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OPORTUNIDADES PARA O DESENVOLVIMENTO SOCIOECONÔMICO NA RÚSSIA: INTEGRAÇÃO DE EDUCAÇÃO, CIÊNCIA E NEGÓCIOS ATRAVÉS DO MODELO 'UNIVERSIDADE 4.0

OPPORTUNITIES FOR SOCIO-ECONOMIC DEVELOPMENT IN RUSSIA: INTEGRATION OF EDUCATION, SCIENCE, AND BUSINESS THROUGH THE "UNIVERSITY 4.0" MODEL

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ABSTRACT

Objective: To analyze the forms and mechanisms of integrating education, science, and business based on the organizational structure of an innovation ecosystem following the "University 4.0" model.

Method: The study utilized a qualitative research approach, including a review of scientific literature indexed in Scopus and Web of Science concerning the integration of education, science, and business.

Results: Identified forms of integration include leading research centers, project integration, and the establishment of technoparks, among others. The study developed an organizational structure for the innovation ecosystem under the University 4.0 model.

Conclusion: Integrating education, science, and business by forming an innovation ecosystem around the University 4.0 model enhances the positive impact of academic and educational activities on the socio-economic development of cities, regions, and the nation. This is achieved through training highly qualified personnel aligned with the needs of innovation and promoting the commercialization of scientific results.

Keywords: integration, forms of integration, innovation ecosystem, knowledge production, science park.

Objetivo: Analisar as formas e mecanismos de integração entre educação, ciência e negócios baseados na estrutura organizacional de um ecossistema de inovação seguindo o modelo "Universidade 4.0".

Método: O estudo utilizou uma abordagem de pesquisa qualitativa, incluindo uma revisão da literatura científica indexada nas bases Scopus e Web of Science sobre a integração de educação, ciência e negócios.

Resultados: As formas de integração identificadas incluem centros de pesquisa líderes, integração de projetos e a criação de parques tecnológicos, entre outros. O estudo desenvolveu uma estrutura organizacional para o ecossistema de inovação sob o modelo Universidade 4.0.

Conclusão: A integração de educação, ciência e negócios, formando um ecossistema de inovação em torno do modelo Universidade 4.0, aumenta o impacto positivo das atividades acadêmicas e educacionais no desenvolvimento socioeconômico de cidades, regiões e do país. Isso é alcançado através da formação de pessoal altamente qualificado alinhado às necessidades de inovação e promoção da comercialização dos resultados científicos.

Palavras-chave: Integração; Formas de integração; Ecossistema de inovação; Produção de conhecimento; Parque científico.

INTRODUCTION

The Fourth Technological Revolution, development of digital technologies, platforms, and analytical applications, along with other modern trends, are transforming contemporary universities into the "University 4.0" (digital university) model (Abduvakhidov & Mannapova, 2021; Novichkov, Ilyichyova, & Potapov, 2022). The transformation of societal ecosystems alters social demands. Today, we observe the rise of educational hubs, networked communities (Abdullayev et al., 2024), and other innovative organizational forms in university operations (Neborsky, 2017), alongside the rapid development of open educational resources offering varied learning combinations (Kaplan & Haenlein, 2016; Zhang et al., 2020).

Breakthrough technologies demand universities restructure both the form and essence of education (Kryucheva & Tolstoukhova, 2023). Central to this new university model are communication systems supported by adaptive technologies and a unified

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digital environment centered around scientific research and innovation (Efremova et al., 2022). This model develops educational approaches that integrate digital technologies, scientific achievements, business requirements, solutions to global challenges, and sustainable development goals (Akhmetshin et al., 2021; Sousa, Moreira, & Santos, 2023). Notably, this model supports the growth of distance learning, adaptive teaching methods, and a focus on feedback and mentorship in education (Fadeev, Zmeev, & Gazizov, 2020; Shichkin et al., 2024).

The effectiveness of educational programs, regardless of the phenomena studied, is measured by the creation of viable products by students or their contributions to the development of local ecosystems. Addressing global and local issues (resources, hunger, ecology, epidemics, etc.) further emphasizes the need for society's involvement in higher education and university science. Transnational corporations and public organizations increasingly drive social demand for essential medicines, materials, technologies, cultural codes, and tools for social regulation (Santotskaya, 2020).

Thus, the emergence of the University 4.0 model is underpinned by the need for continuous skills and qualifications development within formal education; the growing demand for applied research through deep industry partnerships and shorter timeframes for converting ideas into commercial outcomes; and the development of digital technologies and ecosystems (Feest, 2016).

