

## Integrated and Network Systems of Research Education in the Knowledge Society (By Example of the Russian Educational System)

Karpov Alexander

PhD in physics and mathematics; researcher at Bauman University (Moscow, Russia)  
danilenko\_d@mail.ru

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### Abstract

The purpose of the paper is to present the results of the theoretical study of the research education modern model institutionalism that describe the structure of learning communities, their social forms and systemic genesis. The methodological approach is based on the structural-functional analysis of the 25 years' experience of the Russian scientific and social programme for young people and schoolchildren "The Step into the Future". The article explains the concept of an "integrated educational system" in the context of the development of modern education in line with the movement towards the knowledge society. An integrated educational system becomes the basis for modern educational socio-morphism and relies on a network of specialized partnerships. The cluster-network organization scheme of an integrated system is considered, as well as its forms and the model of genesis. Classification of integrated educational systems that associate institutions of secondary and higher education and professional systems of the society has been developed; examples have been provided. A conceptual analysis of a special integrated educational system is given, that is, of a macro-school", which is an educational network of geographically distributed partnerships. The genesis of the institutional-environmental structure of learning communities of the research type has been shown to be determined by the development of the interdependent system of "environment – method" relations.

**Keywords:** education, institutionalism, knowledge society, research, education

### 1. Introduction

Modern education systems are developing as institutionally complex structures, which build the process of learning on the basis of professional organizations from different sectors of society (Ursul, Ursul 2013). The educational institution that focuses on the production of knowledge takes on characteristics of a scientific organization. The deep structure of its cognitive attitude is built coherently oriented at sociomorphic models of research thinking. In other words, social ways of the research cogito functioning have a determining effect on transformation processes of the institutional and environmental basis of learning communities. In its turn, without an authentic sociomorphic transformation of educational environment, the research cognition is unable to become a genetic part of modern education. There exists an interdependent system of "environment - method" relations, which determines the genesis of the institutional and environmental structure of the research-type learning communities and forms the locus of "scientific natural gifts" in the modern paradigmatically-differentiated education system (Karpov 2013).

The objective of the study is the development of modern model of scientific research education institutionalization, this model oriented at training specialists for the knowledge society, who are able to produce a new knowledge, realize its technologization and provide social and economic development.

The methodology of the study includes two main components. The first component is a cultural and historical analysis of the genesis of the knowledge society concept and present-day ideas about network forms of education integration with professional institutions of the society. The second component is a structural and functional analysis of 25-year experience of the Russian scientific and social programme for youth and schoolchildren "The Step into the Future". The first methodological component permits to substantiate the development of modern educational systems from the viewpoint of establishing network partnerships, which provide effective ways of knowledge exchange in the innovation system of the modern society. The second methodological component provides the validity of the study results because it includes facts and analyses resulted from the practice of the most vigorous and representative system of research education in present-day Russia developed by "The Step into the Future" Programme. At present more than 150 thousand young researchers – schoolchildren and students – are participating in it as well as more than a hundred universities and research organizations, about five thousand schools. "The Step into the Future" Programme cooperates

in the field of scientific education of young people with the European Union Commission and partner organizations from 46 countries, which favours the accumulation of the most progressive educational experience in its activity.

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## 2. Network Integration in the Society of Knowledge

Modern society is developing as a society of interconnected organizations that either institutionally integrated within an overall administrative platform, or interact as complex network partnerships (Ursul 2015). The appearance of this social configuration was already envisaged by the concept of the knowledge society developed in the 1940 's-1960 's, in particular, in the writings of P. Drucker.

In the "Concept of the Corporation" (1946), Drucker says that the problems of a modern corporation are, first, the problems of *social* organization and the development of its social structure (Drucker 2008). In the "New Society" (1950), Drucker argues over a special role of a knowledge worker, the basis of which "is intellectual ability rather than skill" (Drucker 2010). In the book the "Landmarks of Tomorrow" (1957), Drucker is developing the set of ideas on the *innovation* system of the society; among them, there is the concept of "education society", that is, a society, which is based on education and the idea of advanced education (Drucker 1996). In "The Effective Executive" (1967), Drucker states that in today's society a knowledge organization becomes the focus of reality, where the center of attention is shifting to the knowledge worker who produces knowledge, ideas, information (Drucker 2006).

In his fundamental work "The Age of Discontinuity" (1968) P. Drucker sums up much of what he said earlier about the new society and the idea of its socio-economic development. For the name of this society, he uses the term the "knowledge society", (the "society of knowledge"). He points to the need of organizing continuing education in the knowledge society. University laboratories, states Drucker, are the basis of the scientific organization of which it grows (Drucker 1969).

As one of the main components of the concept of the knowledge society, Drucker addresses the "society of organizations". He will devote four chapters to this concept that make up a separate part of the book (it is called exactly "A Society of Organizations"). Today's organizations are interdependent, says Drucker; their main problem is a problem of communication, while the arising management networks are rather a kind of "felt" with tangled disparate threads (Drucker 1969).

