PERIÓDICO TCHÊ QUÍMICA
ARTIGO ORIGINAL

O SISTEMA EDUCACIONAL NO CONTEXTO DAS TRANSFORMAÇÕES SOCIOECONÔMICAS

THE EDUCATION SYSTEM IN THE CONTEXT OF SOCIO-ECONOMIC TRANSFORMATIONS

СИСТЕМА ОБРАЗОВАНИЯ В УСЛОВИЯХ ОБЩЕСТВЕННО-ЭКОНОМИЧЕСКИХ ТРАНСФОРМАЦИЙ

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RESUMO

O mundo moderno está entrando em um novo estado de desenvolvimento associado ao processo de digitalização. Afeta todos os aspectos da sociedade, muda as fundações tradicionais e impõe novos requisitos para o processo educacional. Os sistemas educacionais nacionais não podem permanecer distantes desse processo. O objetivo deste artigo é estudar o processo de digitalização e seu impacto no sistema educacional do mundo e na Federação Russa. A metodologia do artigo é baseada em uma abordagem sistêmica e estrutural-funcional. A validade dos resultados do estudo é baseada no uso de métodos científicos e especiais populares, incluindo análise, síntese, análise histórica e comparativa. Com base na análise da literatura científica, os autores formaram uma imagem geral do problema em consideração. O trabalho analisa os processos que ocorrem no mundo associados ao início de um novo período histórico. O novo tempo também impõe novos requisitos em vários ramos do conhecimento, atualiza abordagens para o uso de tecnologias da informação modernas e futuras. Um lugar específico é dado à abordagem sinérgica, que é uma alternativa otimista para dominar o conhecimento e as competências da educação digital. No artigo, os autores apontam para o atraso na base teórica do processo de digitalização, o atraso na infraestrutura, deficiências na organização do processo educacional, revelam contradições cognitivas e, ao mesmo tempo, mostram formas possíveis de resolvê-las.

Palavras-chave: *sinergética, revolução digital, economia do conhecimento, modernização do sistema educacional.*

ABSTRACT

The modern world is entering a new state of its development associated with the digitalization process. It affects all aspects of society, changes the traditional foundations and imposes new requirements for the educational process. National educational systems cannot remain aloof from this process. The purpose of this article is to study the digitalization process and its impact on the education system of the world and the Russian Federation. The methodology of the article is based on a systemic and structural-functional approach. The validity of the results of the study is based on the use of popular scientific and special methods, including analysis, synthesis, historical and comparative analysis. On the basis of the analysis of scientific literature, the authors formed an overall picture of the problem under consideration. The work analyzes the processes occurring in the world associated with the beginning of a new historical period. The new time also imposes new requirements on various branches of knowledge, updates approaches to the use of modern and future information technologies. A particular place is given to the synergistic approach, which is an optimistic alternative to mastering the knowledge and competencies of the digital education. In the article the authors point to the lag in the theoretical base of the digitalization process, the lag in infrastructure, shortcomings in the organization of the educational process, reveal cognitive contradictions and, at the same time, show possible ways to solve them.

Keywords: *synergetrics, digital revolution, knowledge economy, modernization of the educational system.*

АННОТАЦИЯ

Современный мир вступает в новое состояние своего развития, связанное с процессом цифровизации. Он затрагивает все стороны жизни общества, меняет традиционные устои и налагает новые требования к образовательному процессу. Не могут остаться в стороне от данного процесса национальные образовательные системы. Целью представленной статьи является исследование процесса цифровизации и его влияние на систему образования мира и Российской Федерации. Методология статьи строится на системном и структурно-функциональном подходе. Достоверность результатов исследования основана на использовании общенаучных и специальных методов, в том числе анализа, синтеза, исторического и сравнительного анализа. На основе анализа научной литературы авторы сформировали общую картину рассматриваемой проблемы. В работе анализируется процессы, происходящие в мире, связанные с началом нового исторического периода. Новое время налагает и новые требования к различным отраслям знаниях, актуализирует подходы к использованию современных и будущих информационных технологий. Особое место здесь отводится синергетическому подходу, который является оптимистической альтернативой для овладение знаниями и компетенциями в рамках цифрового образования. В статье авторы указывают на отставание теоретической базы процесса цифровизации, отставание инфраструктуры, недостатки в организации образовательного процесса, вскрываются когнитивные противоречия и, одновременно, показаны возможные пути их разрешения.