The interaction of education, science, and the real economy through state mediation fosters human capital development, new technologies and products, and satisfies the innovation demands of the labor market, enhancing competitiveness at both regional and national levels (Kulyasova & Trifonov, 2020; Vasilev et al., 2020).

However, in Russia, gaps persist between educational, scientific, and business innovation activities, negatively impacting these areas and socio-economic development overall. This necessitates efforts to optimize the "education – science – business (production)" chain to ensure competitiveness and sustainable development in Russia.

Globally, there are various forms and mechanisms for integrating education, science, and business, all aimed at fostering favorable conditions for knowledge generation, dissemination, and application. Russian and foreign researchers distinguish different levels of integration between science and education within socio-economic systems. These can be categorized into micro-, meso-, and macro-levels (Sazhina, 2020):

• Micro-level integration refers to collaboration within a single organization or intradepartmental integration (e.g., partnerships among institutions under the same administrative umbrella).

• Meso-level integration represents interdepartmental partnerships and involves collaboration between institutions from different administrative backgrounds.

• Macro-level integration encompasses comprehensive educational and scientific systems within the national economy (Gordeyeva & Savchenkov, 2016).

In the context of analyzing the integration of educational and scientific activities, various types, forms, and kinds of integration are distinguished.

By type, integration is categorized as:

• Institutional integration, which involves the establishment of new institutions, such as network structures, clusters, etc.

• Functional integration, which refers to collaborative activities, including scientific research, the development of educational programs, and educational activities, among others (Kirillova, 2021).

Depending on the parameters of systems and the functioning environment, the following types of integration are identified:

• Structural-organizational integration, which encompasses the creation of new enterprises, associations of enterprises, or units, such as the formation of a cluster.

• Material-technical integration, which involves the sharing of resources by several independent organizations, for example, common databases of scientific information or shared-use centers for scientific equipment.

• Human resource integration, which entails the involvement of scientific personnel in the development and implementation of scientific and educational programs, as well as participation in joint research projects (Sheinbaum & Budzinskaya, 2018).

Forms of integration are differentiated based on structural features of scientific and educational interactions (the depth of integration processes). These include full, partial, and temporary (or contractual) integration (Abramova & Trotskaya, 2018).

However, in our view, considering the ultimate goal of creating integrative connections between education, science, and business, a classification that accounts

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for the specific characteristics of the innovation ecosystem being formed around universities and research institutions is more appropriate.

The innovation ecosystem (IE) is defined as a tool for creating conditions that enhance the competitiveness of organizations in national and regional economies. According to this concept, innovations are viewed as a process of transforming scientific research into a market product or service, requiring the collective efforts of various participants: businesses, universities, research companies, venture capital, and other financial funds. Due to its systematic nature, the innovation ecosystem enables a synergistic effect in creating innovations (Akhmadeev & Moiseyev, 2016).

The concept of an "innovation ecosystem" is also defined as a network community that acts as a catalyst for participant interaction, facilitating the transformation, exchange, dissemination, and efficient allocation of knowledge and other resources (Karanatova & Kulev, 2015). One of the primary goals of innovation ecosystems is to organize the cooperation of participants in the innovation process, where agents lacking sufficient resources achieve common goals through resource complementarity (Babikova & Fedosova, 2021).

Essentially, the innovation ecosystem is a combination of two distinct systems: a research system and a commercial system (de Vasconcelos Gomes et al., 2018).

Thus, an innovation ecosystem is understood as an open system that self-organizes, self-regulates, and self-develops, characterized by input flows of ideas, value, human resources, and information. A distinctive feature of the innovation ecosystem is its ability to generate innovations, ideas, intellectual property, and to train qualified personnel for society and other industries. In return, it receives tasks, requests, and resources for self-development (Rabelo & Bernus, 2015).

Significant research has been devoted to various forms of integration between higher education institutions and enterprises.

For example, according to (Syupova & Bondarenko, 2014), the connections between higher education institutions and enterprises in educational and scientific activities are growing, with the primary forms including: development of curricula and training programs for specialists; organization of internships and student thesis design projects; targeted training of specialists upon request by partner organizations; involvement of personnel and technical staff from partner enterprises in the educational and research process; creation of basic departments. Notably, employer participation

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in the development of higher education programs is a mandatory condition for ensuring education quality.

