modern education.

Immersive technologies imply the transformation of the role of the teacher, emphasizing the design of a multimodal virtual environment, the creation of immersion scenarios. Its main function is to model different routes and educational scenarios for the student and together with the student, support the processes of goals and content in the learning process, which is impossible without face-to-face communication. Designing the most complete virtual environment is a new feature for the teacher. Now the teacher becomes an observer and an active participant in communication. He uses his experience and authority to orient the student in the area of educational meanings and change the parameters of the learning environment. In this case, the function of the lecturer gives way to the role of a guide, which enhances (facilitates) the psychological effect of group communication with the virtual world.

Speaking of immersive immersions, we should mention the technology of immersion in cyberspace. One of the earliest technologies is the Responsive Workbench system. CyberStage is similar in technology to CAVE 3D, but the image is based on CRT projection of active stereo images. I-CONE design technology is in many ways similar to CyberStage. It should be noted that HMD-devices are gaining popularity, in particular VR-glasses with a screen installed in them make some of the above immersive immersion technologies uncompetitive.

Of course, the full supremacy of the immersive approach in education should not be expected, but the prospect of close cooperation with the new «artificial» world is likely a prospect in the coming years, stimulating the development of flexible information immersive environments.

Over the last few years, «virtuality» in education has been recognized as a powerful and effective tool to support learning. In particular, virtual worlds allow you to perform specific tasks in various «settings» created as scripts for specific learning purposes. Virtual reality technologies, immersive technologies have become a powerful and promising tool in education due to their unique technological characteristics that distinguish them from other IT applications. A number of views indicate a radical change in the ordinary world, the coming revolution, which will affect, including learning. This is a big task to change pedagogical technologies, create promising integrated educational systems, where the key role will be given to the immersive approach – a set of progressive techniques that are implemented in fundamentally new conditions.

6. Storytelling – effective educational technology

Storytelling describes the social and cultural activities of sharing stories, sometimes with improvisation, theatricality or decoration. Each culture has its own stories or stories, which are shared as a means of entertainment, education, preservation of culture or inculcation of moral values¹⁰. Decisive elements of stories and narratives are the plot, characters and narrative point of view.

Storytelling as one of the modern pedagogical techniques that solves such problems of higher education as information overload and poor implementation of educational goals in practical classes, seminars. To date, storytelling is well established in the areas of personnel management, management, is actively used in business, PR, marketing and magazines.

The problem of using storytelling was studied by H. Aiyar, A. Agun, D. Brynt, D. Wilson, R. Gill, E. Erdogan, H. Keskin, P. Mong, P. Smith, A. Simmons, D. Sole, M. Schumayt, S. Guzenkov, K. Gopius, R. Jensen, N. Duarte, J. Campbell, R. Mackie, N. Malik, M. Sykes, M. West, L. Seger, A. Simmons, P. Smith, J. Trumpets, Hutchens O. Kolesnichenko, O. Fadeeva, O. Chesnokova. Articles by O. Karamanov, M. Vasylyshyn, K. Symonenko, E. Erdnieva, N. Gushchyna, O. Hradnyushka, M. Maevska, O. Todorova, works by M. Bakunin, L. Vasylyk, P. Volovik, I. are devoted to him. Gorbachev, N. Zayats, S. Kalinin, D. Kaplunov, S. Krutko, A. Medvedev, A. Putyatin, R. Skrupnik, D. Tamashin, J. Yanenko and others.

Modern storytelling has a wide range of activities. It is also widely used for educational purposes. New forms of media are creating new ways for people to record, express and consume stories. Tools for asynchronous

¹⁰Ruediger Drischel, Anthology Storytelling – Storytelling in the Age of the Internet, New Technologies, Artificial Intelligence. Retrieved January 15, 2019

group communication can provide an environment for processing individual stories into group stories. Games and other digital platforms, such as those used in interactive fiction or interactive storytelling, can be used to position the user as a character in a larger world. Documentaries, including interactive web documentaries, use storytelling techniques to convey information about their topic.

