Institutional Redesign and Dynamics of Collaborative Ties in the Educational Ecosystem

Diana Koroleva
Higher School of Economics

Daria Tomasova
Higher School of Economics

As the landscape of education evolves, there is a growing need to understand and adapt to the changing dynamics of partnerships and collaborations within the educational sector. While previous studies have predominantly focused on spiral models, social networks, and platform models, little attention has been given to the emerging new institutional design in education. Through an extensive analysis of open sources, this research identifies the roles played by both conventional and non-conventional actors in shaping the educational landscape and their contributions to community development.

The study reveals the evolving roles of universities, highlighting their active engagement in fostering entrepreneurship, creating vibrant communities, and supporting lifelong learning. As a result of our study, we propose a mapped scheme illustrating the relationships between the university and other actors within the educational space and illustrating the university's potential to gain ecosystem leadership.

In summary, by capitalizing on the identified opportunities, both parties (universities and non-conventional actors) can foster a thriving ecosystem, driving community development, lifelong learning, and local entrepreneurship.

Keywords: institutional redesign, ecosystem approach, cooperative ties, educational ecosystem, unconventional actors

INTRODUCTION

Over recent decades, the educational system has become a great deal broader and more complex than the totality of traditional educational organizations (universities, colleges, and schools). The educational process is increasingly going beyond the usual institutional framework.

The traditional educational system model has long been based on assumptions of the industrial development model: large-scale design of educational products (long-term educational programs), standard flows of educational services, and restricted access to open resources. There has also been a long-standing tendency towards a production line principle: a limited set of educational service providers were functioning based on established rules and provided unified educational results (Nowell, et al., 2020).

The emergence of digital technologies and disruptive communicative tools has radically reshaped the structure and institutional design of educational services. Like any other markets, contemporary educational markets are increasingly characterized by eliminating intermediaries between the provider and the consumer of services. This happens in many professional areas like journalism, marketing, HORECA, and transport (Parker, et al., 2016). In education, this tendency leads to an exponential increase in the diversity of educational actors. These new educational actors transcend borders and locations with distance learning, cross-discipline learning, and instant worldwide access to knowledge and expertise becoming a new norm (Nambisan, et al., 2019). We also witness the disintegration of educational organizations in a traditional sense.

All these ongoing changes relate to the greater interdependence among different actors and to the co-evolution that binds them together over time. Cooperation and competition ties are becoming much more complex and qualitatively new partnerships appear. First, new actors bring new business models including their location choice, entry mode, knowledge transfer, organizational design, and new market niche creation (Wu & Lin, 2020). Second, there are additional mechanisms of interaction between the formal system and new actors, between educational institutions, businesses, and local communities. These strengthening communication networks are changing the structural characteristics of the educational system (Barokas & Barth, 2018). Third, this shift is driven by the emergence of educational initiatives in urban cultural spaces: new actors use territory infrastructure and resources for research and educational projects (Okano & Samson, 2010) (Vermeersch & Vandenbroucke, 2014). All these processes, in turn, imply different roles for actors to play in the educational system and different interfaces for their interactions with each other.

There is a significant debate over traditional universities' identity deconstruction related to new actors' emergence (Schaeffer, et al., 2018). From one perspective, the current situation could be interpreted as a crisis. However, taking an ecosystemic approach it may also be viewed as a potential opportunity. Taking the shift as a turning point for development, universities sought to investigate communities' needs and students' attachment to campuses to reassess their functions (Carayannis & Campbell, 2006). Aligning their activity with new ecosystem logic creates, for universities, the potential to gain ecosystem leadership.

These transformational changes make it necessary to reassess the research approaches that we apply to studying the multi-layeredness of educational spaces and the high level of internal diversity of each layer. This article makes a twofold contribution: establishing the relevance of the ecosystem approach in educational research, and revealing the ecosystem features in the educational sphere through its economic and institutional components, and collaborative ties. In this article we:

1) We articulate promising avenues of ecosystem model as an approach for future conceptual and empirical educational research, and we develop the principles of this model
2) We explore the implications of the institutional redesign in the educational sphere through the processes of new actors' emergence
3) We consider what the scheme of interactions looks like in an educational ecosystem
4) We define the new role of universities as a "core" around which new educational formats are integrated.

INSTRUMENT AND PRINCIPLES OF FORMING EDUCATIONAL ECOSYSTEM MODEL

We suggest the ecosystem approach as a response to a serious research deficit associated with the scarcity of appropriate methods to modeling the educational sphere development. Prior to commencing our study, we will summarize previously elaborated approaches.

On the one hand, plenty of research has revealed and analyzed new ties and interactions in education. On the other hand, the cumulative benefit of this research has been limited by fragmented nature of studies and inconsistent definitions of what a deinstitutionalization process is.