T.M. Davidenko (Davidenko, 2016) identifies various forms of integration between universities and businesses, emphasizing agreements on joint research, development, or risk-sharing; the creation of consortia with grant funding; and conducting research supported by external resources, particularly from businesses. Additional forms include participation in public research organization programs, subsidized research, and consulting projects carried out by university scientists. Networks for knowledge and experience exchange between universities and small or medium enterprises, mechanisms for trading science-intensive products, and advisory support for newly established enterprises are also highlighted. Moreover, the establishment of small innovative enterprises, technoparks, temporary creative complexes, and intermediary structures to facilitate technology transfer is discussed. A key aspect involves designing curricula through dialogue between scientific and industrial sectors.

According to researchers (Yesina, Stepanenkova, & Agafanova, 2015), integration between universities and employer enterprises is facilitated by mechanisms such as business-funded collaborations, including endowments, tax loans, and incentives. Partnerships in research and development are also crucial, supported by the establishment of technoparks, business incubators, and innovation platforms, as well as the organization of competitions for student research and business projects. Comprehensive information on internships, vacancies, and employer requirements is necessary, along with the facilitation of employer presentations at universities through masterclasses, lectures, career fairs, and similar events. Businesses also play a role in university governance, aiding in the development of education standards based on professional benchmarks and in creating methods to evaluate specialists' compliance with these standards, including certification. External evaluations of university performance, incorporating business perspectives and expert opinions, further enhance the integration process.

A.O. Karpov (Karpov, 2014), in his study of the interaction between universities and business structures, highlights the most effective forms as masterclasses, project-based learning, and the creation of creative teams that include professors, researchers, students, and company representatives. The choice of specific forms and methods of collaboration between a university and a company depends on several factors, such as the goals of both parties, the university's research focus, production conditions and technologies, financial resources, and the ability to attract various funding sources.

Since the mid-20th century, knowledge production models have evolved into three conceptualized modes, which now form a basis for defining integration directions and interactions between education, science, and business. Mode 1 is driven by fundamental research without immediate concern for practical applications. It follows a linear approach, often within specific disciplines, without necessarily contributing to sectoral or knowledge economy development. Mode 2, in contrast, involves context- and problem-oriented interdisciplinary research. It relies on short-term multidisciplinary teams tackling specific economic problems, adhering to principles such as problem orientation, transdisciplinarity, heterogeneity, social responsibility, and reflexivity. Mode 3 reflects the coexistence and co-development of diverse knowledge-generation methods, emphasizing mutual learning among models, interdisciplinarity, and transdisciplinarity to produce new knowledge (Veit et al., 2017).

The "Triple Helix" model (Msomphora, 2016) provides a structural explanation of the transition from Mode 1 to Mode 2, advocating the formation of tripartite networks and hybrid organizational relationships among universities (fundamental research), industries (commercial production), and governments (market regulation). This model suggests that as interactions between these components increase, hybrid institutions emerge, blending characteristics of each sector. According to G. Etzkowitz (2010), the driving forces of the Triple Helix innovation model—universities, industry, and government—play equivalent roles. Initially, knowledge generation involves government-university collaboration, followed by university-business partnerships for technology transfer, culminating in the market introduction of research outcomes through joint efforts of government and industry. These interactions evolve with the economic development level, supported by structures like research parks and technology clusters.

The "Quadruple Helix" model (Razinkina, 2022), a development within Mode 3, adds civil society and end-users of knowledge to the Triple Helix. This model recognizes the influence of not only governments, universities, and companies but also other stakeholders, grouped under a "fourth component." The fourth helix lacks a precise definition in the literature. K. Nordberg (Nordberg, 2015) describes it as societal values, culture, and the innovation process background. E. Carayannis and D.

Campbell (Carayannis & Campbell, 2009) define it as civil society, while I. Ivanova (Ivanova, 2014) identifies it as consumers or end-users of scientific knowledge, including individuals and organizations.

The central element of the Quadruple Helix is the active "human factor" and the circulation of knowledge across social subsystems, implemented in society and the economy (Lew, Khan, & Cozzio, 2018). Its core lies in innovation users, fostering the creation of innovations significant to civil society. The model encompasses educational systems (academic institutions and schools) as human capital, economic systems (enterprises and services) as economic capital, political systems (policies and regulations) as political and legal capital, and civil society systems (media, culture, and social networks) as social and informational capital (Karayannis & Grigorudis, 2016).

The evolution and increasing complexity of knowledge production models necessitate their consideration in forming national innovation systems. Systems based on the Triple Helix rely primarily on market regulation, but as the role of social institutions grows, a shift toward social regulation becomes essential. Civil society, through media, social networks, and other platforms, plays a growing role in knowledge creation and socio-economic regional development. Incorporating social institutions into innovation systems through the Quadruple Helix model enhances their stability and competitiveness.

