

THE CONCEPT OF THE FORMATION AND DEVELOPMENT OF A DIGITAL INTELLECTUAL ECOSYSTEM OF BLENDED UNIVERSITY LEARNING

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Abstract

The article proposes the concept of the formation and development of an adaptive ecosystem of university learning. The concept can allow not only to eliminate the shortcomings inherent in the distance education system, but also to create the basis for building a full-fledged educational technology. The basis for constructing such an ecosystem, in addition to purely didactic developments, can be modern achievements in the field of systems theory, digitalization and artificial intelligence. The education market is seriously affected by advances in artificial intelligence and the rapid development of Industry 4.0. It is also necessary to consider rather unpredictable natural disasters and pandemics. Under these conditions, the only way to maintain and strengthen their positions in the education market, which will rapidly change in the coming decades, is the transformation of processes within the framework of new technological trends and integrated network cluster ecosystems. Decentralized training and outsourcing can become two key functions for the successful application of artificial intelligence in education. Modeling, optimization and analytics of big data make it possible to form a complete set of technologies for creating an outsourcing network and digital educational chains, which allows us to identify the state model of all processes in real time. At each moment in time, the digital twin displays the status of outsourcing processes and educational chains with actual data on planning, preparing the necessary equipment, directly preparing educational programs, loading teachers, accounting and monitoring learning outcomes, etc. The digital twin can be used both for making decisions in real-time, and for forecasting and planning outsourcing. In fact, the university and the companies providing outsourcing services within the framework of this approach are integrated into a single mechanism for solving tasks of flexible individual training. Within the framework of the proposed approach, it is possible to build an educational university environment integrated with real objects of the economy of the territory, which is a component of the educational ecosystem. The concept under consideration allows predicting and planning the training of required specialists, since the model of its work is closely connected with enterprises in the real sector. This becomes possible due to the fact that training takes place according to flexible programs that reflect the ever-changing requirements of enterprises to the competencies of their employees. In fact, a university or a group of universities is becoming an essential component of territorial industrial clusters, which makes it possible to increase the efficiency and quality of specialist training and to quickly develop new curricula and courses that will quickly develop competencies demanded by the real sector of the economy. The use of artificial intelligence technology in combination with the capabilities of the Internet of things and digitalization of the main business processes provides, in fact, the functioning and development of the university's ecosystem by analogy with the ecosystems of large sectoral system-forming enterprises.

Keywords: artificial intelligence, ecosystem, educational cluster, blended learning, digitalization.

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1. Introduction

Three months ago, the authors didn't even have distant plans to write an article on this topic. But the situation with the pandemic completely changed the

course of the university educational process throughout the world and made it very relevant to study the possibilities of its practical rapid transformation. It became completely clear that the former education paradigm is living out its last days, that some

completely different future awaits us, but practically no one understands what awaits us. World education is currently at a point of uncertainty. There is a turning point in the eras, one of the signs of which is, for example, the rapid spread of digital communication and training formats. Another sign was the understanding that existing educational programs are hopelessly outdated, that a competent person in the twenty-first century should have a completely different set of skills than previous generations.

Based on the three-month experience of intensive distance teaching of a number of disciplines and the results of quite a long work on the introduction of IIoT (Industrial Internet of Things) technologies at the country's leading manufacturing enterprises, the proposed concept for the formation and development of an adaptive ecosystem of university education has developed. This type of ecosystem, according to the authors, can not only eliminate the disadvantages inherent in the distance education system, but also create the basis for building a full-fledged educational technology. In addition to purely didactic developments, the basis for building such an ecosystem can also be modern achievements in the field of systems theory, digitalization and artificial intelligence. It is also important that an intensive adaptive education accompanies a person living in the present century throughout his entire conscious life.