First, there have been different variants of spiral models created - Triple Helix, Quadruple Helix, and Quintuple Helix, aimed at describing various kinds of collaborations between the state, business, society, public organizations and universities (Colapinto & Porlezza, 2012) (McAdam & Debackere, 2018) (García-Terán & Skoglund, 2019). Interest in spiral models has exploded among academic researchers, and for more

than 25 years, they have added new variables to these models making them more complex and detailed (Carayannis, et al., 2012). At the same time, each spiral model considers a limited set of actors and, given their exponential growth, a universal model is needed.

Second, along with models of institutional collaboration, many researchers address the models of social networks for the transfer and commercialization of knowledge and skills (McKelvey, et al., 2012). This approach has been used to explain various sociological, organizational and infrastructural factors that support fruitful interactions in the educational sphere (Teichler, 2006). However, even though these models emphasize different formats of interaction, they rarely define the deinstitutionalization process. Moreover, these studies are broadly descriptive or are focused on the study of several individual cases and set of specific conditions. Thus, they do not offer a unified "lens" for structuring the totality of interactions in the educational system, the contingency of its components and levels.

Finally, a platform approach is developed and adapted to describe interactions in the educational system (Kerres & Heinen, 2015) (Peruzzo, et al., 2022). It enables a more comprehensive understanding of the mechanisms and outcomes of platform processes: reducing transaction costs, increasing communication connectivity, and developing network ties between providers and consumers of educational services. However, this approach only describes interactions within commercial electronic educational platforms.

To conclude, we witness the lack of a holistic approach to modeling a new institutional design of the educational system and all its levels - general, secondary vocational, higher education, and lifelong education. A broader and more integrative perspective is needed to overcome this deficit and combine disparate streams of institutional design research into a more comprehensive framework. Thus, to develop a comprehensive model of the educational sphere, its actors and relationships, we propose considering it as an ecosystem.

This approach seems to be justified, since it pays special attention to the main features of any ecosystem. According to multiple research, these features are mutually beneficial relations of actors and institutions that convert into networks of co-creation (Kapoor, et al., 2021) (Bogers, et al., 2019); the redundancy and modularity of resources and competencies (McKelvey, 2022); the co-evolution of all elements (Oksanen & Hautamäki, 2015).

As shown above, these properties are fully applicable to the educational sphere at its present development stage. Moreover, within the framework of the ecosystem approach, these properties will receive a new interpretation.

When applying the ecosystem approach there is a need to define a suitable level of digitalization and the criteria for inclusion and exclusion. The ecosystem should not be too broad (include too many elements) such that there is little overlap between all the components of the educational system. Neither should it be so narrow that we lose some components and ties. Thus, in studying the institutional design of the modern educational sphere, we will follow two main principles:

- species diversity of the educational ecosystem actors – meaning that we take into consideration both conventional and new providers of educational services, as well as open educational spaces and integrators;
- Functional diversity of the educational ecosystem actors, that is, the diversity of their tasks, their functions in the educational system and their contribution to the development of education.

Complementarity of functions and interests is what distinguishes ecosystems from other types of networks, and greater complementarities make it easier to align interests and start the co-evolution process. Thus, with taking the educational ecosystem as the main unit of analysis, we will deeply investigate complementarities that arise between actors.

To fully embrace, operationalize and measure complementarities, we will make a twofold analysis. On the one hand, we will identify new partnerships and collaborations within educational organizations and with the periphery of the educational ecosystem. On the other hand, we will search for new roles of traditional and new actors. This approach is expected to proceed to one of our tasks - to consider the scheme of interactions in an educational ecosystem.

INSTITUTIONAL REDESIGN: TYPOLOGY OF NEW ACTORS AND THEIR ROLES IN THE EDUCATIONAL SPHERE

We consider the educational ecosystem as a space of interaction between three actors: educational service providers (conventional and non-conventional ones), platforms, and open spaces. Functions and interactions of these actors and peculiarities of their emergence cumulatively determine the institutional design of the educational sphere.

Educational service providers include conventional and non-conventional actors. The former consist of schools, colleges, universities, and extracurricular education establishments. Using the term "non-conventional actors", we mean organizations and communities which do not belong to the educational sphere but provide some educational services, often within a particular practice-oriented specialization.

New non-conventional actors constantly appear due to the high dynamism of requests and expectations placed on the educational sphere. In conjunction with the rapid formation of new educational formats, this situation provides new niches and new opportunities for non-conventional actors to fulfill their potential and apply their competencies in education. The study of institutional redesign in education primarily identifies such non-conventional actors. In addition, and as part of a broader discussion, we emphasize the problem of classifying or non-classifying these actors as educational providers. We will argue that it depends on the scope and depth of these actors' educational functions. Thus, in the present study, we focus on identifying the list of non-conventional actors that explicitly broadcast their educational functions.