In conclusion, theoretical models of integrating science, education, and business offer practical recommendations for advancing the scientific and educational sectors while promoting socio-economic development through innovation. The objective of this article is to analyze forms and mechanisms of integrating education, science, and business based on the organizational structure of the innovation ecosystem under the "University 4.0" model.

METHODOLOGY

In accordance with the outlined approaches to the integration of education, science, and business under the "University 4.0" model, a qualitative research approach was selected. The study was conducted as a review of scientific literature on the chosen topic.

The objective of the research was to synthesize findings related to specific research questions:

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1. What are the main forms of integration of education, science, and business in terms of the type and characteristics of the innovation ecosystem?

2. What is the organizational structure of the innovation ecosystem under the "University 4.0" model?

In the first stage of the research, information sources necessary to achieve the study's objective were selected. The data for this study were drawn from articles and reviews published in scientific journals indexed in Scopus and Web of Science. The search was conducted using keywords and phrases such as "University 4.0," "integration of education, science, and business," "innovation ecosystem," and "knowledge production" in both English and Russian.

During the second stage, based on an analysis of the selected scientific literature, the primary forms of integration of education, science, and business were identified, categorized by the type and characteristics of the innovation ecosystem.

In the third stage, the organizational structure of the innovation ecosystem for the University 4.0 model was developed based on the analysis of the selected scientific literature.

RESULTS

The analysis of scientific research made it possible to identify the main forms of integration of education, science, and business based on the type and characteristics of the innovation ecosystem (Table 1).

Table 1. Main forms of integration of education, science, and business based on the type and characteristics of the innovation ecosystem

№	Forms of Integration	Characteristics
1	Leading Research (Technology) Centers	Structures established by combining leading higher education institutions, academic and sectoral research organizations, funded on a competitive basis. Their primary function is to create favorable conditions for scientific research, knowledge exchange, and idea sharing.
2	"Project Integration"	Focuses on forming effective partnerships between research institutions, design bureaus, higher education institutions, and businesses to develop and implement specific scientific, technical, or innovation projects.
3	Testing (Scientific-Testing) Centers	Science-production structures created to develop and implement new technologies and products in various industries and agriculture, often established at universities or research organizations.
4	Technoparks	A union of high-tech companies clustered around a major university, institute, or research laboratory. Technoparks integrate education,

		science, and industry to facilitate the commercialization of research outcomes.
5	Research Parks	Established around universities, they integrate research, production, educational, and socio-cultural zones to ensure a continuous innovation cycle. They provide infrastructure to connect research centers with businesses, fostering high-tech startups.
6	Scientific (Industrial) Parks	Serve as a foundation for venture businesses, acting as "factories" for medium and small innovative enterprises. Established by universities and research institutions, they provide scientific ideas, knowledge, and consulting, along with resources such as facilities and equipment, in partnership with industry stakeholders.
7	Scientific and Innovative Enterprises	Small enterprises associated with universities that address graduate employment and promote innovation by creating favorable conditions for small and medium-sized business development.
8	Innovation Consortia	Associations of universities, research institutions, enterprises, and financial organizations aimed at solving specific tasks and implementing projects. Members retain operational independence while adhering to the consortium's goals in relevant activities.
9	Innovation Clusters	Advanced integration of educational, scientific, and business structures, often supported by government authorities. Cluster members collaborate to improve operational efficiency through shared infrastructure, reduced research costs, and commercialization of innovations, accelerating technology development and dissemination.

Note: Compiled based on Pivneva et al. (2023), Eskerkhanova et al. (2023)

To implement the conceptual model of integrating education, science, and business, an organizational structure for the innovation ecosystem under the University 4.0 model was developed (Table 2).

Table 2. Organizational structure of the innovation ecosystem under the University 4.0 model

№	Components of the Organizational Structure	Characteristics
1	Science Park	Organized as a limited liability company.
2	Technological Platforms	Facilitate information exchange between university laboratories and science park participants.
3	Project-Engineering Consulting Company	Handles project work, tenders, contracts between university departments and businesses, coordinates project implementation, and provides feasibility analysis and consulting services.
4	Startup Center	Organizes presentations, crash tests, brainstorming sessions, training seminars, and business games with entrepreneurs. Supports participation in national and international competitions, promotes partnerships, and runs a startup school.
5	Startup Festival	Regularly organizes startup project competitions, provides expert evaluations, selects projects, and identifies funding sources.
6	Endowment Fund	A fund supporting scientific activities and startup projects.
7	Business Incubator	Creates conditions for establishing and developing small innovative enterprises, ensuring their readiness to operate effectively both within the university and after exiting the incubator.