Drucker highlighted the issue that found an effective solution in twenty years with the creation of the Internet global communications network. The Internet was implemented on the basis of the ARPANET, developed with funding from the Ministry of Defense of the United States in the event of nuclear war with the Soviet Union, and by the mid-1990's it had approximately 20 million users whose number was grown exponentially (Castells 2010).

The society of interrelated organizations described by P. Drucker became the network society, the concept of which was proposed by M. Castells in the first book of his three-volume work "The Information Age", released in 1996 year. The social structure of the information age, writes M. Castells, is made up "of networks of production, power and experience, which construct a culture of virtuality in the global flows that transcend time and space" (Castells 1998). The networks are becoming "fundamental stuff of which new organizations are and will be made." The network structure "allows small and medium businesses to link up with major corporations, forming networks that are able to innovate and adapt relentlessly" (Castells 2010).

Today, network partnerships are the basis of high-performance innovative environments, developing in the paradigm of the knowledge society. They unite distributed organizational structures dealing with research, technologization of projects, industrial production and commercialization of products (Karpov 2012). Thereby the advantages of small technology towns or regional business centers are whittling away. So, the United States are gradually moving from a business incubator model like Silicon Valley to the network of the distributed partnerships (Il'ina 2001).

The development of modern forms of education systems is in line with the establishment of networks of partnerships between universities and high-tech companies, research institutes and venture businesses based on the model of open innovation (Karpov 2013). Specialized networks of partners provide a kind of ecosystem for an educational organization that ensures educational investment in human capital.

At the beginning of the new century, universities are becoming the key link in building the knowledge society as they are at the crossroads of research, education and innovation (Commission of the European Communities, 2003). At the European meeting at Hampton Court (2005), universities were called the basis of European competitiveness (Commission of the European Communities, 2006). The decisive factor for the EU research superiority was announced to

be the superiority of *teaching* research activities (Commission of the European Communities, 2002). In the concept of establishing excellence networks in EU the focus is on the idea of *combining scientific environments* of universities into network structures at the global level, which could use the strengths of their participants (European University Association, 2003). Thus concentrated reserve fund of knowledge, talent and energy is becoming a strategic resource of society to address the multidisciplinary and transdisciplinary challenges (Commission of the European Communities, 2006).

The improving quality and increasing productivity of research studies performed in Western universities make them the lead agent in the commercial development of scientific knowledge (Thursby, Kemp 2002). The collaboration between universities and industry results in scientific discoveries (Shugurov 2015) translation into innovative products, which are commercialized with the help of suitable business models (Chesbrough 2007). Thus, the innovation strategy of the UK, as set out in the Innovation Nation White Paper (2008), provides a dramatic increase in the number of knowledge transfer partnerships.

In Russia, inter-university corporations are being built in line with the educational systems of superiority. A supercomputing consortium, uniting 45 universities, according to MSU Rector V.A. Sadovnichy, allowed Russia to occupy one of the leading places in the world in this sphere. He singled out biotechnology, nanotechnology, sciences of man as promising areas for pooling scientific environments of universities (Bulgakova 2011). The prospects of establishing an open network federal university as a single information and telecommunication space, combining federal universities of the country are being discussed (Kudryashova 2013), the issues of multi-tier production-scientific-educational complexes and clusters are being studied (Pisareva 2013). Systems of dual education are evolving in the form of integrated networks, which connect the academic study and vocational training at an enterprise. They are functioning, for example, in Krasnoyarsk Krai and Tambov Region (Bulgakova 2015). In 2015, eight leading universities joined in the Association "Russian national platform of open education" with the aim of establishing a network university. In Moscow Region, a design and technology cluster is planned to be created, the center of which will be an educational complex combining academic higher education institutions, secondary schools and post-secondary education. In addition, the cluster will comprise creative, production and infrastructure units (Dulenkova, Mertsalova, Aminov 2015).

Modern educational systems, particularly systems of research education, are seeking to build successive teaching between secondary and higher schools. The enhancement of the socio-cultural space of school has been debated since the mid-20th century. Thus, K. Mannheim argues about the need for integration of schools with other public institutions. In 1989, the Russian sociologist Igor Kon defined basic terms and conditions of such integration, according to which "the cooperation of school with extracurricular ... agencies inevitably means a serious breakdown of the usual, emerging from the XVII century forms of educational process" (Kon 1989). In the early 2000 's in Western education, the issue of bringing to teaching the institutions, specialized on functions performed by knowledge in the post-industrial culture was being discussed (Carr 2003), and the viewpoint that the roots of creative society were to be found in general education was stated (Higgins 2000). Academic, professional and cultural institutions of the society were included into the scope of educational institutions. For example, J. Graham called this kind of association the "transformative partnerships" (Tomlinson 2000) and W.E. Dall named it "dynamic social communities" (Doll 1993).