The Russian economy suffers greatly from the fact that two fundamental scientific and technological revolutions were missed, in microelectronics and in biotechnology. But the situation is different in education. Firstly, and this is really a fact, truly advanced training systems constantly appear in Russia: the Yasnaya Polyana school of L. Tolstoy, the Russian Method of training engineers D. Sovietkin in the late nineteenth century became the basis of the educational approach of the Massachusetts Institute of Technology, in the sixties of the last century A. Kolmogorov created one of the most developed systems for teaching students mathematics, and in the eighties. the followers of G. Altshuller for the first time in the world began to massively teach children systemic and divergent thinking. Therefore, the potential of Russia in forming a picture of the desired and possible future education for individuals, communities, nations and the world as a whole is quite high. It is obvious that the international community has three main tasks:

- to understand the new social and economic realities of this century, to determine the knowledge and competencies that will help everyone to live a prosperous and quality life in the coming decades;
- explore the most productive educational models that can be used by people and communities for lifelong learning;
- understand how educational systems can become a tool for changing the world community in order to achieve long-term sustainable development and protect our civilization, the prosperity of all mankind and the biosphere [1].

At the same time, the professional-technological, information-communication and socio-educational environment of society should ensure continuous personal development, personalization based on big data and artificial intelligence, constant updating of knowledge, skills and competencies, the development of new technologies. New skills must also be formed: emotional intelligence, cognitive flexibility (the ability to operate with diverse and even conflicting ideas), the right to choose, interpersonal skills, including the ability to work with dissimilar people, network competency, etc. [2].

Today, artificial intelligence actively penetrates into all areas of human activity. Intelligent systems can autonomously control moving objects, they successfully manage the infrastructure of large cities (Smart City solutions), reduce traffic jams, and recognize faces in large flows of people. At modern assembly plants, robots deliver all the necessary components. Already a large part of modern weapons is based on artificial intelligence technologies, especially in the accuracy of guidance and delivery of warheads to the target. Autonomous robotic intellectual weapons replace soldiers on the battlefield and pilots in the sky, etc. But at the same time, only a very small part of information messages really reveals the essence of innovative ideas in education and pedagogy using artificial intelligence.

Among other factors, the main difficulty here, apparently, is that it is extremely difficult and quite expensive to model the processes and phenomena of learning, and even more so education for their implementation (perception) in intelligent systems. A huge number of dynamic stochastic factors and causes act simultaneously on the pedagogical object of consideration. These factors are constantly transforming, forming new and destroying old connections, and in this case, the surrounding educational space is changing. In fact, artificial intelligence in the role of a teacher constantly deals in fact with "new material" due to the fact that it is never possible to observe the same conditions as before, and therefore, it is very difficult to accurately repeat the results already achieved using established patterns. This most often causes an unpredictable reaction from students.

Pedagogy, as a science and art, by definition deals not only with development and didactics, its main function also lies in the plane of education. Formalizing and modeling the objects and processes of art, ethics and morality is extremely difficult, because they are based on the laws of harmony and beauty, human emotions, feelings, a sense of responsibility and duty, on the self-affirmation and volitional qualities of the individual. Therefore, it is rather difficult to apply and use intelligent systems with the functions inherent in a harmonious personality in pedagogy. Society as a whole (and the educational system of the state in particular) is constantly in a state of variability, the social goal of education is being clarified all the time, the role and significance of society values are being transformed, and society periodically changes its goals and the tasks arising from them. Therefore, it becomes

more and more difficult to use the revealed social laws and laws in the world of evolving norms in pedagogy. And all the more difficult to train an intelligent system to understand and take into account this variability. But artificial intelligence also successfully copes with this task: using dynamic models and approaches, it can switch from processing knowledge about these hard-to-form objects to the side of modeling the way they act and develop flexible process control [3].