Research in cognitive psychology shows that anything that usually makes information memorable is more likely to make sense. Because stories are more expressive, interesting, and easier to associate with personal experience than rules, laws, or directives, they are better remembered, more meaningful, and more influential in people's behavior. Modern psychology allows us to understand the nature of the influence of simple stories. Psychologists who study human consciousness have put forward a theory that there are two types of thinking: narrative and logical-scientific. Each type of thinking has its own ways of verifying information. Narrative thinking helps people make sense of themselves and their lives. The practice of storytelling is based on understanding the effectiveness of short emotional stories in advertising, media, social media and education, their purposeful use. Thus, storytelling is a method of transmitting information and transmitting values through short narrative texts, a genre of discourse, communicative tactics that have a certain value-colored end result.

Today, pedagogical storytelling is used in the active use of multimedia technologies, and therefore can be used by teachers in both full-time and distance learning.

Digital storytelling is a storytelling format in which storytelling is complemented by a visual series (video, scribing, mind-MEP, infographics). Digital storytelling has a number of advantages and allows you to: make the explanation more convincing and clear; quickly share digital stories with students and colleagues; individualize learning; to model various situations, processes and phenomena without special financial and time costs; increase the involvement of students in the learning process; digital storytelling to preserve the structure and basic elements of traditional storytelling, while giving the opportunity to significantly expand the format of information.

Types of storytelling. A distinction should be made between oral, written and digital storytelling, as each will have its own scope and specificity.

Oral storytelling is inseparable from public speeches, an important part of it is the look, emotions, gestures, personality of the speaker. It is used both in presentations and in interpersonal communication.

Today, written storytelling is the subject of close study, and this technology of influencing and gaining audience attention is in demand by copywriters, bloggers, marketers, and journalists.

Multimedia or digital storytelling is used in site building and digital journalism, in social networks, as well as in the creation of presentations and videos. Digital storytelling can be implemented in various formats: in the form of a video, presentation or digital publication with multimedia content. The urgency of digital storytelling is due to the general trend of development of electronic media – improving the ergonomics of perception of all ways of presenting information, including text. Developers of software for creating multimedia content, interested in improving the quality of products created on their platforms, promote and promote the concept of storytelling. The use of storytelling in education allows you to stand out from the competition and create attractive content for the audience.

In the field of education, the idea of using techniques and technologies that allow you to create content within the social order that brings pleasure from use, always remains relevant. Yes, an experienced lecturer is able to attract the attention of the audience by telling an appropriate story that illustrates what is being taught. The didactic potential of storytelling is used in popular science books and films, the authors of which, to keep the audience's attention, tell stories, create characters, try to maintain the plot tension with new problems and mysteries. Information presented through stories is better perceived.

Arguments or descriptions in a scientific style, similar to the text in the first column, are designed to capture knowledge and involve an accurate and formalized presentation of the material. On the other hand, information presented through plots and characters evokes empathy, awakens the imagination, they are adapted for perception by a wide audience and are well remembered.

The use of storytelling in education can be considered in the context of understanding the concept of «education» (from the English: education – learning and entertainment – entertainment) and analysis of the effectiveness of its application. The concept of «education» in pedagogy is defined as modern pedagogical innovation based on visual material, story, modern psychological techniques, game format, modern information and communication technologies, the most informative and less didactic teaching methods, which aims to facilitate event analysis, support emotional connection with the object of study, involvement and long-term retention of students.

There are two main types of pedagogical storytelling: classic and active.

1. Classic storytelling. The real life situation (or fictional story) is told by the teacher himself. Students only listen and perceive information. The classic story is used to broadcast explicit knowledge. Explicit knowledge is expressed verbally or exists in the form of text. When using classical storytelling, the teacher gives students specific educational information: rules, theories, experimental laws, etc., dressed in a vivid form of memorable history.

2. Active storytelling. The teacher sets the outline of history, determines its goals and objectives. Listeners are actively involved in the process of creating and telling stories. Students can: create stories on their own, following the tasks and recommendations of the teacher; simulate different situations and look for ways out; analyze stories independently or with a teacher. Active storytelling promotes the transfer of not only explicit but also implicit knowledge. Implicit knowledge is a type of knowledge that is not logically formalized and not verbally expressed. It is especially manifested in practice and is a transfer of skills and abilities.

It should be noted that in real pedagogical practice the teacher can combine classical and active storytelling.

The method of storytelling, or storytelling, is especially effective in the age of technology, when facts that students need to remember are lost in the noise of information. A well-constructed story has a great chance to take root among the student audience. After all, storytelling involves the infusion of one's own or someone else's experience, communication and emotional empathy. Bringing ideas, not just information.