In 1991, the Russian scientific and social programme for young people and schoolchildren "The Step into the Future" started its activities (Karpov 2012). The program cultivates the research learning method based on cognitive-generative principles (Karpov 2010). By the mid 90-ies, on the territories of nine time zones, it has generated more than 100 geographically distributed cognitive structures of the network type for successive education of young people engaged in scientific research and technological development.

The activities of the "The Step into the Future" Programme has provided the first experience of creating a powerful, extensive and multi-level educational partnership system of the research type. Not coincidentally, at the World Summit on innovative education (WISE, Doha, 2011) the two reports were invited from Russia, the first was devoted to "The Step into the Future" Programme (the second report dealt with the Skolkovo innovative project). The experience obtained by "The Step into the Future" Programme shows that the development of integrated and network systems is a genetic feature of the educational institution of the research type. Therefore, the study of their capabilities and configurations provides the key to effective forms of organization of modern education. This experience has formed the basis for this article.

### 3. Integrated Educational System

The basic concept of educational sociomorphism today is an *integrated educational system*, that is, such organization of education that includes the socio-cultural environment in a cognitive architecture of learning communities (the concept of

an "integrated educational system" was introduced by the author in 2003) (Karpov 2003). The institutionalization of research education is arranged in reliance on social structure, which is the place of knowledge production and its professional use.

Research education requires academic and professional mentors, specialized search modes of cognition, a material-technical basis, which define the research area of cognition. Therefore, research education should incorporate a social structure that is able to provide the educational function of the research type. The possibilities of the latter, in turn, are growing commensurably with the instrumental and environmental wealth of the outside cognitive agents involved in the training process. Thus, the growth of the socio-cultural environment of an educational institute that is working in the conditions of the research paradigm is being stimulated. Hence the integrated educational system is formed, which acts as an organized partnership (an association) of higher and secondary educational institutions (including special education) with professional institutions of society, performing cognitively generative, technological and socio-cultural functions in the production of modern knowledge.

One of typical forms of an integrated educational system is a *cluster-network model*. A separate cluster is a set of social institutions that has a distributed educational infrastructure and constitutes a whole in external educational interactions. In turn, clusters are linked together with a network of relationships that form a local partnership system, which allows enriching the curricula and social practices, to conduct joint studies and use the results, to create shared resources and exchange mechanisms, etc.

Figure 1 shows a morphological diagram illustrating a cluster-network model of an educational system organization. The network nodes represent three types of objects; of them, the cluster type objects are: (1) a "hard" institutional complex that combines a university, school, technical college, research institute, production, and (2) a social partnership - institutionally "soft" association of academic and professional organizations; a non-cluster type is represented by a separate educational or professional institute. The scheme represents a "star-shaped" form of the network organization in which a separate cluster is a switcher that provides some form of educational domination.

Thus, a historically established form of the educational institution existence in the form of a mono-organization, or, in other words, a uniform education system, is being subjected to structural-functional and educational transformations while it is moving towards the knowledge society. It finds its new existence in the association of institutional agents of a new culture of knowledge, whose genetic quality is the ability to produce the *science-supporting* environment with individually attractive cognitive content. This environment is always greater than an institution. Its "lifestyle is a condition for the emergence of ideas and, particularly, for their serious perception"; its contents delivered from the world become a subject of the study; its intentions pave ways leading to the achievement of results, and thus form a special, *scientific and methodical* mind, which is the only one science can exist with (Jaspers 2006).

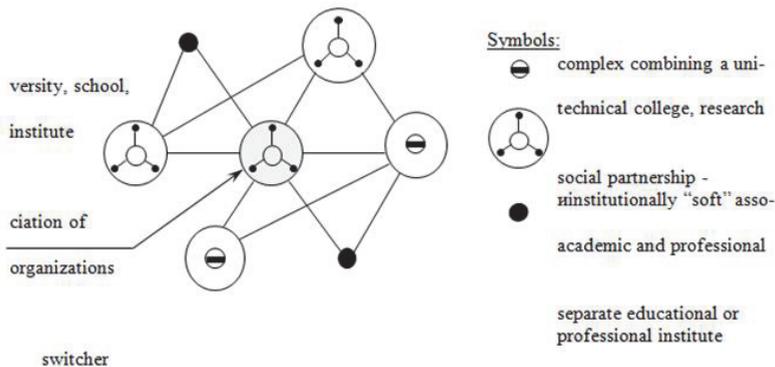


Figure 1. Example of a cluster-network organization of an integrated educational system

The cognitive environment arising in the process of formation and functioning of the integrated educational system must be able to carry a range of opportunities and uncertainties, whose wealth contains the research capacity of the reality. The functional learning environment of the research type should not *simulate* the external world (in the abstract-logical understanding of the action), but create such a kind of content of educational communities, whose mental and instrumental contents would exceed the capacity of the local areas of existence of the individual. This superiority can be

achieved, firstly, with the quality and the intensity of the socio-cultural contents; secondly, with the degree of friendliness of the cognitive field, including individual attractiveness; thirdly, with cognitive mobility (Karpov 2008) that generates trajectories of psychosocial growth of a personality in a stimulating didactic system.