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8	Business Environment	Represents the customer of the final innovation product, including clusters in the university's city and other regions of Russia.

Note: compiled by the authors

DISCUSSION

One of the key structural elements of the proposed mechanism for integrating education, science, and business (see Table 2) is the **Science Park**, established at the university with contributions from business representatives. This park aims to develop scientific, technical, and innovation activities and commercialize research results. Notable examples of science parks in the United States include those at Stanford, the University of California, Berkeley, and the University of San Francisco. Stanford's science park is located on university land leased for 51 years to "high-tech" companies collaborating with the university. Engineers and researchers from these companies often teach at the university (Sumska, 2007). Prominent tenants include tech giants such as IBM and Hewlett Packard, along with major U.S. Geological Survey institutions, aerospace firms, and chemical and biotech companies (Sumska, 2007).

Despite Stanford's success, science parks in the U.S. initially developed slowly. Many initiatives to establish science parks at universities and technical institutions did not progress beyond their initial stages. However, examples like the Research Triangle in North Carolina and Philadelphia's Urban Park in Pennsylvania achieved their goals of fostering high-tech businesses in their regions. A successful case is the Illinois Institute of Technology Center, a private research center where nonprofit research institutes collaborate closely with industry on university land (Neborsky, 2011).

The Japanese model of science parks differs significantly from the American approach. It emphasizes the construction of entirely new cities, called **technopolises**, focusing on research in key economic sectors and high-tech industries. Japan identified 19 zones across its four main islands for technopolises, with Tsukuba serving as the "core" for some, such as Hiroshima, Ube, and Kagoshima. Tsukuba is primarily a hub for fundamental research with minimal private sector involvement, and its construction is funded regionally through local taxes and corporate contributions (Sumska, 2007).

Science parks represent new forms of integration among higher education, science, industry, entrepreneurship, funding sources, and local and regional authorities. They enable the effective deployment of 21st-century technologies. However, the base model for a science park must adapt to local conditions, objectives, financial resources, and legal frameworks (Yesina et al., 2015). Parks can be founded by a single organization or through joint interests of multiple entities. Although each park may pursue different goals, their significance depends on local conditions and the founders' priorities. A common feature of all science parks is their support for integrating scientific, educational, and entrepreneurial activities, with universities playing a critical role in most processes (Karanatova & Kulev, 2015).

Another essential structural element of the University 4.0 model (see Table 2) is the **Business Incubator**, designed to support startups in their early stages. Business incubators are crucial tools in innovation ecosystems, helping research teams and developers create high-tech companies with university support. These companies typically hold intellectual property rights in their charter capital. Business incubation involves mentorship programs, investor outreach, and providing startups with workspaces, meeting rooms, and essential services such as banking, legal, and tax consulting. Additional support includes market analysis, competitor assessments, technical services, equipment leasing, and advertising assistance.

In the U.S., the slow development of science parks led to the rise of **technology business incubators**. These provided budding entrepreneurs with production spaces, service packages, and connections to universities and financial institutions. Similarly, in Western Europe, innovation centers emerged, supporting small high-tech enterprises by offering facilities and resources for turning ideas into commercial products. These centers, often tied to local governments, are part of the European Network based in Brussels, which facilitates international technology trade (Sumska, 2007).

Integration of education, science, and business is a critical component of socio-economic and technological development worldwide. The model often operates through science parks, research parks, technoparks, and technopolises, with universities as the central participants. Students gain practical knowledge, apply it in research and production, and acquire skills for future high-tech ventures (Gabidullina et al., 2023).

Different integration models exist depending on the regional context. In the U.S. and the U.K., integration is implemented through narrowly defined science parks, research parks focused on pre-prototype innovations, incubators (U.S.), and innovation centers (U.K. and Western Europe). These centers provide startups with access to facilities, laboratory equipment, and services at affordable rents.

Most universities in the U.S. and Europe actively develop strategies for integrating education, science, and business, evidenced by projects with businesses and local communities. Many countries offer tax incentives to companies to strengthen their partnerships with universities (Stroev et al., 2022). The success and efficiency of such cooperation depend on the benefits each partner derives from the collaboration. For society and the state, this partnership offers substantial economic, scientific, and social advantages, with investments in human and intellectual capital being the most effective in the long term (see Table 3).