- Educational programs and projects of private companies aimed at vocational guidance and professional training;
- Makerspaces, fablabs, and hacklabs maintaining specialized skills and abilities for technological creativity;
- Accelerators and business incubators that provide expert support and mentoring for startups;
- Specialized business schools and intensive business programs developing innovative entrepreneurial thinking and the basics of project management;
- Case championship communities that foster leadership competencies and prepare participants for career building through business problem-solving competitions;
- Volunteer organizations developing a set of soft skills, emotional intelligence and social work skills of current and future volunteers
- Crowdfunding and crowdsourcing platforms that educate startups in fundraising and project launching principles, and promote entrepreneurship culture;
- Communication and technology companies that create digital educational products based on end-to-end digital technologies.

A variety of platforms occupies a special place in the educational ecosystem. They aid in constructing students' learning trajectories effectively because they are open to interacting with many educational product providers. They are also associated with faster and more efficient tracking of students' achievements, finding the relevant resources, and providing equal access to them. These platforms include EdTech platforms, cultural and educational hubs, and educational marketplaces. They are also recognized for their ability to flexibly integrate different digital technologies in the individual educational track.

The event layer of the educational ecosystem is represented by open spaces and so-called "third places". The third place is a special social environment, away from home and work, open and accessible to all. It is designed primarily for communication, exchange, and meaningful pastimes. Usually the third place has its own style of functioning, as it is adapted to the local visitors' needs and interests (Hadi & Ellisa, 2019). Libraries, parks, cinemas, community and sport centers, and loft spaces are typical examples of third places (Aguilar-Forero & Cifuentes, 2020). Given their focus on social activity in general, many of the third places are also centered on educational activities when distributing ideas, initiatives, and knowledge in the community. They act as a creative laboratory for new educational practices through many educational events and edutainment programs. They facilitate the development of new educational formats, such as exhibitions, edu-festivals, open lectures, and master classes, which have not yet gained sufficient maturity

for traditional educational programs. The third place provides resources to address local cognitive needs and create realistic learning experiences, which may be educational, cultural or social projects launched in cooperation with municipal organizations, businesses, and communities.

Relying on our study of open sources, we identified different ways new educational actors contribute to community development. After a content analysis, we distinguished the four most explicit facets.

First, new actors actively disseminate professional skills in the format of master classes, demo-days, webinars, and meetings with business representatives. For example, crowdfunding platforms attempt to help startups learn fundraising principles, often utilizing extensive consultation with mentors, transferring fundraising experience from experts. Makerspaces and fablabs bring together technology enthusiasts, hi-tech companies, and corporations around projects at the intersection of education, science, and technology businesses. In addition, unlike conventional educational institutions, the new actors are associated with outcomes for a much broader audience: they guide their educational initiatives to all interested stakeholders. Business accelerators provide networking opportunities and meetings with a range of mentors with diverse perspectives and experiences in a shared co-working space. Educational activities of volunteer organizations are focused on expanding the age of active participation in social change. They involve "silver age" representatives in social activities and social design skills acquisition.

Second, new actors strive to develop project management literacy, theory and practice of entrepreneurship, thus enhancing motivation for local entrepreneurship. Specialized business schools and intensive business programs unite participants starting their own business, ensure valuable guidance for business ideas, and provide them opportunities to assemble a team. Case championships emphasized learning through solving real business cases, thus providing participants with the opportunity to create real value for an actual client. These actors support prospective startups and grow business leaders and promote innovative culture and social entrepreneurship in the community.

Third, new actors contribute to the formation of lifelong learning, that is, the development of human capital throughout one's life. Lifelong learning can be developed, on the one hand, through upskilling and reskilling programs that actively engage learners in obtaining new qualifications at any age, and, on the other hand, through expanding one's own personal development. For example, the programs of these business schools are often devoted to giving everyone the opportunity to change their job and find new professional growth areas. All these initiatives are aimed at rapid career advancement even if participants may initially be inexperienced in both business and entrepreneurship, but motivated by the desire to be a founder or manager. Educational initiatives to raise the cultural level occur in intellectual leisure including applied art workshops, thematic quests, gastronomic and aroma lectures, and socio-cultural discussions. Such educational events can be held on a regular basis or as part of cultural events such as book fairs, music festivals, astronomy festivals, or scientific forums.

Fourth, new actors emphasized soft skills development as the basis of successful professional activity and self-realization in the business and social sphere. Compared to conventional educational institutions, new actors focus more on leadership skills, communication skills, and creativity. Accelerators claim an "ability to work with the future" as being key to fulfilling entrepreneurial initiatives, and through a set of educational events they build the main skills necessary to make decisions under conditions of high uncertainty and to use flexible thinking mechanisms. Case championship organizers meet with the participants to reinforce their teamwork and customer relations skills, while offering multiple insights on many issues related to CV writing and job interviews. Volunteer organizations' training programs are oriented on the communication skills necessary for social work in a person-to-person system, as well as the formation of the ability to work in stressful situations. Finally, we observe many short-term courses with soft skills development at the core of their educational programs: for example, school of creative thinking, courses in public speaking and negotiation, and courses in emotional intelligence.