Ключевые слова: *синергетика, цифровая революция, экономика знаний, модернизация системы образования.*

1. INTRODUCTION:

The beginning of the new century is characterized by reaching important positions is in the economic development, based on the innovative knowledge, digital technologies, usage of artificial intelligence, full application of robotic systems with the extended range of adaptation to production. Nevertheless, there are such problems on the way of the scientific and technology progress which have never been faced by the society before - lack of linearity, super-complexity, non-specificity, creation of innovative knowledge bases which meet the requirements of high technologies and large scale of the expanding digital revolution (Alajmi, 2019**)**.

The solutions that can give answers to the whole combination of the interrelated questions are in high demand. At the same time, there are more critical issues related to the appearance of the new digital technologies, knowledge and self-organizing very complex machine systems and large-scale digital infrastructure. It is necessary to create unique and reliable security systems and devices for the defense from cyberattacks (Bulanichev *et al*., 2007; The program "Digital Economy of the Russian Federation," 2017; Sveiby, 1997).

In the modern world, the efficiency of any organization, including higher education institutions, is defined by mobilization of the staff members' intellect, learning new competencies and acquirement of new knowledge (Korableva *et al*., 2019 a, b; Ziyadin *et al*., 2018).

The outstanding foreign and Russian scientists researched the background and conditions of the modern digital revolution development: A. Toynbee, I.R. Prigozhin, (1986), P.F. Drucker, (2003). C. Shannon, R. Ashby, K.E. Swaby, M. Rumisen, G. Haken, and also N.N. Moiseev, V.M. Glushkov, A.A. Samarsky, (1989). S.P. Kurdyumov, (1989), G.G. Malinetskiy, (2002), D.S. Chernovsky, (2004), A.N. Uemova, and others.

The technological features of the new era are “Questions of “unknown complexity” (A. A. Samarsky, 1989); problems of "incredible scale" (S.P. Kurdyumov, 1989); aspects appeared due to the introduction of non-linearity, non-equilibrium, irreversibility, paradox, ambivalence in calculating the effectiveness of the economic processes (I.R. Prigozhin, 1986); problems connected with the transition from cybernetics to synergy, when the chief aim is not the stability in the systems and processes, but their constant change, development, re-engineering (G.G. Malinetsky, 2002).

These technological changes were responded by such organizational answers as research and development; moreover, it was not research of some specific organizations, but studying the trends of development (Johnson and Hinton, 2019). The description of the researched trends in the quantity form becomes so complicated and even impossible that new research methods are needed; it is also necessary

to change traditional ways of solving problems into new ones, which refer to the phase and structural level.

Scientists state that the methods of research which used to be successful are not relevant anymore. The new comprehension of nature is undergoing groundbreaking changes in the direction of diversification, temporality and complexity. The processes linked to contingency and irreversibility, which used to be considered as exceptions, nowadays are beginning to play a significant role (Prigozhin *et al*., 1986, p. 11). The complexity originates from the non-linearity of the issues under research and the diversity of the possible answers to the questions. The basis of scientific research technology, analysis, and prognosis is compound of mathematical model and simulation experiment on computers (Samarsky *et al*., 1989, p. 126).

The change of the scientific paradigm in the information sphere due to the progress of computer facilities is inevitable. The development of society and the economy led to the appearance of such a new non-material asset as knowledge. Information technologies speed up the process of integrating knowledge into economic turnover (Rumezen, 2004, p. 18). In the USA, experts in the management, sphere raised a question about managing non-material assets as the central management task in the XXI century. Knowledge is not only a business resource; it is a universal social resource (Drucker, 2003, p. 14).

Thus, society faces a unique resource that changes the material world, yet, it the kind of support that requires specific organization, technology, and management. Information technologies are the product of knowledge evolution on the one hand and an instrument for knowledge management on the other side (Knowledge Management, 2000).

The information revolution brings forth new requirements. In the first place, it is a necessary staff assistance. Besides the users of the end information products, there is a need for specialists that can create computer programs. Computer systems analysts and programmers who will be able to transfer users' tasks into the computer language are required (Pospelov, 1988, p. 14-15).

It is beneficial to study the experience of the countries which are most advanced in the sphere of informatics, robotic systems and system researches, such as Japan, the USA, Singapore, Finland etc (Lysytsia *et al*., 2019). The Japanese, for example, think that computing techniques should not be more challenging to use than using a washing machine. The Japanese example shows that people got used to cooperation with a device, considering its compactness, speed of operation, low price, reliability, large memory capacity, optimized architecture and adjusted to the work, not with the numerical but with the symbol information (Pospelov, 1988, p. 22).

Thus, the purpose of the presented article was to analyze the problems, tasks, prospects for the development of the digital revolution and its impact on the economy and education system of the Russian Federation.