#### 4. Forms and Genesis of Integrated Educational Systems

In the process of systemic genesis of educational communities of the research type, one or more organizations take the function of a switcher of the integrated educational system upon themselves, i.e. coordinate educational and management actions. As the formation of such associations takes place, two system components are being transformed: the educational and structural-functional ones. Synchronization of the environment and the method development, as you will see later, is a principal factor in determining both the stages of genesis of integrated educational systems and the rules of designing their socio-cultural environment. It is through the method that synchronization of institutionalization and educational technicism in systemic genesis of an educational institution of the research type is implemented.

In the development of the *educational* component, which determines the ways of knowledge transfer, one can mark out several stages. In an association coming into existence at the initial stage of a systemic genesis, the research training is fragmentary and is, as a rule, of a prescription-technological nature. It is implemented in isolated specialized groups, educational and scientific laboratories, through specialized courses and optional classes, i.e., it is realized in the form of additional practices, which are non-integrated in the basic educational process.

Further development of the educational process in the research direction results from more intensive connections with the disciplines, expansion of trans- and interdisciplinarity, critical analysis of the results of education and correction, building the whole network including both traditional and cognitive research methods. At this stage, one can talk about the formation of the research method of learning in the integrated educational system (Karpov 2014).

The next stage of the research education development is related to the establishment of a methodological support for the searching educational activity, which allows to explore, develop and design training methods using scientific and technological ways of invasion into reality. At this stage, epistemological approaches in research training are conceptualized and the methodology of scientific-educational activity is formed.

So, there are three stages of development of the educational component in an integrated educational system of the research type, which are respectively characterized by: (1) non-integrated educational practices of the search type, (2) the method of research training, (3) methodology of scientific-educational activity.

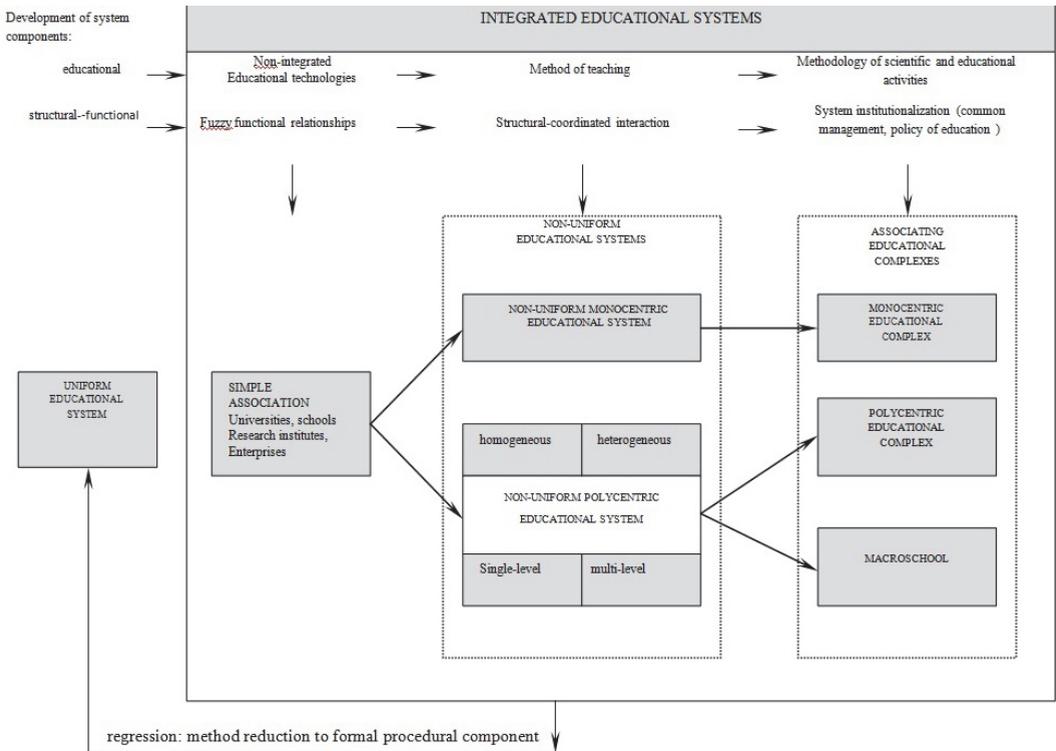
States of *structural-functional* components of an integrated educational system as their complexity increases can be classified as follows: (1) fuzzy functional links, (2) structurally coordinated interaction, (3) the institutionalization of the system.