To summarize, the educational activities of new actors react to learners' demands that arise around their transition to a new social role or professional field.

COOPERATIVE BEHAVIOR OF ACTORS IN THE EDUCATIONAL ECOSYSTEM

The educational ecosystem is constantly evolving through the deployment and acceleration of new partnerships between traditional actors, informal venues, integrators, and spaces. Such partnerships emerge at the intersection of research, cultural, social, professional, and teaching activities. These partnerships become valuable, and many times 'notorious' for creating dynamic and rich educational content, and providing a breeding ground for social initiatives, startups and ventures (Rogers, et al., 2013). Partnerships among actors express themselves through cooperative ties stemming from the complementarity of their resources and their efforts to create shared value for stakeholders and extract their part (Chesbrough, et al., 2018) (Radziwon, et al., 2017).

Further, we will consider the relationships that arise in the educational ecosystem among the three types of actors described above.

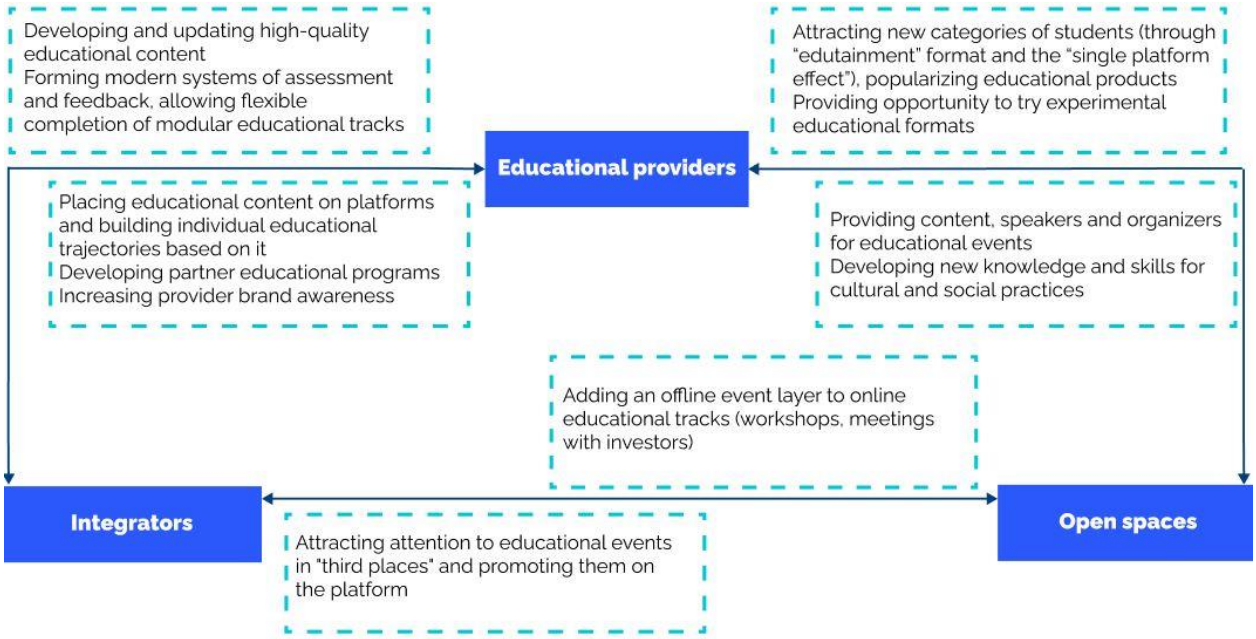
Educational service providers create content, design methodological materials and assessment tools, elaborate new educational formats, and provide speakers for educational events.

"Third places" make their influence visible through providing various locations for educational events and ensuring the popularization of educational initiatives. In other words, they add an event layer to different educational programs.

Platforms have long fulfilled the role of navigators and libraries: they allow placing different content in a single network of interrelated educational programs. Their distinctive function can be described in a few words, as providing a flexible combination of different educational opportunities and overcoming the informational overload of students.

We will briefly reflect the identified cooperative links in the diagram (see Figure 1).

FIGURE 1
COOPERATIVE LINKS IN THE EDUCATIONAL ECOSYSTEM



THE NEW ROLE OF UNIVERSITIES AS THE CORE OF THE EDUCATIONAL INNOVATION ECOSYSTEM

The role of traditional universities is no longer limited to training. Nowadays, university programs have also diversified into industry-vertical interactions, which focus on transferring and commercializing new ideas. Many studies have examined the relationships between educational processes and meaningful social changes. Universities are involved in cultural values creation, and in overcoming social problems. They enable people to engage in multitasking and dynamic university communities.