2. MATERIALS AND METHODS:

Digital device which allows us to analyze, calculate, experiment, and plan is called a computer of 5-6th generation. This provides the basis for creating the artificial intellect. In the Institute of Applied Automatic Control Engineering named after M.V. Keldysh, applying the methods of computer-oriented experimentation, there were held works on using plasma processing, peaking regimes, non-linear phenomena etc.

This puts the question of acquiring new modes of scientific research and educational process (Gafurov *et al*., 2020; Safiullin *et al*., 2019; Suwarni *et al*., 2020). Notably, the synergy approach to the educational process is more spread nowadays (Bulanichev *et al*., 2007; Knyazeva *et al*., 2005; Kuzetsov *et al*., 1998; Malinetsky *et al*., 2002; Prigozhin *et al*., 1986). In this regard, the systematic and structural-functional approaches have become the methodological basis of scientific research. The reliability of the presented research results is ensured by the use of general scientific and special methods, including analysis, synthesis, modeling, content analysis, statistical, historical and others.

The historiographic analysis of works on the impact of digitalization on the modern world is widely used in the work. This method is based on the identification of historical knowledge, its paradigmatic foundations and connections with the historiographic culture of its time. The need for its use is justified by the fact that, based on the observance of the time sequence, the continuity of the change of periods and stages, each fact was analyzed in the process of occurrence, formation and development.

The article also widely used structural-functional analysis. Based on it, conclusions were drawn about cardinal changes in the technological

and information space of our time.

To identify the problems of the impact of the digitalization process on the education system, we used content analysis. This method made it possible to determine the composition and structure of digitalization problems in the world, determine their quantitative significance, and outline priority areas for improving the education system under the influence of emerging trends.

A significant place was given to the synergistic approach to the educational process. The general background of the research was based on a special methodology, the core of which is the guarantor of the continuity of scientific values, on the one hand, and openness to innovation, on the other. Such an open adaptive formation methodology is the methodology of synergetics. It is designed to realize, root the principles of synergetics in the public mind, and adapt them for lay people no longer at the level of metaphors, but constructive principles that help to understand and model reality.

A synergetic approach (synergetic paradigm) was used in relation to the educational process, the mastery and use of knowledge in which takes into account openness, self-organization (search and use in the educational process of those methods that allow you to obtain maximum results in solving specific problems); recognizes non-linearity as a natural stage in the cognitive process, bifurcation of the environment, non-uniformity of decisions, disproportionate responses to small influences.

The system of obtaining knowledge was considered not as the transfer of knowledge from one head to another, but as the production of new knowledge, as a transition to a new quality of understanding of new meanings, mastery of a new categorical apparatus based on logical-structural search and research. The recognition of learning as a cascade of phase and structural ascensions to truth, the recognition of the historical development process as an irreversible convergence of chaos and disordered forms into ordered systems. Synergetics in the educational process has opened up new opportunities for the recognition of an interdisciplinary synthesis of knowledge that dominates processes in a space of interrelated scientific areas. The synergetic approach has opened up the possibility of mastering such "wrong" phenomena as emergence, resonance, ambivalence, chirality, etc. as a normal method of cognition, which expanded the potential of cognition of objects and processes. The synergetic approach proposed by the authors drew attention to the role of such weak signals in cognition as coordination, synchronization, catalysis (autocatalysis), vibrations (self-oscillations), and modification, which have not yet entered the vocabulary of cognitive and educational programs. Meanwhile, these “weak” signals form strong structures.

It is the synergistic approach that is the most optimistic alternative for acquiring new knowledge and competencies in the digital revolution.

3. RESULTS AND DISCUSSION:

A wide range of knowledge and competencies required to manage the digital revolution requires professional training of students, specialists, and employees of organizations dealing with digital technologies (Figure 1).

It is impossible to compose a classifier and codification of knowledge in one particular article. Moreover, there is a danger of limitation and even loss of information (including digital) resources in Russia. Hacker attacks on the Russian information systems cause a great amount of danger. The security issue is of immediate interest now. For the educational tasks of students training, it is necessary to create bases of knowledge in a specific regime (automated or manual) or to buy them. University education programs should include the necessary training courses. The Ministry of Science and Higher Education should support this process. The selection of information knowledge bases for each particular task should be specific, with the possibility of maximum expansion, with a certain expenditure of funds. Most advanced corporations created programs of knowledge management – Intel, Siemens, IBM, Johnson & Johnson, World Bank Group, British Petroleum, British Telecom, etc. Since the 1980s, in the USSR there existed Reference Information Systems (ZAPSIB, DILOS, POET, GRANIT, MAVR) in which application software packages were developed.