The association with fuzzy functional relationships between educational and non-educational organizations involves the allocation of resources (educational, professional, communication and information, material) in one or more areas of joint activities, such as research and project work, research and production practice, vocational guidance, etc. In such systems, the switcher performs the minimum organizational and methodological functions.

In the structurally coordinated system, the switcher determines and approves educational functions, works out the overall strategy and direction of training activities, forms scientific and methodological, organizational and expert functional sections in which representatives of the association members participate.

The institutionalization of the system involves the formation of an integrated managed educational complex, based on the resources of the association members, with the substantive aspects of its work described in legal documents, as well as following the general educational policy by all association members. The switcher functions are transferred to the management structure of the complex.

In practice, the development of educational and structural-functional components demonstrates a high degree of consistency. This gives grounds to single out the following general stages of the integrated educational system genesis. The first stage is a *simple association*, characterized by non-integrated educational technologies and fuzzy functional relationships. The second stage is a *non-uniform educational system*, which involves creating a method of teaching and formation of structural-coordinated interaction. The third phase is an *associating educational complex*; the latter is characterized by the development of the methodology of scientific-educational activity and institutionalization of an integrated educational system. The scheme of the integrated educational system genesis is presented in Figure 2.

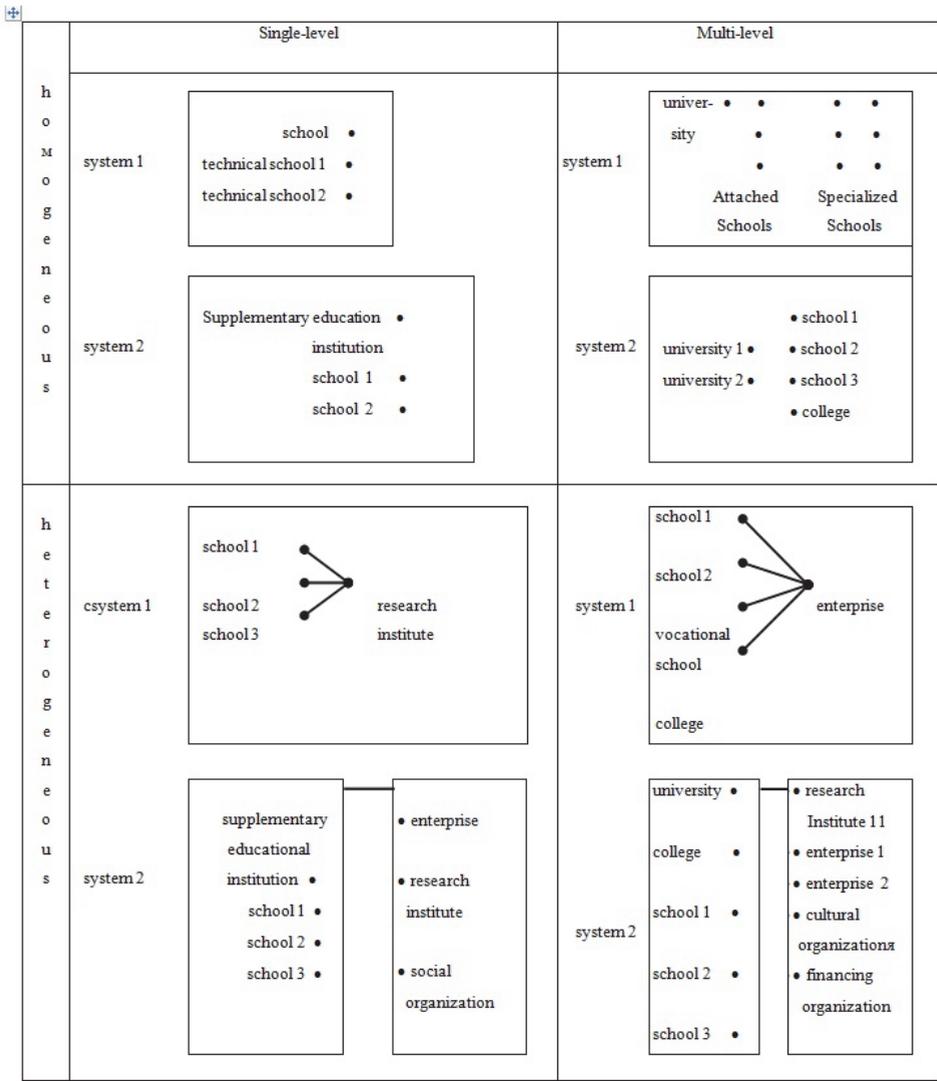


**Figure 2.** The genesis of integrated educational systems Classification of integrated educational systems

Depending on the number of educational institutions that are members of the association with professional organizations, the non-uniform educational systems can be classified as *monocentric*, which contain one educational institution, and *polycentric*, which combine several institutions. It should be noted that monocentric configurations have revealed instability since, as a rule, an educational institution operates today in a multilevel educational environment, and hence tends to polycentric forms of interaction.