In view of the continuing changes in the educational sphere, the universities are constantly acquiring new functions, which entail their internal structure transformation and new interactions with other actors. In general, we can identify two main directions of universities' role shifts.

First, educational processes are integrated into their surroundings; they enable collective coexistence of students, teachers, and urban communities through holistic educational experiences, including co-creation and co-design. Universities form a vibrant community, in aiding social bonding and strengthening social capital and social change. They act as a center of big ideas, becoming a platform for public, expert, and informational support of social initiatives (Wang & Zhang, 2019). For example, student teams develop IT solutions for social tasks at the request of urban communities and municipal authorities.

Second, the universities create hubs for venture building: they provide an environment conducive to entrepreneurship skills training, business coaching, together with expert sessions and creative workshops (Teichler, 2006). Such hubs facilitate immersion in breakthrough research to launch startups and spin-offs (Wu & Lin, 2020). To promote this technology-oriented entrepreneurial culture, university-based laboratories actively support technological transfer and launch joint innovative projects that unite business community representatives and centers of student initiatives (Belitski & Heron, 2017). Thus, universities not only fulfill the mission associated with the development of innovative entrepreneurship but also influence their graduates' economic sustainability by overcoming the fragmentation of education-job track.

This shift in university's roles, in turn, transforms the demands on its internal environment. These demands are no longer limited to the accessibility, openness, and high technological level of the educational space, but also imply the need to provide "brainstorming" space. Such a space, physically and psychologically comfortable, should impact people's creativity, innovative experiences, and launch an exchange of cross-disciplinary ideas. We witness emerging smart university campuses, where business incubators are combined with university-industry departments and startup schools (Cai, et al., 2020). Other elements of this new "innovative-friendly" infrastructure could be scientific centers for support of feeder schools, career guidance centers, centers for educational network development, interregional projects platforms, basic chairs of industrial or information and communication companies, and project fairs. Thus, being an active part of a regional innovative ecosystem development, the university creates its own complex internal ecosystem of educational, project, and innovation activities.

As a result, some researchers express the view that the university is now turning to a new higher education system model, and proposes the concept of multiversity (Megahed & Ghoneim, 2022). This concept bridges the gap between theoretical classroom learning and the real-life application of innovative ideas, between cognitive students' results and successful social and technological initiatives. The main multi-university principle is to integrate in a single space, the priorities of innovative regional development (social and environmental sustainability, economic security, and innovative growth), on the one hand, and the students' needs (personal, educational, social, and professional), on the other hand.

Further, we will reveal the relationship between the university and other actors of the educational space that appear in the context of its new roles.

The university interacts with other traditional educational organizations at the level of schools, colleges, and institutions of additional education.

Schools

University-school relationships have two main directions. First, it is teachers' professional support, in the form of thematic events, methodological materials, educational sessions, and content provision. Various

subdivisions and substructures of universities (chairs, research laboratories, science parks at universities) work with school methodological associations and elaborate new assessment strategies for teachers of grades K-12, together with planned strategies for implementing new educational methods. These partnerships have contributed significantly to profile teachers associations (like remedial educators, speech therapists) by offering data driven professional recommendations and developing research on complex topics. These include such issues of inclusive education, early pedagogical assistance, assistance to bilingual children, and adaptation of the educational environment to the children's communicative abilities, on a common university platform. Second, the university provides career guidance and professional self-determination for schoolchildren through demonstrating core professional activities in the form of master classes, preparing for specialized competitions and supervising their scientific research. The university is becoming a platform, providing additional courses for schoolchildren and holding national and regional olympiads, summer schools, and other events. Schools and lyceums can make part of the profile university district, resulting in schoolchildren joining different science park programs at universities.

Organizations for Additional Education

In partnership with organizations for additional education, universities support various educational events, such as learning camps and art residencies. Research universities, together with houses of creativity and youth ecological stations, invest efforts in restoring thematic movements in the sector of additional education - ecological training, search teams, geological parties. Universities facilitate early talent development systems, providing specialists and mentorship for children's technology parks. This provides the basis for developing the research component within additional education for children and adolescents.

Educational Platforms

Partnerships between universities and platforms primarily focus on content development in the form of mass open online courses (MOOCs). Universities offer learning materials supported by their academic reputation, while EdTech platforms contribute to popularization by making university courses available online on their network technology platforms and multiplying student audiences. They also earn recognition as experimental spaces, providing opportunities to test new methodological solutions (like micrograde), and collect big data, which enables universities to personalize their materials and learning formats based on analytics. In addition, EdTech platforms provide organizational and technical services related to different aspects of the educational process in university - such as administrative work (accreditation, students' funding), content (assessment systems, curriculum development, individual learning tracking), scientific (big data for pedagogical research, storage and publishing educational materials).