So, the knowledge economy started its existence about forty years ago, but with the transition to digital technologies, the development acquired an intensified character. Digital programming, information distribution, project development got a breakthrough role in the advanced countries and the USSR and the Russian Federation, especially when there was a transition to the computers of 5th and 6th generations.

This transition to the intellectual, self-organizing, self-programming computers raises a question of new types of problems. First of all, there are robotic complexes, remotely piloted vehicles, taking digital issues to space. There has been brought up the question of preparing 2-3 million specialists of the new type. Taking into consideration the difficult demographic situation in Russia, preparing skilled workers for the digital revolution is becoming an issue of vital importance. The solution to this problem should be found by educational institutions, scientific-research institutes, design, and technology institutes.

There is a demand not only for specialists in digital programming but professionals in expert automated systems, control of complex production systems, nanotechnology with automated research and management.

The need for artificial intelligence arose in the 1980s about the attempts to simulate psychophysical, creative, chess-game, research operations, composing literary texts, music, etc. on computers. Modeling of psychophysical processes, in addition to the general theory of systems, system analysis, system synthesis, system dynamics, includes theories of biology, physiology, social economics, the theory of large (TLS), and complex systems (TCS). Models which can simulate way of thinking of specific people or groups of people are in high demand (Polyakova *et al*., 2019; Neizvestnaya *et al*., 2018; Abramovich *et al*., 2019; Shrestha, 2019; Magsumov, 2019; Tarman, 2016; Yemelyanov *et al*., 2019; Kolawole *et al*., 2019). Bionic, neurological, neurophysical, neuropsychological attempts to simulate the work of the brain require special devices that started to be used in computers of the 5th and 6th generations.

Artificial intelligence theory is at the stage of being developed. The emergence of automated control systems (ACS), computer-aided design (CAD) systems, network clustering, scaling in 3D, 4D, 5D space require new competencies, knowledge, and strategies. The new paradigm of the cascade of scientific and technological revolutions of the XXI century in the sphere of computer science includes the several trends (Drucker, 2003; Knyazeva *et al*., 2005; Kuznetsov *et al*., 1998; Malinetsky *et al*., 2002; Sturm and Quaynor, (2020):

The information program itself finds the data necessary for its work, converts them into text or voice signals, or transfers it to the relevant executive bodies; the task of searching for the programs that bring knowledge to the necessary condition is being solved; computer is getting the ability to set aims itself; computer beside the symbolic system of storing and processing data starts to have the “sensor-based” system of data handling, choice of crucial factors of solving problems, ability to recognize images, mental pictures, “see the future”;

The person who studies the modern paradigm of information technology should master a systematic approach, including system analysis, system synthesis, system dynamics and, above all, non-linear dynamics (synergetic), as well as cybernetic methods of information security; a logical and mathematical methods of analysis and modeling synthesis; modern languages and procedures of programming; contact and non-contact methods of interaction with a computer; construction of positive (synergetic) and negative (cybernetic) connections in knowledge management systems; master the techniques of overcoming uncertainty, ambiguity, fractal dimension, non-linearity, disequilibrium in the tasks of systematization, structuring, as well as emergence, non-uniqueness of solutions at bifurcation points, building hierarchy of databases, knowledge bases, modeling of objects and processes with a large number of degrees of freedom, ambivalence, chirality; and creating innovative content to expand the digital economy space.

Optic fiber and holographic entered the sphere of digital technologies to store, processing data, and provide its security. That’s why these trends should be included in the contents of the educational program for specialist training. The rules of safety suggest storing information in the system that has some branches around the whole net as vibrations of different frequencies (Rumezen, 2004, p. 3).

The interconnection of informatics, optic fiber, and holographic provides new promising opportunities for the digital economy, intelligence systems, and unattended machining. Artificial intelligent robots are getting the ability to change their behavior within a wide range in terms of autonomous management centers. In the future, the conflicts between intelligent systems will constitute more frequent threats and danger than ever (Popper, 1983; Walton, 1997; Sveiby, 1997).

We should expect conflicts of aims, tasks, and interests of the systems functioning in the frame of cybernetics and synergetic. All these facts demand robust programs for providing security and high-speed performance. There will

be a need for the program of coordination of autonomous systems working in the same area and conducting the program ensembles. Complexity, scale, uncertainty, non-linearity, disequilibrium, autocatalysis, self-oscillations of large and complex systems (LTS and CTS), carry threats and challenges, and people who work in the area of intelligent systems and modern informatics should be prepared for it.