A systematic approach, which is one of the main methodological principles that substantiate research activities in pedagogy, is widely used today at the stages of design, organization and management of the educational process. Under the system, as you know, understand an ordered set of interconnected elements isolated on the basis of certain characteristics, united by a common goal of functioning and unity of management, and acting in interaction with the environment as an integral phenomenon. The increase in efficiency in the activity of a holistic system, obtained as a result of the integration of separate interconnected components, occurs due to the emergence of new properties that were initially not characteristic of its initial components, and this phenomenon is called emergence. It seems logical that a systematic approach to pedagogy should lead to the emergence of emergent learning [4, 5], which can be considered as a system consisting of specific teaching methods, tools and forms, as well as content designed and implemented in accordance with the indicated indicators of competency achievement. The balance in the relationship between traditional teaching and elements using information and communication technology should apparently be based on an analysis of the relevant federal or independently established educational standards by the university, as well as on the basic categories [5] that affect the quality of student training. The main structural components of educational systems — the teacher, students, goals, content, means, methods and forms — determine the whole system of activities of the teacher and student. In this list, learning tools used to be understood mainly as the material and technical support of the educational process, but over the past decades there has been an intensive penetration of computer training tools in the educational process. And instead of stationary personal computers in classes students in the classroom often use their own devices to access the Internet. Various devices are used both for the initial search for information on topics of interest and for self-study, for example, on online courses. Thus, the role of the electronic gadget as a learning tool has significantly increased and transformed. And from the secondary component in the hierarchy of structural components of educational systems, “tools” moved to a fairly separate position, and their functions now consist not only in transmitting information, but also in its accumulation and structuring. As practice shows, electronic learning systems are capable of influencing the formation and transformation of learning goals, content presentation formats, teaching methods and forms. It is logical that significantly transformed digital teaching aids transform the properties of the educational system

as a whole. Thus, at the present stage of development of education, independent implementation, distribution and use of electronic devices in the educational process are observed.

2. Integrated network cluster ecosystems

The world economy has recently been seriously affected by the achievements in the field of artificial intelligence and the rapid development of Industry 4.0, as well as quite unpredictable natural disasters and pandemics. The only opportunity to maintain and strengthen their position in the market, which will change rapidly in the coming decades, is the transformation of processes within the framework of new technological trends and integrated network cluster ecosystems. Technology has always had an impact on the business, for example, increasing productivity by replacing human labor with machines. Continued progress in information technology and related areas should dramatically change both the content of work and the way of life in general. The potential power of combining artificial intelligence technologies and Industry 4.0 leads to global consequences and challenges that must now be quickly enough addressed and overcome in order to maintain and develop the business and personnel training system, making the necessary changes to the project management methodology.

In modern engineering, for example, there is an active introduction of intelligent integrated technologies in the entire production and distribution value chain [6–8]. This interconnection of digital and physical systems combines almost everything: from designing and planning products to the supply chain and production. The reason for this approach is a short life cycle of products, a high level of customer focus in the face of fierce competition.

Digitalization capabilities are becoming important to enable collaborative production networks that can better adapt to future dynamic markets. With the increasing prevalence of Internet technology, production systems are becoming so-called cyberphysical production systems (CPPS). They include a network, autonomous components with local intelligence control, which can autonomously communicate with other devices, machines, production modules and products through open networks and semantic descriptions. Thus, traditional rigid hierarchical production will be replaced by decentralized self-organization, where the use of reengineering will allow the creation of significantly more flexible production systems.

Dynamic adjustments and reconfiguration of the production system, equipment, design software can be performed more quickly. Production components can be easily removed or added during product creation. This will allow to better meet the unpredictable requirements of the market or respond flexibly to failures and failures.

Over the past years and decades, information technology has constantly transformed both jobs and society itself. They have become an essential part of