Communities

The university interacts with public organizations (volunteer organizations, veterans' unions, communities of artists, etc.) and youth policy centers to develop social initiatives based on co-creation principles. Participants (students and active community members) are faced with the real tasks of developing an actual cultural, social or entertainment project. The universities also create edutainment formats for the community by opening science parks and collaboration houses in their locations, which become points of science popularization through fascinating and interactive exhibits. Community-university partnership has multiple benefits: it broadens the educational content of universities, through adding intellectual capital, skills and experience, distributed among local community members and also, universities create new tools to solve social problems.

Third Place

University students are involved in cultural institutions' projects; they apply their skills and learning experience to create museum sites and art objects for urban spaces, prepare thematic exhibitions, and conduct excursions. University professors and specialists serve as judges, experts and tutors at competitive events in urban spaces. The university earns recognition as a third place, creating an open infrastructure

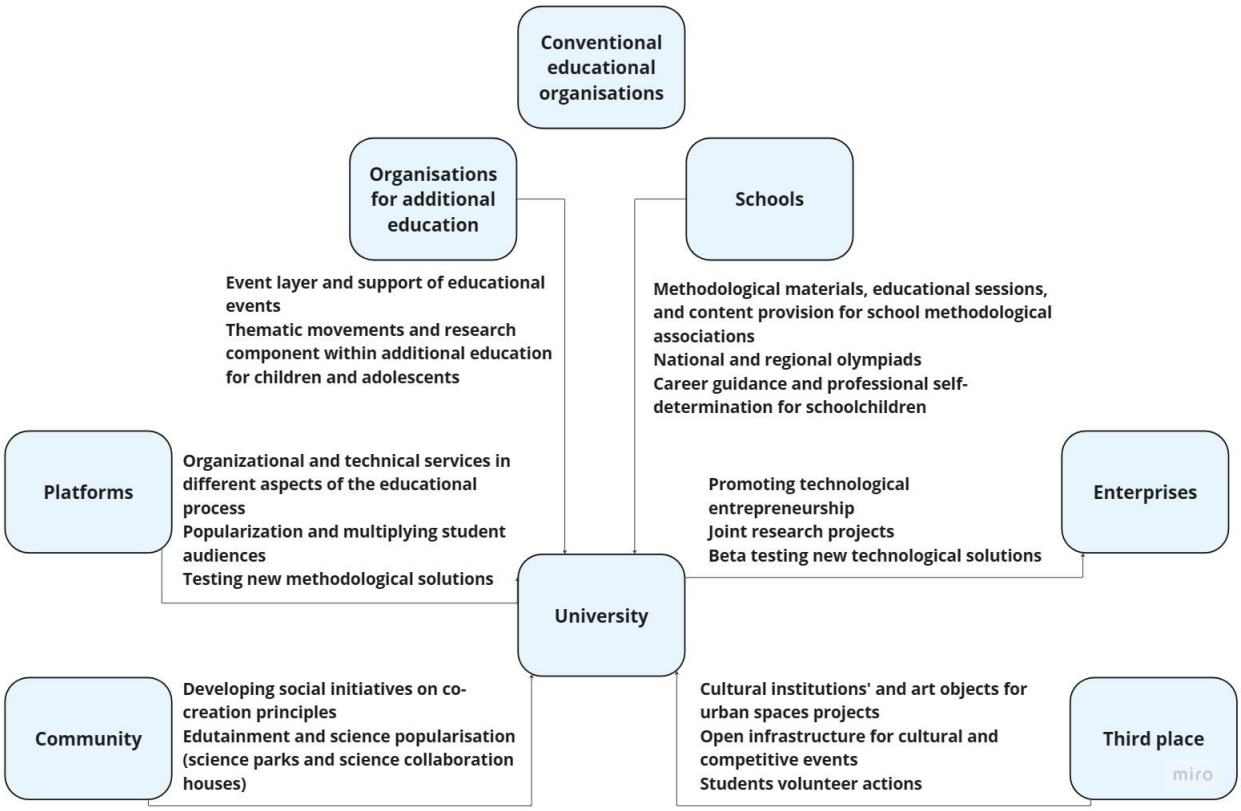
within which cultural events for community (exhibitions, book presentations and meetings with writers, total dictations, foresight sessions, and others) take place.

Business

Universities actively cooperate with enterprises, financial and investment structures, and crowdsourcing platforms to promote and strengthen technological entrepreneurship. Being at the core of a regional innovation ecosystem, universities conduct joint research projects with innovation-industry clusters, mediate the process of beta testing, and turn laboratory samples into new technological solutions.

We will present these interactions on the diagram (See Figure 2).