Synergetics as science allows us to solve new problems of the information revolution and prepare specialists according to the new requirements with the necessary digital competences. D. Nash, A. Turing, A. Toynbee, S. Hawking, K. Sagan predict the most severe complications that await humanity in the future. This means that a mighty intellectual effort will be required to quench the threats and challenges related to information technologies. To create a security system and neutralize the destructive difficulties and risks of the new information world, it is necessary to remove worldview myths, barriers, gaps, contradictions in the minds of people who generate and consume new ideas and technologies in the information sphere. Information development can be stable, safe and translationally progressive in case people master the methods of self-organization (synergetics). These methods involve the transition of chaos into order, spontaneity in purposefulness. In terms of the digital revolution, the formation of ordered structures can be carried out according to the schemes and principles described by R. Clausius, C. Darwin, E. Schrödinger, A. Einstein, I.R. Prigogine, V.I. Vernadsky, A.A. Bogdanov, A. Bertalanffy, S. Hawking (2004).

In the information sphere, order and chaos are created according to the same schemes and principles that operate in thermal, organic, physical, space, chemical, geological systems. This challenging task must be solved in classrooms, laboratories, at philosophical seminars, and mathematical congresses. The global landscape is such that a particular cannot break out of the whole and dominate it. It is necessary to create a collective mind (Schrodinger, 2019, p. 52). Presumably, to a certain extent, no more than 3% of the part of the Universe surrounding us is available to humanity (Prigozhin *et al*., 1986, p. 6). Mankind hasn't yet mastered many secrets and laws of nature and does not even try to think about it. Nevertheless, these facts do not relieve us of responsibility for the future (Kuzetsov, 1998, p. 3).

The movement into the future of large complex systems goes through rhythm cascades imposed on each other. To cause a resonant position of rhythm cascade oscillations and to obtain the maximum synergistic effect, complex management actions on the mega system are required. These are the conditions necessary for minimizing losses and ensuring digital security (Drucker, 2003; Knyazeva *et al*., 2005; Vu, 2019; Kuzetsov *et al*., 1998; Malinetsky *et al*., 2002; Prodanova *et al*., 2019; Prigozhin *et al*., 1986). Revolutionary changes in the sphere of computer science, including the digital economy, oblige the generation of the first half of the XXI century to act competently, rationally and consistently in the area of digital technology development.

There are other trends in the information sphere. Scientists encourage us to discover and introduce new methods of cognition without fear (Popper, 1983, p. 27). Hundreds of billions of dollars around the world are spent on the search for adequate methods and developing new ways of describing and modeling. The cognition of the world demands research in all areas (gnoseological, epistemological, ontological, systemological, etc.). A lot of special attention is paid to objects and processes characterized by openness, nonlinearity, irreversibility, nonequilibrium, ambiguity, uncertainty, emergence, synergy, chirality, ambivalence, self-oscillation, auto-catalysis.

There is specific experience in the formation of economic knowledge and the creation of knowledge management systems in Russia - this is the "Strategy for the Development of the information society for 2017-2030. " This document was approved by the Decree of the President of the Russian Federation of 9 May 2017 No. 203 (The program "Digital Economy of the Russian Federation," 2017; Decree "On the Strategy for the Development of the Information Society in the Russian Federation for 2017-2030", 2017). In the Russian Federation, centers, technology parks, technopolises in the field of information technology have been arranged. Directive and regulatory documents were created, including "The Digital Economy of the Russian Federation," ratified by order of the Government of the Russian Federation of July 28, 2017 No. 1632-r.

There have been created documentation and structures, scientific centers, technopark structures throughout the country. There were created regional centers with a world level of information technology - Moscow, St. Petersburg, Nizhny Novgorod, Kazan, Yekaterinburg, Novosibirsk, Tomsk, Samara. The Kaspersky Center, dealing with information security systems,

information technology technopolises in Zelenograd, Tomsk; Innopolis in the Republic of Tatarstan won world fame. Some enterprises are making efforts to work on unmanned driving vehicles. In general, Russia makes the top fifty in the ranking of countries' readiness for the digital economy, and make the top forty in the use of innovative results in digital technologies. Russia is lagging in creating a regulatory framework for the digital economy; the level of digital technology usage in business structures is rather low.