everyday life and work, changing job descriptions, initiating new business models and processes, and changing their viability over time. Employees, like enterprises, must be able to adapt quickly to remain competitive and in demand. Changing conditions and markets has always been difficult and problematic for business and workers, therefore, to answer the question of how the “fourth industrial revolution” differs from the previous ones, you must first understand what the essence of the widespread dissemination of artificial intelligence is. Artificial intelligence is not some other type of computer that can do something new. Artificial intelligence seeks to imitate and replace human thinking processes and create a “learning” virtual computer that can replace human decision-making. Those. it is an attempt to copy a person’s thought process by a computer. Artificial intelligence, using machine learning, can independently learn and adapt, like a person [9]. The concept was widely recognized thanks to the victory of the artificial intelligence-based program over the world champion in the ancient Go game, although the idea and the threat of replacing people with intelligent machines were discussed in the second half of the last century [10]. However, the “fourth industrial revolution” increases these threats. Thanks to the widespread use of technologies such as 3D-design and printing, Nano-Tech and BioTech, etc., labor productivity increases many times. Along with flexibility and convenience, the cost [9] of production and supply is also decreasing, which leads to an “abundance economy” [11]. In the future, the location of companies will no longer be a problem, and two business partners can participate in any venture company, starting production immediately after signing the contracts and starting deliveries, as soon as the goods and services are ready. In the process of production planning, it is also possible to take into account the potential of outsourcing and supply chain management. The increased use of three-dimensional design and progress in three-dimensional printing, along with new developments in the field of materials science, undoubtedly give an unprecedented degree of flexibility to all undertakings. An example is the first 3D-printed object in space for the ISS [12]. Even today, you can already start production as soon as the product is designed. It is no longer necessary to create new production facilities, since the product can be manufactured on any three-dimensional printer and delivered to the addressee by a specific logistics company. In fact, the need for human participation can be limited by the approval of the concept of designs with artificial intelligence, which solves all other issues — from fully automated production to the delivery of finished products by self-propelled cars and unmanned aerial vehicles. Naturally, all these global changes will have a huge impact on the whole business scheme, which will be largely outsourced to artificial intelligence. The workplace of the future will be significantly different from the modern corporate world.

The transfer to artificial intelligence of template repeated tasks that are performed according to

deterministic algorithms (for example, accounting) can be only the first step. The ability of artificial intelligence systems to learn and to self-learn can ultimately make it possible to fully replace a whole army of white-collar workers. The owners of companies may have come up with (and many have already thought of) the idea that instead of hiring one or several hundred people, you can buy one artificial intelligence system that will never hurt, be absent or complain about working conditions. At the same time, there is no need to solve all the complex and often poorly predicted problems that arise in the team. The costs of simple, maintenance and modernization of the artificial intelligence system will be insignificant compared with the cost of labor and related administrative work. The economic incentive is likely to convince many enterprises to automate work processes. Cost, as you know, was one of the factors of outsourcing and transfer of production to countries with low labor costs. Therefore, there is no reason why these capabilities of intellectual automation will not be used by industries [13]. Given that even bibliographic work at the university was transferred to artificial intelligence [14], it is easy to imagine that many other similar jobs are under serious threat of automation [15].

Deep Learning — a branch of the development of machine learning, based on the model of interaction of neurons in the human brain or artificial intelligence that is not inferior in accuracy to a person when performing tasks, will simply surpass people in the amount of work performed. For project management, this would mean carrying out all types of work, for example, highly qualified risk analysis and planning, optimizing resources and related tasks faster and more comprehensively than any strongest project manager team could even dream of. Given the sad statistics of numerous failures in this area, artificial intelligence can indeed significantly increase productivity and reduce their cost.

Flexible production methodology combined with artificial intelligence and material science will allow for a short time to organize localized and economical production on an ad hoc basis and largely without human intervention, which, in this case, will have the auxiliary role of ensuring the “operation of the machine”. How can we increase the sustainability of human labor and counteract its replacement by machine? In [16], the main arguments that can oppose the replacement of human labor with machine labor are creativity, social intelligence, and operations management. In addition to the new jobs associated with maintaining and creating these smart supply chains and network outsourcing, the aforementioned variables ensure that people keep their jobs, albeit perhaps in a slightly modified form.

3. Transformation of education in the face of rapid change

Whenever the economic environment undergoes rapid and dramatic changes, in every area there are winners and those who are behind. Given the realities of the upcoming challenge, it is necessary to act now to become leaders and

drivers of serious market changes. For the correct use of the capabilities of artificial intelligence, it is necessary to carefully and critically evaluate which model of education we present and where we want to be when the “smart university” begins to become an objective reality. Refusal to solve these problems in this case is not an entirely suitable option: competitors will step up and force other market participants to either follow their example or drop out of the competition.