FIGURE 2
UNIVERSITY'S RELATIONSHIPS MAP



DISCUSSION

This study advances the field of educational research by proposing the ecosystem model as a promising approach for conceptualizing and studying the complexities of the educational landscape. The principles developed in this study provide a framework for understanding the dynamics of the educational ecosystem, including the implications of institutional redesign and the changing role of universities as a "core" for integrating new educational formats. Moreover, the research uncovers the involvement of unconventional actors, such as makerspaces, accelerators, and crowdfunding platforms, in disseminating professional skills, developing project management literacy, and nurturing soft skills. These insights contribute to the ongoing discourse on educational ecosystems and highlight the need for adaptive strategies in response to the evolving educational landscape.

A limitation of our study lies in the fact that, in our pursuit of obtaining a comprehensive understanding of the interrelationships in education, we have disregarded the affiliation of actors to different levels. We

have depicted the main types and effects of interactions between universities, educational service providers, open and cultural spaces, communities, and enterprises without contextualizing them on municipal, regional, or federal levels. However, interactions among actors occur at different levels and exhibit their own specificity. Considering this, we now discuss how the relationships between universities and other actors may vary depending on the level of affiliation.

First, we want to stress that the new roles and functions of universities are different when applied to different levels of the social system. At the municipal level, the university transforms municipal districts' socio-economic and cultural characteristics. It also affects the quality of the infrastructure, filling the space with scientific, cultural, and educational events.

At the regional level, the incentives of the university are closely aligned with the region's development plan, and the university establishes contacts with different regional institutions like youth policy departments or public initiatives foundations. It focuses on the task of preserving small towns. Another byproduct of the structured partnerships with regional administrations is that university acts as a social trust builder and guarantor of certain agreements among regional actors.

Finally, at the federal level, the university significantly contributes to implementing federal projects and national programs (in cooperation with the Ministry of Science and Higher Education, the Ministry of Labor and Social Protection, and the Ministry of Economic Development). It provides expertise, information (including research results), and human resources to the federal development institutions involved in these programs.

Thus, the university's role in shaping the socio-economic and cultural climate differs at different levels. We can also track the difference of ties and interaction types between the university and actors of the same type operating at different levels. Let us consider an example of the entrepreneurial initiatives of university accelerators—municipal, regional and federal.

Municipal accelerators at universities serve hubs for solving "smart city" infrastructure problems. They help nascent technological and informational projects intended to be integrated into the economy and social environment of the city. The university intensively interacts with the city administration and professional communities to fulfill this function. Administrations provide platforms for piloting projects as well as access to the necessary data. Communities provide the combined benefits of project expertise and networking. Along with this, the university involves city enterprises and investors in co-financing start-ups and placing pre-orders for samples of new products.

At the regional level, universities establish accelerators that focus primarily on the resources of the local economy and its internal development drivers. These accelerators are often built as industry focused (according to the region's industrial priorities). They are designed to develop a regional innovative ecosystem in cooperation with regional public organizations, initiative development agencies, innovation promotion foundations, and regional industry committees. Regional accelerators at universities act according to the concept of spatial proximity. This means that the direct effect of interaction between the university and high-tech business in the form of launching spin-off companies, ventures, and license and technology transfer is local. In other words, this effect works well within a municipality or a small region.

Federal accelerators arise on the basis of federal or national flagship universities. These accelerators are affiliated with foreign investment companies, strategic government laboratories, and branches of large corporations. They focus on supporting growth-oriented, technology-intensive national-level or even international ventures. As a significant part of their activities, federal accelerators facilitate business communication with foreign partners, perform tender export support and become a platform for forming cross-national partnerships and joint projects. The university also enters into partnerships with national digital services, enabling free access to, for example, recruitment, creation of online stores, procurement, and financial accounting for projects.

Thus, we can suggest further research on this topic by undertaking a detailed analysis of the differences in the mechanisms of university contributions to innovation, human capital, and sociocultural and environmental development at different levels.

ACKNOWLEDGEMENT

The research was supported by RSF (project no. 22-18-00687 “Research on the institutional design of the Russian education system transformation in the context of post pandemic reality: Ecosystem analysis and landscape mapping”).

REFERENCES

Barokas, J., & Barth, I. (2018). Multi-stakeholder ecosystems in rapidly changing educational environments. *2018 IEEE Global Engineering Education Conference (EDUCON)*, pp. 1934–1938.

Belitski, M., & Heron, K. (2017). Expanding entrepreneurship education ecosystems. *Journal of Management Development*, *36*(2), 163–177.

Bogers, M., Sims, J., & West, J. (2019). What is an ecosystem? Incorporating 25 years of ecosystem research. *Academy of Management Proceedings*, *19*(1), 3–31.

Cai, Y., Ma, J., & Chen, Q. (2020). Higher education in innovation ecosystems. *Sustainability*, *12*, 43–76.

Carayannis, E.G., & Campbell, D.F. (2006). *Knowledge creation, diffusion, and use in innovation networks and knowledge clusters: A comparative systems approach across the United States, Europe, and Asia*. Greenwood Publishing Group.