4. CONCLUSIONS:

The experience of such countries as the USA, Japan, China, Singapore, and other countries that have achieved the immense success in the field of information revolution proves that the main trends of applying efforts by the advanced countries are formation of the society of knowledge; creation of the digital economy; raising the level of information awareness and digital literacy of the population; creation of new digital technologies, new digital platforms; enhancing the material and technical base of organizations in the field of information technology; increasing attention to environmental safety of the information sphere, a variety of forms, methods of representing the reality; support for creative ways of knowledge presentation; researchers' attention is focused on the breakthrough knowledge in the field of computer science and pattern recognition; growing recognition in the science of the direction known as “creative self-destruction”; the status of paradoxical and intuitive knowledge of our world is reinforced; the interdisciplinarity of knowledge is intensified; and the synergistic approach to cognition becomes dominant.

The main trends of the development of the digital economy in Russia are statutory regulation, the formation of a new regulatory environment that provides a favorable legal regime for the emergence and development of modern technologies; creation of a permanent mechanism for managing changes and competencies (knowledge) in the area of the digital economy regulation; withdrawal of key legal restrictions and the creation of separate institutions aimed at solving the high-priority tasks of creating a digital economy; the formation of a full-scale legislative regulation of relations emerging due to the development of the digital economy; taking actions aimed at stimulating economic activity related to the use of modern technologies, data collection, and use; the formation of a policy of the digital economy development in the territory of the Eurasian Economic Union, the harmonization of approaches to legal regulation that contribute to the development of the digital economy within the Eurasian Economic Union; and establishment of a methodological basis for the development of competences in the field of digital economy regulation.

Time has propelled knowledge to the top strategic position. Digital technology is one of the contemporary elements of the "knowledge" system. Knowledge management determines the effectiveness of production systems and the quality of life to a large scale. The new scientific paradigm - synergetics - aims at integration, cooperation, blending into mega systems, and their self-organization. This paradigm brings intellectual resources in the activities of staff, harmonization, synchronization, constructive interaction for achieving a common goal. This is entirely applied to knowledge, knowledge management, the knowledge economy, to such an essential part of knowledge as digital technology.

Education proves to be essential in terms of mastering innovative knowledge. For 10 thousand people in Russia, there are 340 university students. On top of that, an extensive army studies at colleges, technical schools, and other educational institutions. The educational process is carried out in technopolises, innopolises, IT- technology parks. While choosing effective forms of education, harmonizing goals, tasks, financing the educational process with the infrastructure, it will not take long to see the results. The experience of India, Singapore, Japan, Finland, and other countries confirms the possibility of optimistic prospects.

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6. REFERENCES:

1. Alajmi, M. A. (**2019**). The impact of E-portfolio use on the development of professional standards and life skills of students in the Faculty of Education at Princess NouraBint Abdul Rahman University, Entrepreneurship and Sustainability Issues 6(4) 1714-1735. http://doi.org/10.9770/jesi.2019.6.4(12)
2. Bulanichev, V. A., Serkov, L.A. (**2007**). Synergetic modeling of educational processes. Yekaterinburg: Institute of Economics, Ural Branch of RAS: AMB

Publishing House.