We can already observe this effect even today, although to a lesser extent. Why should buyers of educational services put up with the fact that you cannot deliver to them what they want, when they want, and how they want. Creating value in this case is the key to success. Only innovative, flexible and customer-oriented competitors will remain on the market. Thus, the transformation of the model of education and ourselves is a task that must be started now, so as not to lag behind forever.

We need a corporate strategy, which, ultimately, will ensure sustainable market success, offering the necessary value for students. The proposals “value and usefulness” will be the main goal and future distinctive advantage, which is necessary for achieving the goal and interactive communication with students.

Value and usefulness are much more than just buzzwords that identify valuable offers to our students, which they consider superior to their competitors. They will become the decisive factor for future success in the education market. Obviously, all products are becoming increasingly interchangeable on the technical side. Literally, it doesn't matter which university, for example, you choose, because all offers are almost identical.

Therefore, the offer of a “personal” educational process will be a distinctive advantage of your university over its competitors, in which it is necessary to invest and, thereby, create the ability to instantly satisfy requests. Modern digital advances allow you to quickly establish basic processes, instantly enable and disable functions with a single button and initiate a training program as soon as the final training model is agreed.

Decentralized training and outsourcing can become two key functions for the successful application of artificial intelligence in education. Today, there are already the necessary tools to expand such a bottleneck as individual learning in a group, by introducing artificial intelligence methods into the learning organization process. However, in order to really get around this bottleneck, it is necessary to have a localized flexible learning space that has decentralized capacities for working next to students. Moreover, the training should be sufficiently “smart” to accept and execute orders automatically using an intelligent system, reducing or completely eliminating the need for human intervention, in addition to making initial decisions [1, 17]. Naturally, in this case, the training chain discussed above will be very vulnerable to external shocks, which makes viability the main task for the management team, whose functions should be significantly different from today's management.

4. The new function of a learning management system in a digital transformation

The transformation of the learning ecosystem is essentially a revolution precisely because there are not superficial, but radical changes: the ecosystem is being rebuilt from top to bottom. Learning models are changing, new universities are appearing, world-famous brands with a long history are being wiped off the face of the earth if they do not have time to join the ranks of digital innovators. Recipients of educational services have changed their behavior; they want an individual approach, unique training programs.

The type of managerial specializations required in the education system and their relative role in the management team have constantly changed since the advent of universities, which initially did not have positions based, for example, on “equality” or “sustainability”, since the need for them only developed over time. As the educational ecosystem develops, it will be necessary to develop, create, modify and replace managerial positions and responsibilities based on emerging needs.

The actual need for management will be reduced to managerial and business functions, depending on individual decisions and preferences. This “thrifty” approach to education management can be resolved only with the help of a combination of artificial intelligence and digitalization, and to a large extent dependent on network outsourcing within the framework of the production and educational cluster [7]. Creating flexibility for a decentralized model of education will eliminate the need to retain unclaimed educational capacities that will actually begin to become a burden, not an asset.

All this will create the need for new managerial functions, as well as change the content and list of responsibilities for all departments of the university. Naturally, these functions will be largely supported by artificial intelligence systems, and human intervention, if at all necessary and desirable, should be carried out only at the very last stage.

The main idea of the development of Industry 4.0 and CPPS is the creation of self-organizing and self-adaptive dynamic network educational outsourcing structures and curricula throughout the entire life cycle of the university to implement the most flexible individual training with the costs of mass stream education. This trend is already clearly visible not only in education, but also in many key sectors of the global economy and political decisions are largely determined by the increasingly fierce struggle for markets for innovative products and services.

The integration of digitalization in education is actively and effectively inhibited by a number of factors. In addition to doubts about the security of digital data and the need for large investments, one can note the insufficient qualifications of students and trainees at all levels, the lack of effective business processes and standards for using the advantages of the digital

approach. It is this approach that can provide new opportunities for new educational programs. Integrated automation, informatization and intellectualization of the main educational technologies will ensure guaranteed growth in turnover, flexibility of training, productivity and overall university efficiency. The main difficulty is that the implementation and use of Industry 4.0 technologies and cyberphysical systems will take place under the influence of various kinds of uncertain factors, for example, indifferent, targeted, related to the uncertainty of subjects' goals, etc.