In turn, a non-uniform polycentric educational system can be typified according to associating educational institutions of different educational levels and the inclusion in the system of professional organizations. The education system, which includes educational institutions working with students of the same *limiting* educational level, will be referred to as a *single-level* system, otherwise it will be called *multi-level* system. For example, systems incorporating schools only, or schools and vocational schools, or schools, vocational schools and institutions of supplementary education will be referred to as single-level ones. These systems will become multi-level if they include, for example, universities and/or technical colleges. Note that these associations can include or not include vocational organizations.

A non-uniform polycentric educational system is *homogeneous* when it combines educational organizations only; if the association incorporates vocational organizations, it becomes *heterogeneous*. A non-uniform monocentric educational system is always heterogeneous. The classification scheme for non-uniform polycentric systems based on the characteristics: "homogeneous", "heterogeneous", "single-level" and "multi-level" is shown in Figure 3. In fact, single-level polycentric educational systems, both homogeneous and heterogeneous, are monocentric systems institutionally split in its educational structure, which makes them unstable by one and the same reason - by their attraction to dominant multi-level educational relations in the conditions of the movement to the knowledge society.



**Figure 3.** Sample configurations of heterogeneous polycentric educational systems, classified on the basis of characteristics: "homogeneous", "heterogeneous", "single-level" and "multi-level"

Regional educational and research partnerships created by the "The Step into the Future" Programme have passed through the stage of non-uniform educational systems in their development. Being a structural-functional link of the Programme, they have positioned themselves as regional coordination centers. Therefore, an integrated educational system in the Karelian Republic, the switcher of which was the Petrozavodsk State University and the associated organizations, along with the schools of Karelia, were the Republican Center of technical creativity and education authorities at different levels, functioned as a homogeneous multi-level configuration. In the District of Kolchugino, Vladimir Region, the Programme supported a heterogeneous multilevel educational system. The District Centre for out-of-school activities and the Department of education in Kolchugino acted as switchers in the scientific and educational network, which included in addition to urban and rural schools and universities, the S. Ordzhonikidze plant. Other examples of integrated educational systems will be provided later.

In the typification of the associated educational complexes one can mark out a *monocentric* complex, which develops from a non-uniform heterogeneous system, and a *polycentric complex* and a *macro-school*, the latter two being

the result of the heterogeneous polycentric systems transformation.

In the framework of integrated educational systems generic genesis, the stages of formation of the institutional environment in a modern educational institution are described in the form of partial paths: various types of its associations with partner organizations and also university complexes, systems of pre-university training, specific system constructs – macro-schools that are geographically distributed scientific and education systems.

For example, the actively developing nowadays university complexes are polycentric educational complexes, here we mean multilevel and, as a rule, heterogeneous educational systems. Monocentric and single-level educational complexes are typical for cities and regions where there are no higher education institutions. Such systems have also been developed in the regional system of "The Step into the Future" Programme.

A macro-school (Karpov 2004), in contrast to the monocentric and polycentric complexes, is a geographically distributed educational system that integrates academic and professional institutions that are located in different locations. The geographical criterion underlying the formation of a macro-school introduces peculiar network specificity both into the educational and into the structural and functional components of the integrated educational system.

The explanatory scheme for implementation of integrated educational systems was based on the educational institutionalization of cognitive relationships of the research type. However, this is not the only possible propeller of the educational partnership design process. Thus, the trajectory of pre-university training evolution fully fits into the framework of the model in question (Karpov 2006). Structural, functional, and educational changes in the system of pre-university training occur as a result of transformations undergone today by the classic technology of professional orientation of schoolchildren. Higher educational institutions, as a rule, act as switchers in pre-university training systems. In the framework of the scheme that has been worked out by the author, the following path is realized: a simple association of a university with schools, vocational school and technical colleges is converted first into a non-uniform polycentric educational system, which is multilevel and, as a rule, homogeneous, and then into a polycentric educational complex, which is institutionalized, for example, in the form of a university scientific and educational complex.

Such a complex may include, in particular, an educational and research center, combining special and specialized schools, vocational schools and technical colleges; an institution of supplementary education providing teaching and research activities of schoolchildren on the basis of the university; a scientific-methodological center and a faculty of pedagogy. The basis for the development of similar configurations is methodical, educational, environmental and material-technical resources of the educational process. Therefore, as it is all about the development of a specific, but still quite concrete, special teaching method.