3. Chernovsky, D. S. (**2004**). Synergetics and information. Dynamic information theory. Moscow: URSS.
4. Chervinskaya, K. R. (**2019**). Methods of the conceptual analysis of knowledge. Methods and decision-making systems.
5. Decree of the President of the Russian Federation of May 9, **2017** No. 203 “On the Strategy for the Development of the Information Society in the Russian Federation for 2017-2030”
6. Dresvyannikov, V. A. (**2006**). Building a knowledge management system in an enterprise: a training manual. Moscow: KNORUS.
7. Drucker, P. (**2003**). Effective Management. Economic Tasks and Optimal Solutions. Translated by. M. Kotelnikova. Moscow: AIR-PRESS.
8. Gafurov, I. R., Safiullin, M. R., Akhmetshin, E. M., Gapsalamov, A. R., Vasilev, V. L. (**2020**). Change of the higher education paradigm in the context of digital transformation: from resource management to access control. International Journal of Higher Education, 9(3), 1-16.
9. Hawking, S. A. (**2004**). Brief History of Time - St. Petersburg: Amphora.
10. Johnson, C., & Hinton, H. (**2019**). Toward a Brillant Diversity. Journal of Culture and Values in Education, 2(1), 56-70. Retrieved from http://cultureandvalues.org/index.php/JCV/article/view/27
11. Knowledge Management. Research Report (**2000**).
12. Knyazeva, E. N., Kurayumov, S. P. (**2005**). Foundations of synergetics, Synergetic worldview. Moscow: Komkniga.
13. Korableva, O., Durand, T., Kalimullina, O., & Stepanova, I. (**2019a**). Usability testing of MOOC: Identifying user interface problems. Paper presented at the ICEIS 2019 - Proceedings of the 21st International Conference on Enterprise Information Systems, 2 468-475.
14. Korableva, O., Durand, T., Kalimullina, O., & Stepanova, I. (**2019b**). Studying user satisfaction with the MOOC platform interfaces using the example of coursera and open education platforms. Paper presented at the ACM International Conference Proceeding Series, 26-30. doi:10.1145/3322134.3322139
15. Lysytsia, N.; Martynenko, M.; Prytychenko, T.; Gron O.; Us M. (**2019)**. Prospects for innovations in marketing of economic educational services in Ukraine, Entrepreneurship and Sustainability Issues 6(4): 1771- 1783. http://doi.org/10.9770/jesi.2019.6.4(16)
16. KPMG Consulting (**2001)**. Retrieved from http//wwwkpmg.com
17. Kuzetsov, B. L. (**1998**). Introduction into Economic Synergetics. Naberezhnye Chelny: KamPi Edition.
18. Malinetsky, G. G. (**2002**). Order parameters, self-organization and education. Electron. Dan, Moscow: IPM named after M.V. Keldysh, Russian Academy of Sciences.
19. Parangishvili, I. V., Abramova, N. A., Spiridonov, V. F., Kovriga, S. V., Razbegin, V. L. (**1999**). Search for approaches to solving problems. Series “Information Russia on the threshold of the XXI century”. Moscow: SINTET.
20. Pikovsky, A., Rosenblum, M., Kurihs, J. (**2001**). Synchronization, Cambridge University Press.
21. Popper, K. (**1983**). Logic and the growth of scientific knowledge. Moscow: Progress.
22. Pospelov, G. S. (**1988**). The soul and heart of the latest information technology. Hypotheses. Prognoses (Future Sciences): International Yearbook. Moscow: Knowledge.
23. Prigozhin, I., Stengers, I. (**1986**). Order from chaos: A new dialogue between man and nature: Translated from English. Ed. by V.I. Arshinova, Yu.L. Klimontovich and Yu.V. Sachkova. Moscow: Progress.
24. Rumezen, M. K. (**2004**). Knowledge Management: Translated from English. Moscow: Publishing House. LLC: Publishing House. LLC; 2004.
25. Safiullin, M. R., & Akhmetshin, E. M. (**2019**). Digital transformation of a university as a factor of ensuring its competitiveness. International Journal of Engineering and Advanced Technology, 9(1), 7387-7390.

doi:10.35940/ijeat.A3097.109119

26. Samarsky, A. A., Kurdyumov, S. P. (**1989**). Paradoxes of a multivariate nonlinear world - the world around us. Hypotheses. Prognoses (the future of science): International Yearbook. Moscow: Knowledge.
27. Shrestha, M. (**2019**). Influences of gender and locale on teachers' job satisfaction. Research in Educational Policy and Management, 1(1), 17-32. Retrieved from https://repamjournal.org/index.php/REPAM/article/view/7
28. Schrodinger, E. (**2019**). Quantum Code of the Universe: Translated from English by Migunova E.O. Moscow: Rodina LLC: 2019.
29. Sturm, E., & Quaynor, L. (**2020**). A Window, Mirror, and Wall: How Educators Use Twitter for Professional Learning. Research in Social Sciences and Technology, 5(1), 22-44. Retrieved from https://ressat.org/index.php/ressat/article/view/439
30. Suwarni, Okagbue, H. I., Lydia, E. L., Shankar, K. (2020). Digital Economic Challenges and Economic Growth in Environmental Revolution 4.0. Journal of Environmental Treatment Techniques, 8(1), 546-550.
31. Sveiby, K. E. (**1997**). The New Organizational Wealth, San Fransisco.
32. Tarman, B. (**2016**). Innovation and Education. Research in Social Sciences and Technology, 1(1). Retrieved from http://ressat.org/index.php/ressat/article/view/3
33. The program "Digital Economy of the Russian Federation" dated July 28, **2017** No. 1632-r.
34. Vaga, T. (**2019**). Profiting from Chaos. Using Chaos Theory for Market Timing, Stock Selection and option Valuation. Mc-Graw-Hill, New York.
35. Vu, T. (**2019**). Theoretical Constructs and Practical Strategies for Intercultural Communication. Journal Of Curriculum Studies Research, 1(1), 43-53. Retrieved from https://curriculumstudies.org/index.php/CS/article/view/3
36. Walton H. (**1997**). Measuring Knowledge-Based Assets Publishers? Sam Francisco.
37. Werbos, P. (**1974**). Beyond Regression: New Tools for Prediction and Analysis in the Behavioral Sciences. PhD Thesis, Dept, of Applied Mathematics. Harvard University: Cambridge: Mass.
38. Wiener, N. (**1983**). Cybernetics or Management and communication in the animal and machine. Translated from English by I.V. Soloviev and G.N. Povarova; Ed. G.N. Povarova. 2nd ed. Moscow: Science; The main edition of publications for foreign countries.
39. Ziyadin, S., Ermekbaeva, B., Supugaliyeva, G., & Doszhan, R. (**2018**). Transformation of basic indicators of socio-economic processes in the digital economy. Paper presented at the Proceedings of the 31st International Business Information Management Association Conference, IBIMA 2018: Innovation Management and Education Excellence through Vision 2020, 2009-2017.