Analysis of the uncertainty of competitors' actions can be based on multi-agent systems, various game models, and fuzzy logic methods. These approaches implement the principles of conflict management, as well as taking into account the so-called "soft" factors that are difficult to formalize, such as common goals, flexibility, trust, reputation, and so on. The digital revolution in the management of educational program chains and outsourcing can lead to a real increase in the efficiency of universities, a significant improvement in the quality of education

Very often, even leading universities use home-made educational process management information systems, which leads to significant costs and time losses. It is much more advisable to use a multifunctional updated platform supported by a serious operator, while creating a single space for cooperation of all participants in outsourcing and educational chains.

Modeling, optimization and analytics of big data allow forming a complete set of technologies for creating an outsourcing network and digital educational chains, identifying the state model of all processes in real time. At each point in time, a digital twin displays the status of outsourcing processes and educational chains with actual data on planning, preparing the necessary equipment, directly preparing educational programs, loading teachers, accounting and monitoring learning outcomes. A digital twin can be used both for real-time decision making and for forecasting and planning outsourcing. In fact, the university and the companies providing outsourcing services within the framework of this approach are integrated into a single mechanism for solving flexible individual training tasks. If, for example, an emergency occurs in the educational chain, this deviation can be noticed by the risk data monitoring tool and transferred to the simulation model to form alternative options. Simulation in a digital twin can help show the spread of the impact of emergency events in the system and provides effective adaptation of action plans in accordance with the situation almost online.

5. Practical implementation of the proposed concept

The transformation of the sphere of education in accordance with modern challenges is inevitable. Technologies that have already become the driver of large-scale socio-economic changes have huge potential for application in the educational process. Already

today, the use of big data processing technologies, artificial intelligence, personalization in training is no longer the subject of academic discussion and is becoming the content of real-life projects, educational services and platforms. To be able to respond to global challenges, participants in the educational ecosystem must very well understand the main trends in its development.

This is especially important for Russia, which for many decades has been exposed to "raw material dependence" and the accompanying significant centralization of public administration in everything, including education. Today, when natural wealth ceases to be the basis and guarantee of success of individual countries in the context of global competition, it is necessary to focus all attention on the development of the only truly inexhaustible resource for shaping a better future - human potential in all its manifestations [18].

One of the most acceptable options here is blended learning — an educational concept in which a student gains knowledge both independently — online and in person — with a teacher. This approach makes it possible to control the time, place, pace and way of studying the material. Blended education allows you to combine traditional techniques and current technology. The model does not imply a radical rejection of B&M education, since full-time education provides important speech and socio-cultural skills. Thus, blended education is becoming an approach that universities can apply "here and now" in the realities of an ordinary institution, updating the educational process. Here it is necessary to clarify: brick and mortar (B & M) is an english-language idiom, which means something settled and traditional. In the context of education, B&M education means the traditional model of full-time study. The student attends "live" classes in classrooms, but the so-called computer-mediated activities are widely used, that is, the computer, online mode, mobile devices and special training programs / platforms / resources are used as mediators of educational activity [19].

The educational paradigm of blended learning is applicable to different audiences: it can be training for schoolchildren and students, and it can be trainings and corporate training for employees. Blended learning synonyms such as blending learning, hybrid learning, technology-mediated instruction, web-enhanced instruction, and mixed-model instruction are often used. Blended learning stands on three pillars: distance learning, face-to-face learning, and online learning. This concept allows you to maintain the level of training even in the event of emergencies, which, unfortunately, in the past occur almost everywhere. Blended learning teaches to organize and plan work independently, independently obtain and analyze knowledge, search and select information, make decisions, develop skills for presenting projects, and engage in self-education. There are six blended learning models with different emphasis, needs, and costs [19].

1. Face-to-face driver. The teacher personally gives the bulk of the educational plan, interspersing online

training as needed as necessary. This model often includes classroom and laboratory work on computers.

2. Rotation model. There is a rotation of the schedule of traditional full-time education in the classroom and independent online training in personal mode (for example, via the Internet according to the link plan drawn up by the teacher; in the school blended program; on a special site).