One should note the presence of a *mechanism of regression*, which transfers the integrated educational system into a uniform educational system, i.e. mono-institution. In traditional educational institutions, there are strong "natural" mechanisms of *formal* assimilation of new educational technologies, of reducing complex methods of education to formal procedural component. Regression occurs when, for example, the connection is broken between the structural components of research training (educational and scientific laboratories, research groups, etc.) and the real scientific and professional environment. An educational institution "draws" these components in itself and forms its own artificial environment, which has nothing to do with the actual practice of work with knowledge. Examples of such a regression are often provided by educational and production complexes and institutions of supplementary education, which should act as switchers among secondary education institutions and professional system of the society.

## 5. A Macro-School as a Network Educational Partnership of Geographically Distributed Type

As noted above, a macro-school is a network educational partnership of geographically distributed type. It is a result of the development of a socio-cultural environment of non-uniform educational systems in the geographical dimension. The concept of a "macro-school" was first outlined in a lecture given by the author at the University of London in the year 2000.

Macro-schools are structurally and functionally open associating social constructs that attach cultural and educational functionality to a segment of public institutions field. They are not limited to one institution and, as a rule, to any particular territory. The macro-school activity brings together the best-trained teachers and professionals and builds the self-adapting educational network of cooperation.

Creative programs and projects for young people play the role of macro-schools. Therefore, the extensive network of scientific and technological fairs presenting research projects made by American schoolchildren Intel ISEF is essentially a macro-school. It is organized by the "Science service" company (Washington, DC), which receives state subsidies for this purpose and has been acting as a system of research training for schoolchildren in the United States for more than half a century. In Russia, macro-school became a reality at the beginning of 90-ies of the last century, largely due to the activities of the "The Step into the Future" Programme.

Macro-schools have included schoolchildren in productive research, have created the methodical support and developed educational technologies using the ideology of “learning through science”, have organized their pedagogical, expert, methodological and organizational structures. Macro-schools have given rise to significant communication in the society induced by research education, and today they play both compensatory and independent, original role in the educational system of the society. An important feature of micro-school is the reproducibility of their activities, the availability of social feedback, manageability and public openness.

It should be noted that the existing macro-schools give us a great variety of ideas and methods of working with youth. The original concept of creating a multinational macro-family enabling to comprehend the role of science and the human place in modern society (London International Youth Science Forum) is one of the examples. There are also national and supranational systems that provide socialization and professional development of young people. As the “virtual” educational culture of the society grows, the systems of distance learning acquire a certain affinity with the cognitive concept of macro-schools. The example of such a distributed macro-educational environment is provided by the Internet resource www.eidos.ru created by A.V. Khutorskoi in the Russian Academy of Education (Khutorskoy 2005).

A macro-school is the associating form of institutional organization of cognitive systems. In its development, it induces network partnership structures in the educational space. Among the main structural components of macro-school there are: an integrated educational system, a distributed learning environment and the organization operating as a switcher. Switchers provide coordination of activities inside the scientific and educational association and scientific-methodical support for distributed learning environment functionality.

The integrated educational system is an institutional carrier and a generative structure for the network configuration. The example of the internal network structure of an integrated educational system is the structure of the coordinating centre of “The Step into the Future” Programme in the Republic of Buryatia, where school No. 49 in Ulan-Ude operates as a switcher. It is depicted in Figure 4. In turn, integrated educational systems may play a role of nodes in meta-structural network structures of educational communities, as it is at the federal level in the “The Step into the Future” Programme.

Macro-schools include in partnerships the objects of national-cultural values, which permits to introduce their experience, reflecting social and historical features of the ethnic communities life, into the context of cognitive activity of schoolchildren, to take into account the specificity of the territory and national interests of nations that populate it. A prerequisite for such integration is the active position towards the young taken by a professional community or members of the organizations, which can help in cultural support and in research consulting; in elaboration of the list of prospective scientific directions, directly related to the culture and history of the region; in organizing creative competitions and the development of joint educational programmes with a significant socio-cultural dimension. Metaphorically, such activities may be defined as *ethno-cultural consulting* for macro-educational systems. Undoubtedly, the existence of museums, national parks, cultural societies produces socio-cultural structuring of the environment. However, in practice, passive forms of such objects functioning in most cases are not able to call the research interest. To ensure their active socio-cultural function, it is essential to design specialized cognitive structures that must be embedded in a distributed learning environment.