Table 3. Benefits of Cooperation Between Universities, Businesses, and the Government

Universities	Businesses	Government
Increased investment in fundamental and applied research	Growth of innovation in production, transforming it into high-tech industries	Development of priority scientific research areas and realization of the country's scientific potential
Establishment of research institutes, laboratories, technoparks, and incubators; modernization of infrastructure; and optimization of technology transfer channels to production	Enhanced market competitiveness through the use of unique technologies	Stimulation of business activity via tax benefits and exemptions for businesses collaborating with universities; creation of new enterprise types
Creation of structural units within universities focused on entrepreneurial activities	Formation of enterprise-based units dedicated to scientific research	Increased economic innovation, growth of human and intellectual capital, and reduced dependency on physical resources
Increased autonomy and financial independence	Increased profits through higher added value	Alignment of professional training with modern labor market needs
Expanded research opportunities and employment prospects for students	Attraction of highly qualified personnel	Socio-economic regional development and growth of regional science and technology centers
Acquisition of intellectual property rights and patents, and commercialization of knowledge	Expansion of business functions, participation in joint venture funds, and involvement in higher education processes	Integration into the international scientific community and promotion of global knowledge commercialization and technology transfer
Enhanced prestige of the university and science as a whole	Improved reputation, recognition, and loyalty from the government and public	Increased national competitiveness
Exchange of personnel, establishment of professional networks, fostering mutual trust between institutions, and closer integration of education, science, business, and government		

Note: Compiled based on Musa Kyzy et al. (2024), Shichkin et al. (2024)

To maintain their position in the education market and uphold a good reputation, university leadership must continuously engage in dialogue with business representatives, respond to their needs, and supply the necessary specialists. Educational institutions that succeed in such conditions become more attractive to both prospective students and employers, which in turn ensures financial stability. Thus, universities should take the initiative in fostering productive collaboration with businesses.

CONCLUSION

The implementation of education, science, and business integration based on the formation of an innovation ecosystem around the University 4.0 model aims to enhance the positive impact of scientific and educational activities on the socio-economic development of cities, regions, and the country as a whole. This is achieved through the training of highly qualified personnel aligned with the needs of innovation-driven development, engaging youth in scientific activities and startup creation, promoting the commercialization of scientific results, and facilitating the widespread use of scientific knowledge as a virtually inexhaustible resource for economic growth. This enables the development of highly efficient technologies, tools, products, services, and knowledge.

The practical significance of the findings lies in the development of a mechanism for integrating science, education, and business under the University 4.0 model in Russia.

The study's outcomes are aimed at improving the quality of educational and scientific activities by establishing an innovation ecosystem based on the University 4.0 model.

REFERENCES

Abdullayev, I., Akhmetshin, E., Nayanov, E., Otcheskiy, I., & Lyubanenko, A. (2024). Possibilities of using online network communities in the educational process to develop professional skills in students. Revista Conrado, 20(98), 395–401.

Abduvakhidov, A. M., & Mannapova, E. T. (2021). Digital development of education and universities: Global challenges of the digital economy. International Journal of Instruction, 14(1), 743-760. https://doi.org/10.29333/IJI.2021.14145A

Abramova, M.A., & Trotskaya, A.I. (2018). Integration of education, science, and business as determinants of societal development. Professional Education in the Modern World, 8(3), 2011–2017.

Akhmadeev, B., & Moiseyev, N. (2016). The innovation ecosystem as a key factor for regional economic growth. Bulletin of G.V. Plekhanov Economic University, 4(88), 145–153.

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Akhmetshin, E. M., Kozachek, A. V., Vasilev, V. L., Meshkova, G. V., & Mikhailova, M. V. (2021). Development of a digital university model in modern conditions: Institutional approach. Digital Education Review, (40), 17-32. https://doi.org/10.1344/der.2021.40.17-32

Babikova, A.V., & Fedosova, T.V. (2021). Reverse model of an innovation ecosystem as a tool for intensifying regional technological development. Economics, Entrepreneurship, and Law, 11(6), 1317–1332.

Carayannis, E.G., & Campbell, D.F.J. (2009). 'Mode 3'and 'Quadruple Helix': Towards a 21st-century fractal innovation ecosystem. International Journal of Technology Management, 46(3-4), 201-234.

Davidenko, T.M. (2016). Interaction between the university and the business community in the field of innovative activity. Higher Education in Russia, 5, 112-117.

de Vasconcelos Gomes, L.A., Facin, A.L.F., Salerno, M.S., & Ikenami, R.K. (2018). Unpacking the innovation ecosystem construct: Evolution, gaps, and trends. Technological Forecasting and Social Change, 136, 30–48.