3. Flex model. For the most part, an online platform is used, the teacher supports students as needed, occasionally working with small groups or even with one student.

4. Online lab. An online platform is used to transmit the entire course in class to classrooms. Such training takes place under the supervision of a teacher. Such a program can be combined with the classical one as part of the usual class schedule.

5. Self-blend model. The student decides which of the B&M courses he needs to complete with remote online classes.

6. Online driver model. Basically, this model involves learning online - through the platform and remote contact with the teacher. However, optional or on-demand verification in-person classes and meetings with the teacher can be added.

It is also necessary to analyze and carefully prepare the program [19, 20]:

- Distribute course / academic year material for full-time, distance / online parts.
- Understand what can be improved with modern technology and software.
- Set a time frame for each topic and determine the rhythm of work. You need to understand in what sequence and how often distance self-study is replaced by face-to-face exercises with “live” discussions.
- Develop or digitalize a ton of materials: “pack” classes, compose “laboratories”, form test tests, “fill in” materials for distribution, compile a media library, record videos, prepare presentations, etc.
- Choose online resources and support programs that will be involved in the training.
- Create a program for training (software), if the budget allows. If it does not allow, adapt online services for team work and project management to your curriculum.

In its pure form, these models are rarely used. Usually they are combined. For example, Face-to-face with Flex: in addition to attending classes, students study online on their own, and then discuss obscure points with the teacher. The Sloan Consortium estimates that more than 60 % of American students believe that blended learning is more effective than usual. This is easy to believe by looking at the pros of blended learning.

1. The flexibility of the educational process. Any number of teachers and students can be involved in it. Teachers can give master classes even when they are on another continent, and you can access electronic training materials at any time and from anywhere.

2. Openness of training. Passing exams on a computer is difficult to write off or run into bias. Also, communication technologies allow students and teachers to constantly maintain feedback, which means that they better understand each other.

3. Individual approach. Teachers can vary the pace and volume of learning material depending on the personal characteristics of students. And the combination of different models allows each student to develop in the direction that interests him.

4. The development of independence. The student must effectively manage his time, be able to plan and be disciplined. Otherwise, with a mixed system, success cannot be achieved.

5. Increase motivation. Many people love gadgets and services. In the 21st century, people want to not just learn — they want it to be interactive and interesting, and they are happy to participate in webinars, conduct discussions on forums, and master various programs.

6. Conclusion

Within the framework of the proposed approach, it is possible to build an educational university environment integrated with real objects of the territory economy, which is a component of the educational ecosystem. For territories with a high concentration of manufacturing enterprises and universities, this model allows us to consider an integrated ecosystem based on the ecosystems of the respective universities. The concept under consideration allows predicting and planning the training of required specialists, since the model of its work is closely connected with enterprises in the real sector due to the fact that training takes place according to flexible programs that reflect the constantly changing requirements of enterprises to the competencies of their employees. In fact, a university or a group of universities is becoming an essential component of territorial industrial clusters, which makes it possible to increase the efficiency and quality of specialist training and to quickly develop new curricula and courses that will quickly develop competencies demanded by the real sector of the economy. The use of artificial intelligence technology in combination with the capabilities of the Internet of things and digitalization of the main business processes provides, in fact, the functioning and development of the university's ecosystem by analogy with the ecosystems of large sectoral system-forming enterprises.

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КОНЦЕПЦИЯ ФОРМИРОВАНИЯ И РАЗВИТИЯ ЦИФРОВОЙ ИНТЕЛЛЕКТУАЛЬНОЙ ЭКОСИСТЕМЫ СМЕШАННОГО УНИВЕРСИТЕТСКОГО ОБРАЗОВАНИЯ