7. Edutainment as a modern effective learning technology

From the very beginning of human history, education has served people as a process of acquiring knowledge and skills to improve everyday life. At a time when traditional teaching methods began to take positions, alternative education began to gain popularity and began to develop game teaching methods.

Edutainment is a concept based on a balance of learning and entertainment. Within this concept, the balance is achieved by introducing various forms of game practices in traditional learning formats. This concept helps to make learning interesting, thereby increasing the involvement of participants in the educational process. Synonymous with edutainment is gamification. Gamification is the process of providing the process of educating the elements of the game. This technology has gained its place in the educational environment. Modern students born in the age of digital technology use technology in every aspect of their lives. This is

one of the reasons why adults and professionals need to adapt using smartphones, tablets and the Internet itself.

According to researchers, edutainment, being part of the permitting sphere, is ahead of many of the popular educational technologies in terms of the number of educational prospects. Participation in edutainment-programs promotes the development of search activity, allows you to unleash potential that is not in demand in everyday life, implements a communicative function, can promote socialization, increases loyalty to learning, etc.¹¹

Electronic gamification is a process that integrates game mechanics into the learning process. It is mainly used to motivate people, makes the learning process more exciting and enjoyable. The gamification of the learning process uses techniques that game designers use to engage their players and reward them for their progress in action.

There is a problem of involvement in the educational process not only in young people but also in adults to learn throughout life. Gamification in education uses the natural desire of people to socialize, learn, achieve, compete, etc. This removes difficulties and discomfort in learning. Basically, gamification is the process of receiving awards for learning. But why does it work? The answer to this question is divided into technical and psychological aspects.

Technical aspects:

- Quick feedback. E-learning through edutainment allows the student to immediately get feedback on their progress and on where they are in the overall ranking among other students, making the process faster than with traditional methods.

- Cash rewards. One of the cornerstones of gamification in education is rewards. Being able to get free stuff is always good, whether it's super useful or not, but getting rewarded for taking certain courses or learning new things leads students to be more productive because it can affect their real lives and improve their learning. In addition, when a student knows that he will be rewarded for completing a task, he pays much more attention to the learning material he is given, as opposed to a book if he is not even interested in it.

- Progress is much more enjoyable. This is where the graphics and the whole design of the platform are included. It is known that visual effects and sounds can affect our productivity and mental performance, but let's face it, it is much more interesting to watch or read content that interacts with us.

¹¹ Beato, Greg (2015-03-19). «Turning to Education for Fun». *The New York Times*. ISSN 0362-4331. Archived from the original on 2017-01-05. Retrieved 2017-04-12.

- Cooperation. Gamification in education allows students not only to compete with each other, but also to collaborate with friends and share knowledge between them.

- Indicators of progress let us know where we are and where we are going. People do not like to feel lost, so it is important to have a map that shows how much work you need to do until you reach the finish line.

On the other hand, from a psychological point of view, the reasons for proving that edutainment really works are more than enough.

Psychological aspects:

- First of all, it gives you complete control over your actions. Many psychological studies have shown that forcing something leads to a drop in motivation. When a student is behind the wheel, he feels in control of his destiny.

- Edutainment in education generates good behavior. One of the best examples is Facebook. Wrote a good article? Your post will be appreciated by likes. If you complete the entire course, you will receive a free certificate.

- The meaning of achievement. Everything we do, we do to achieve something. The feeling of achievement is a good psychological factor.

- Edutainment causes a surge of dopamine. It is known that games in which a person receives positive feedback about their work or wins something can activate the brain chain, causing and releasing dopamine, which is known to occupy most of the motivational component in reward-motivated behavior, and can sometimes be addictive. which makes you return to the habit every day, expecting better results than before. There are many reasons to use playful teaching methods in education. If done correctly, it can embrace powerful human emotions and generate a positive learning experience.

What elements are used in the gamification of education?

Subtly placed in different parts of the process, game teaching methods can bring a lot of variety while acquiring new skills. Here are the most commonly used teaching methods:

- Progress scale. As mentioned above, it is important for users to see what progress they have made and how much is left.

- Levels. This is probably the most popular game item. This is a good way to show others and yourself how far you have come.

- Game coins. It is important for the user to feel that he has achieved something. They are mostly used as rewards for the levels you have passed.