Efremova, P., Romanova, I., Belkin, V., & Vasilyeva, L. (2022). Indicators for assessing the development of innovative activity of a university as a factor of competitiveness in the national and international market. Nuances: Studies on Education, 33(00), e022022. https://doi.org/10.32930/nuances.v33i00.9623

Eskerkhanova, L. T., Beloglazova, L. B., Masyutina, N. M., Romanishina, T. S., & Turishcheva, T. B. (2023). Increasing the competitiveness of future economists for work in industry 4.0. Perspectives of Science and Education, 62(2), 158-173. https://doi.org/10.32744/pse.2023.2.9

Fadeev, A.S., Zmeev, O.A., & Gazizov, T.T. (2020). University model 4.0. Pedagogical Review, 2(30). https://doi.org/10.23951/2307-6127-2020-2-172-178

Feest, U. (2016). The experimenters' regress reconsidered: Replication, tacit knowledge, and the dynamics of knowledge generation. Studies in History and Philosophy of Science. Part A, 58, 34–45.

Gabidullina, F., Nikiforova, N., Afanasyeva, I., & Zharov, A. (2023). European Journal of Contemporary Education, 12(4), 1223-1230. Academic Publishing House Researcher.

Gordeyeva, D.S., & Savchenkov, A.V. (2016). Actual problems of interaction between universities and the real sector of the economy. Bulletin of Chelyabinsk State Pedagogical University, 7, 30-35.

Höglund, L., & Linton, G. (2018). Smart specialization in regional innovation systems: A quadruple helix perspective. R&D Management, 48(1), 60–72.

Itskovits, G. (2010). The triple helix: Universities – enterprises – state. Innovations in action: Translated from English, A.F. Uvarov (Ed.). Tomsk: TGPU-SUR Publishing House.

Ivanova, I. (2014). Quadruple Helix systems and symmetry: A step towards helix innovation system classification. Journal of the Knowledge Economy, 5(2), 357–369.

Kaplan, A., & Haenlein, M. (2016). Higher education and the digital revolution: About MOOCs, SPOCs, social media, and the Cookie Monster. Business Horizons, 59(4), 441–450.

Karanatova, L.G., & Kulev, A.Y. (2015). Modern approaches to the formation of innovation ecosystems in the context of the knowledge economy. Management Consulting, 12, 39–46.

Karayannis, E., & Grigorudis, E. (2016). Quadruple helix innovation spiral and "smart specialization": Knowledge production and national competitiveness. Foresight, 10(1), 31–42.

Karpov, A.O. (2014). The modern university: Environment, partnerships, innovations. Alma Mater. Herald of Higher School, 8, 8–12.

Kirillova, E.A. (2021). Comparative analysis of the main trends in the interaction of scientific and educational organizations with industrial enterprises. Management Sciences, 11(4), 86-98.

Kryucheva, Y., & Tolstoukhova, I. (2023). Modern forms of learning as a means to enhance students' cognitive activity. Nuances: Studies on Education, 34(00), e023006. https://doi.org/10.32930/nuances.v34i00.9963

Kulyasova, E.V., & Trifonov, P.V. (2020). Development of forms of interaction between universities and the business community in the digital economy. Strategic Decisions and Risk Management, 11(2), 216-223.

Lew, Y.K., Khan, Z., & Cozzio, S. (2018). Gravitating towards the quadruple helix: International connections for the enhancement of a regional innovation system in Northeast Italy. R&D Management, 48(1), 44–59.

Msomphora, M.R. (2016). The role of science in fisheries management in Europe: From Mode 1 to Mode 2. Maritime Studies, 15(3). https://doi.org/10.1186/s40152-016-0042-4

Musa Kyzy, A., Azimova, G., Isakova, A., Otorova, A., & Urazalieva, N. (2024). Influence of self-management on the activity of leaders in organizing joint work and improving the quality of educational organization functioning. Revista Conrado, 20(S1), 287–291. Retrieved from https://conrado.ucf.edu.cu/index.php/conrado/article/view/4098

Neborsky, E.V. (2011). Models of integration of education, science, and business in universities of the USA, Europe, and Japan. Problems of Modern Education, 1, 48-59.

Neborsky, E.V. (2017). Reconstruction of the university model: Transition to format 4.0. World of Science, 5(4). https://doi.org/10.15862/26PDMN417

Relações Internacionais do Mundo Atual - unicuritiba
Submetido em: 19/04/2024
Aprovado em: 11/09/2024
Avaliação: Double Blind Review
ISSN: 2316-2880

Nordberg, K. (2015). Enabling regional growth in peripheral non-university regions – The impact of a quadruple helix intermediate organization. Journal of the Knowledge Economy, 6(2), 334–356.