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Аннотация

В статье предлагается концепция формирования и развития адаптивной экосистемы университетского образования. Концепция может позволить не только элиминировать недостатки, присущие дистанционной системе образования, но и создать основу построения полноценной образовательной технологии. Базой построения такой экосистемы, помимо чисто дидактических наработок, могут стать и современные достижения в области теории систем, цифровизации и искусственного интеллекта. Рынок образования испытывает серьезное влияние достижений в области искусственного интеллекта и быстрого развития «Индустрии 4.0». Также приходится учитывать достаточно непредсказуемые природные катаклизмы и пандемии. В этих условиях единственная возможность сохранения и усиления своих позиций на рынке образования, который будет стремительно меняться в ближайшие десятилетия, — это трансформация процессов в рамках новых технологических трендов и интегрированных сетевых кластерных экосистем. Децентрализованное обучение и аутсорсинг могут стать двумя ключевыми функциями для успешного применения искусственного интеллекта в образовании. Моделирование, оптимизация и аналитика больших данных позволяют формировать полный набор технологий для создания сети аутсорсинга и цифровых образовательных цепочек, что позволяет идентифицировать модель состояния всех процессов в режиме реального времени. В каждый момент времени цифровой двойник отображает состояние процессов аутсорсинга и образовательных цепочек с фактическими данными планирования, подготовки необходимого оборудования, непосредственно подготовки образовательных программ, загрузки преподавателей, учета и кон-

троля результатов обучения и т. п. Цифровой двойник может использоваться как для принятия решений в режиме реального времени, так и для прогнозирования и планирования аутсорсинга. По сути, университет и компании, обеспечивающие аутсорсинговые услуги в рамках данного подхода, интегрируются в единый механизм для решения задач гибкого индивидуального обучения. В рамках предлагаемого подхода возможно построение образовательной университетской среды, интегрированной с реальными объектами экономики территории, которая является компонентом образовательной экосистемы. Рассматриваемая концепция позволяет прогнозировать и планировать подготовку требуемых специалистов, поскольку модель ее работы тесно связана с предприятиями реального сектора экономики. Это становится возможным за счет того, что обучение происходит по гибким программам, отражающим постоянно меняющиеся требования предприятий к компетенциям своих сотрудников. По сути, университет или группа университетов становятся важнейшей составной частью территориальных промышленных кластеров, что позволяет повысить эффективность и качество подготовки специалистов и оперативно разрабатывать новые учебные программы и курсы, позволяющие быстро осваивать востребованные реальным сектором экономики компетенции. Использование технологий искусственного интеллекта в сочетании с возможностями интернета вещей и цифровизации основных бизнес-процессов обеспечивает, по сути, функционирование и развитие экосистемы университета по аналогии с экосистемами крупных отраслевых системообразующих предприятий.

Ключевые слова: искусственный интеллект, экосистема, образовательный кластер, смешанное обучение, цифровизация.

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НОВОСТИ

Студенты педагогических направлений подготовки получили право преподавать в школах

8 июня 2020 года Президент Российской Федерации Владимир Путин подписал федеральный закон, который дает возможность студентам старших курсов, учащимся по специальностям и направлениям подготовки «Образование и педагогические науки», преподавать в школах, если они успешно прошли промежуточную аттестацию не менее чем за три года обучения. Соответствующие поправки внесены в федеральный закон «Об образовании в Российской Федерации».

Кроме того, согласно закону, по окончании двух курсов успешно прошедшие аттестацию студенты смогут вести занятия по дополнительным общеобразовательным программам, соответствующим их специальностям и направлениям подготовки.

«Это отличная возможность, она открывает дорогу студентам к практическим занятиям, помогает им войти

в профессию в наиболее комфортном режиме и в конечном счете позволит привлекать все больше и больше талантливой молодежи в педагогическую среду. Я сам был педагогом и скажу, что, когда вы выходите из стен университета и сразу включаетесь в работу с детским коллективом с полноценным ежедневным расписанием, это требует очень серьезной подготовки, в том числе психологической. И такая возможность влиться в этот процесс постепенно, начиная с нескольких определенных занятий по своему предметному направлению под чутким руководством и наставничеством учителей с богатым педагогическим опытом, — это действительно помогает, — отметил министр просвещения Сергей Кравцов. — Прежде всего, здесь можно использовать потенциал талантливых студентов педагогических университетов».

(По материалам, предоставленным пресс-службой Минпросвещения России)