Carayannis, E.G., Barth, T.D., & Campbell, D.F. (2012). The Quintuple Helix innovation model: Global warming as a challenge and driver for innovation. *Journal of Innovation and Entrepreneurship*, *1*, 1–12.

Chesbrough, H., Lettl, C., & Ritter, T. (2018). Value creation and value capture in open innovation. *Journal of Product Innovation Management*, *35*(6), 930–938.

Colapinto, C., & Porlezza, C. (2012). Innovation in Creative Industries: From the Quadruple Helix Model to the Systems Theory. *Journal of the Knowledge Economy*, *3*(4), 343–353.

García-Terán, J., & Skoglund, A. (2019). A Processual Approach for the Quadruple Helix Model: The Case of a Regional Project in Uppsala. *Journal of the Knowledge Economy*, *10*(3), 1272–1296.

Hadi, R., & Ellisa, E. (2019). Rethinking third place in the digital era. *International Conference on Informatic, Technology and Engineering*.

Kapoor, K., Bigdeli, A.Z., Dwivedi, Y.K., Schroeder, A., Beltagui, A., & Baines, T. (2021). A socio-technical view of platform ecosystems: Systematic review and research agenda. *Journal of Business Research*, *128*, 94–108.

Kerres, M., & Heinen, R. (2015). Open informational ecosystems: The missing link for sharing educational resources. *International Review of Research in Open and Distributed Learning*, *16*(1), 24–39.

McAdam, M., & Debackere, K. (2018). Beyond ‘triple helix’ toward ‘quadruple helix’ models in regional innovation systems: Implications for theory and practice. *R&D Management*, *48*(1), 3–6.

McKelvey, B. (2022). *Organizational systematics: Taxonomy, evolution, classification*. Univ of California Press.

McKelvey, B., Lichtenstein, B.B., & Andriani, P. (2012). When organisations and ecosystems interact: Toward a law of requisite fractality in firms. *International Journal of Complexity in Leadership and Management*, *2*, 104–136.

Megahed, N.A., & Ghoneim, E.M. (2022). E-learning ecosystem metaphor: Building sustainable education for the post-COVID-19 era. *International Journal of Learning Technology*, *17*(2), 133–153.

Nambisan, S., Zahra, S.A., & Luo, Y. (2019). Global platforms and ecosystems: Implications for international business theories. *Journal of International Business Studies*, *50*(9), 1464–1486.

Nowell, L., Dhingra, S., Andrews, K., Gospodinov, J., Liu, C., & Alix Hayden, K. (2020). Grand challenges as educational innovations in higher education: A scoping review of the literature. *Education Research International*, pp. 1–39.

Okano, H., & Samson, D. (2010). Cultural urban branding and creative cities: A theoretical framework for promoting creativity in the public spaces. *Cities*, *27*, 10–15.
Oksanen, K., & Hautamäki, A. (2015). Sustainable innovation: A competitive advantage for innovation ecosystems. *Technology Innovation Management Review*, *5*, 18–25.
Parker, G.G., Alstyne, M.W., & Choudary, S.P. (2016). *Platform revolution: How networked markets are transforming the economy and how to make them work for you*. WW Norton & Company.
Peruzzo, F., Ball, S.J., & Grimaldi, E. (2022). Peopling the crowded education state: Heterarchical spaces, EdTech markets and new modes of governing during the COVID-19 pandemic. *International Journal of Educational Research*, *114*, 102–126.
Radziwon, A., Bogers, M., & Bilberg, A. (2017). Creating and capturing value in a regional innovation ecosystem: A study of how manufacturing SMEs develop collaborative solutions. *International Journal of Technology Management*, *75*, 73–96.
Rogers, K.H., Luton, R., Biggs, H., Biggs, R., Blignaut, S., Choles, A.G., & Tangwe, P. (2013). Fostering complexity thinking in action research for change in social–ecological systems. *Ecology and Society*, *18*(2), 31–42.
Schaeffer, P.R., Fischer, B., & Queiroz, S. (2018). Beyond education: The role of research universities in innovation ecosystems. *Foresight*, *12*, 50–61.
Teichler, U. (2006). Changing structures of the higher education systems: The increasing complexity of underlying forces. *Higher Education Policy*, *19*(4), 447–461.
Vermeersch, L., & Vandenbroucke, A. (2014). Schools and Cultural Organisations Natural Partners in Art and Cultural Education (ACE)? *Procedia-Social and Behavioral Sciences*, *116*, 1032–1039.
Wang, Z., & Zhang, Q. (2019). Higher-Education Ecosystem Construction and Innovative Talents Cultivating. *Open Journal of Social Sciences*, *7*, 146–153.
Wu, S., & Lin, C.Y.Y. (2020). *Innovation and entrepreneurship in an educational ecosystem: Cases from Taiwan*. Springer Nature.