- Avatars. It's important to set up your profile the way you want it, so you can feel committed to what you're working on.

– Daily tasks and quests. To increase the priority of returning to the class you are working on, daily bonuses are used to encourage the user to stay consistent.

– Virtual currency and goods. It is important for the platform to have its own currency that can be used to encourage users and enable them to receive virtual goods for it.

Gamification in education helps to better remember information.

The human brain is the most advanced of all living organisms on Earth, but it is still unable to store all the information we receive during our learning process. In many cases, we learn something and forget about it the next day, making the collection of information almost useless. New data in our brain is lost if it is not stored in long-term memory as a result of a multi-layered process of preparation, attention, selection, organization and integration of collected information, which can be easily influenced by Edutainment. It is easier for the brain to hold and remember information if it is processed by several senses. Although the digital revolution over the years has improved our response time and ability to perform multiple tasks at once, it has reduced our focus, so there is a great need for new and effective ways.

Some of the most effective ways to engage the user were discovered by the founder of «Octalysis» Yu-Kai Chow, who developed a gamification design focused on people to increase their motivation. He believes that by applying these basic aspects, it is possible to motivate the user to perform tasks effectively through interactive interaction. The Octalysis platform offers the use of gamification in education, fitness, healthcare and product design to increase user engagement.

Main aspects:

1. Global significance and vocation. This basic engine is known as performing a task that is higher than you consciously chose. This basic driver can be perfectly described by the example of volunteering, when you work without expecting to be paid.

2. Development and implementation. This is our internal driver for progress, overcoming difficulties and skills development.

3. Expanding opportunities for creativity and feedback. Users constantly need ways of self-expression in the creative process, as well as the ability to see the results of their creativity, receiving feedback.

4. Possession and disposal. Creating something from scratch makes you feel in control of what you create. When a person controls something, it forces him to improve what belongs to him. People believe that what they have is much more valuable than it really is.

5. Social influence and connections. This desire consists of social elements that include communication, competitiveness, social recognition

and mentoring. Just as gamification in education brings together people who may have similar hobbies or the same goals.

6. Lack and impatience. This can simply be explained by people's fear of losing something that is time-limited, rare or exceptional. The fact that the user can't get something right now makes him want it even more.

7. Unpredictability and curiosity. This forces a person to be constantly busy, because he does not know what will happen next. This is basically what makes gambling so exciting.

8. Loss and deprivation. The last major driver can be described as the fear of missing something that is commonly used in marketing campaigns for a limited period of time.

The educational process has not stopped developing for many years, and it certainly does not need to be stopped now. It is extremely important to go hand in hand with the new digital era and adapt to our current needs. Edutainment in education fits this.

CONCLUSIONS

Each industrial revolution changed approaches not only to the development of machinery and technology, but also, as a consequence, to issues of work and profession. Industry 4.0 is no exception. The digital transformation has moved humanity into a new period of development, creating a network society that forms a new network culture of man, network self-awareness, covering the spheres of spirituality, social interaction, technology. Based on the analysis of big data, a new methodology of science, education, medicine and other fields of knowledge is being developed. Lifelong learning is becoming a vital necessity both in the 21st century and in the future. Existing professional competencies are rapidly becoming obsolete against the background of the progress of informatization.

Prospects of the digital economy form the need to develop specialists with expanded competencies. This requires the vocational education system to promptly update the content of training. In the near future, the main factor in production development will not be capital as such, but human resources. The shortage of competent staff that meets modern realities will be a major constraint on the development of innovation, competitiveness and growth. In the era of Industry 4.0, the skills and knowledge acquired by students and students of educational programs are of key importance in the learning process.

SUMMARY

«Industry 4.0» makes new demands on the system of human capital training, primarily on education. The main features of the Industry 4.0 technology and critical moments in the activities of traditional higher

education institutions are considered. Three main groups of professional competencies that graduates need are singled out: corporate, managerial, professional. In order to improve the efficiency of the educational process of traditional higher education institutions, it is recommended to introduce modern educational methodologies based on the principles of Agile, Scrum, Kanban, Lean, XP, etc. The possibility of using massively multiplayer online role-playing games (MMORPG), which can contribute to the development of the educational process, is shown. The prospects for the introduction of artificial intelligence technologies in the field of higher education are considered. The possibilities of using such innovative technologies as Immersive learning, Storytelling, Edutainment are analyzed.

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