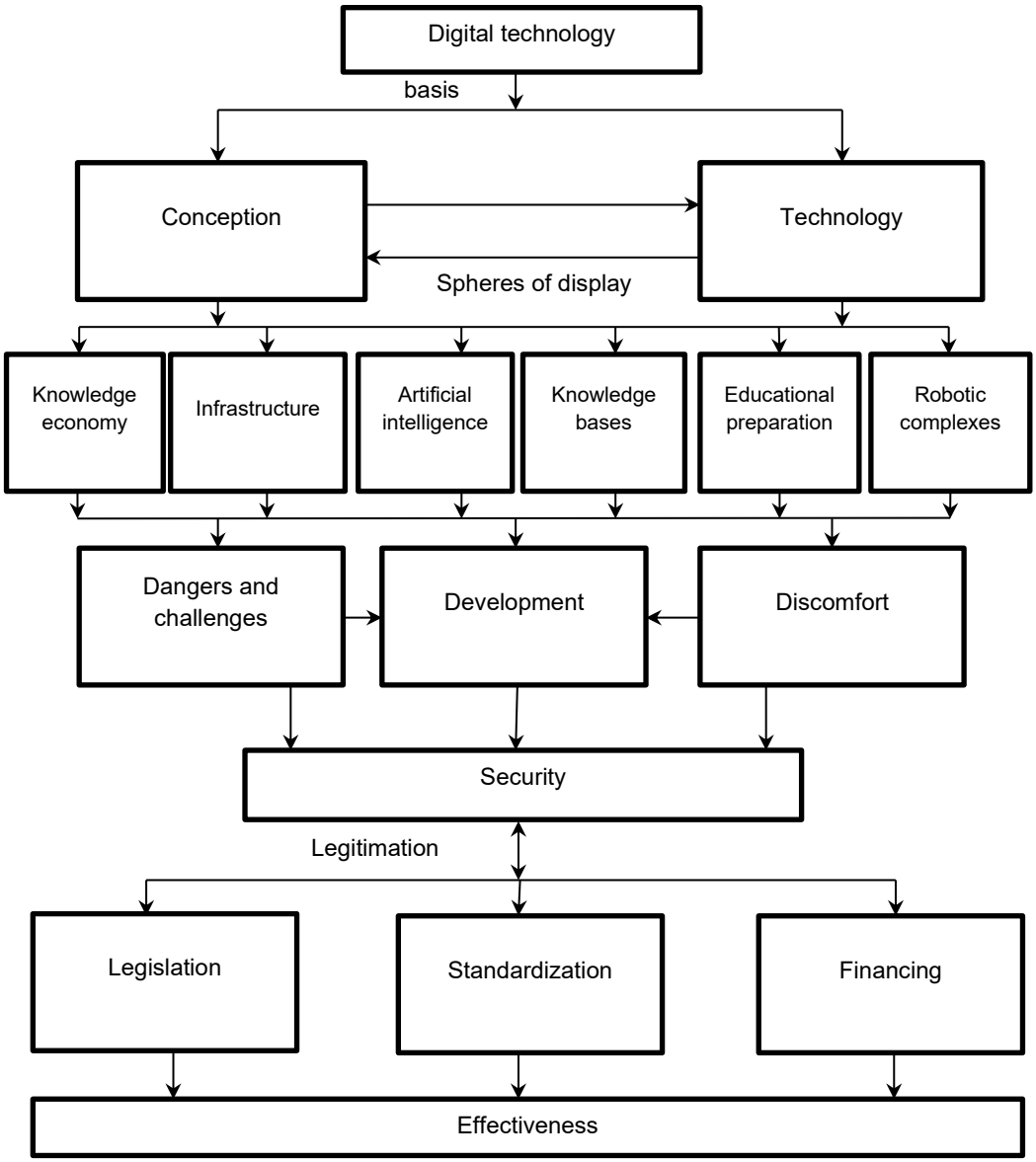

Figure 1. *Structure of the digital economy.*
Source: developed by the authors.