Novichkov, V.B., Ilyichyova, I.V., & Potapov, D.A. (2022). Principles of constructing the content of general secondary education. Anthropological Didactics and Upbringing, 5(4), 10-26.

Pivneva, S., Vaslavskaya, I., Lapir, M., Petrova, O., Shichiyakh, R., & Belova, N. (2023). Assessing the quality of project management in industrial enterprises within the framework of industry 4.0 based on the integral entropy index. Journal of Management & Technology, 23(2), 356–367. https://doi.org/10.20397/2177-6652/2023.v23i2.2662

Rabelo, R.J., & Bernus, P. (2015). A holistic model of building innovation ecosystems. IFAC Papers OnLine, 48(3), 2250–2257.

Razinkina, I.V. (2022). Development of the innovation spiral: Comparative analysis of innovation models of triple, quadruple, and quintuple spirals. Economic Sciences, 1(206), 131–137.

Santotskaya, K. (2020). Evolution of the idea of the university. Vectors of Well-Being: Economy and Society, 1(36), 72-86.

Sazhina, M.A. (2020). The interrelationship of science and education as a factor of innovative economic development. Economic Sciences, 9(190), 151-157.

Sheinbaum, V.S., & Budzinskaya, O.V. (2018). Integration of education, science, and business: Current institutional solutions. Higher Education in Russia, 2(220), 39-46.

Shichkin, I., Ruziev, Z., Jumaniyazova, M., Abdullaeva, M., & Abdullayev, I. (2024). Development of higher education in the context of digitalization: Development of an effective socio-economic integration model. Revista Conrado, 20(S1), 142–147. Retrieved from https://conrado.ucf.edu.cu/index.php/conrado/article/view/4065

Shichkin, I., Sizova, Y., Kolganov, S., & Panova, E. (2024). Perception of the flipped classroom model by students in the process of studying humanities disciplines. European Journal of Contemporary Education, 13(2), 423–431. https://doi.org/10.13187/ejced.2024.2.423

Sousa, R. de O., Moreira, A. D., & Santos, A. R. dos. (2023). Impacts of the pandemic on education and teaching practices: Challenges of new times. Revista Humanidades e Inovação, 10(20). https://revista.unitins.br/index.php/humanidadeseinovacao/article/view/8710

Stroev, P.V., Fattakhov, R.V., Pivovarova, O.V., Orlov, S.L., & Advokatova, A.S. (2022). Taxation transformation under the influence of Industry 4.0. International Journal of Advanced Computer Science and Applications (IJACSA), 13(9). https://doi.org/10.14569/IJACSA.2022.01309116

Sumska, T.V. (2007). The functioning of technopolises and technoparks abroad and lessons for Russia. Herald of NSU. Series: Socio-Economic Sciences, 7, 14-24.

Relações Internacionais do Mundo Atual - unicuritiba
Submetido em: 19/04/2024
Aprovado em: 11/09/2024
Avaliação: Double Blind Review
ISSN: 2316-2880

Syupova, M.S., & Bondarenko, N.A. (2014). Main forms of cooperation between universities and enterprises. Scientists' Notes of TOGU, 5(4), 111–116.

Vasilev, V. L., Gapsalamov, A. R., Bochkareva, T. N., Yumashev, A. V., & Anisimova, T. I. (2020). Digitalization peculiarities of organizations: A case study. Entrepreneurship and Sustainability Issues, 7(4), 3173-3190. https://doi.org/10.9770/jesi.2020.7.4(39)

Vasilev, V. L., Ustyuzhina, O. N., & Akhmetshin, E. M. (2016). The development of education clusters as a tool to enhance economic safety. In Proceedings of the 2nd International Forum on Teacher Education (IFTE) (pp. 411-416). https://doi.org/10.15405/epsbs.2016.07.65

Veit, D.R., Lacerda, D.P., Camargo, L.F.R., Kipper, L.M., & Dresch, A. (2017). Towards Mode 2 knowledge production: Analysis and proposal of a framework for research in business processes. Business Process Management Journal, 23(2), 293–328.

Yesina, Yu.L., Stepanenkova, N.M., & Agafanova, E.E. (2015). Forms and mechanisms for integrating science, education, and the business community in the context of innovative renewal of the regional economy. Creative Economy, 9(12), 1491–1508.

Zhang, T., Shaikh, Z. A., Yumashev, A. V., & Chlad, M. (2020). Applied model of E-learning in the framework of education for sustainable development. Sustainability, 12(16). https://doi.org/10.3390/SU12166420