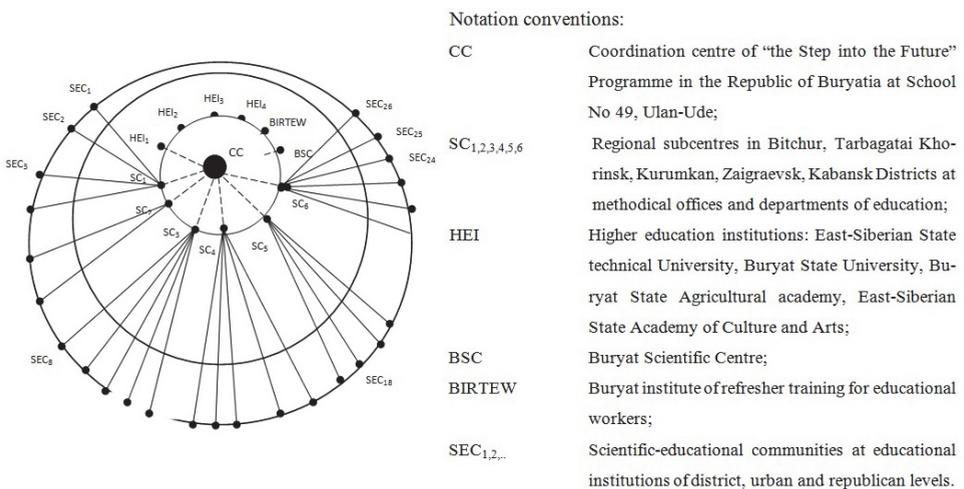


Figure 4. The network structure of the Coordination Centre of “The Step into the Future” Programme in the Republic of Buryatia

The distributed learning environment as one of the component of the macro-educational communities architecture is a form of *instrumental-contextual* organization of a cognitive system, which is organized by the diversity of search methods of learning. In this environment, there appear specialized cognitive structures, working with direct socio-cultural values, for example, science laboratories of local studies that explore historical, ecological, economic, cultural, ethnographic, archaeological and other issues of direct relevance to the lives of people in local communities. The distributed learning environment is the basis of socialization in educational systems of the research type and a research tool for cognitive mastery of problematic reality.

Below one can find examples of integrated educational systems in the form of macro-schools operating in the network of "The Step into the Future" Programme.

With the assistance of "The Step into the Future" Programme, a standard pattern of the research training organization for young people has been introduced in several regions of this country that contains coordination centers, expert bodies, scientific-methodical associations. These regions include, for example, the Republic of Tuva, the Republic of Karelia, the Sakha Republic (Yakutia), the Republic of Buryatia, Kabardino-Balkaria, Khanty-Mansi Autonomous Okrug, Krasnoyarsk Krai, Altai Krai, Irkutsk Oblast, Lipetsk Oblast and others. The basic functional unit of "The Step into the Future" is a Coordination Centre that can act as a switcher on city, village, district or regional levels. The Coordination Centre is developing in the form of an integrated educational system, the structural parts of which are educational, cultural and professional institutions of the society.

The first coordinating centre was opened in 1994 on the basis of Lyceum No 1 in the town of Usolye-Sibirskoye. Due to the effective educational management of its Director Y.N. Ryabov, the centre has become today one of the main organizers of the scientific research work of schoolchildren in the Irkutsk Oblast. The centre has brought together in a unified system the leading universities, schools, research institutes and enterprises, has created a network of the Programme offices in cities and towns of the Oblast. The center is supported by the Irkutsk Region Department of education and the Siberian branch of the Russian Academy of Sciences.

The National Revival Fund "BarGary" under the President of the Republic of Sakha (Yakutia), with the participation of the national company "D'obur", has formed the coordination centre of "The Step into the Future" Programme in the form of a macro-educational system, which provided for search forms of cognitive activity of schoolchildren. President of the Republic M.E. Nikolaev became the first Head of the coordination centre, and E.A. Sidorova, who was at that time the head of the "BarGary" Fund, became the executive director. To research relevant for the Republic problems young people from the most remote regions were recruited for the project. The Academic Center of the Republic, the Yakut State University, research institutes and national parks joined the research training of schoolchildren.

Youth research groups and laboratories under the professional guidance of scientists began to operate in schools and centres of creativity. Scientific and educational institutions, providing research and project activities of schoolchildren, were integrated into the republican network with coordination centres in different locations. Thus created macro-educational system of the research type harmoniously supplemented in Yakutia the complex of creative work with children, which used to develop in the field of music, dance, fine arts and sports.

The Pskov Oblast Center for gifted students, collaborating with the "The Step into the Future" Programme since 1997, has become today a switcher of the ramified network of research training for young people, involving educational, academic and professional organizations of Pskov Oblast and the surrounding regions. The Center's impact extends to educational institutions of Latvia. In the article by I.P. Ryabenko (Ryabenko 2004), Deputy Director on Science, the specific features of scientific and educational activities of the Centre and its socio-cultural functions are described. In particular, she writes: "The creation of this integrated educational network allowed the development of an organizational system of scientific and research activities for schoolchildren consisting of four levels: primary, school, district (municipal) and regional. For each stage, main approaches, objectives and forms of operation have been determined. The specific feature of forming the educational-scientific innovation environment in the Pskov Oblast is the predominance of humanitarian direction in choosing the research subjects. ... This can be attributed to the fact that the Pskov Oblast does not belong to industrial regions, and a large number of monuments of history and architecture influence the choice of the available objects to be researched.

For twenty five years' period, "The Step into the Future" Programme has formed a nationwide network of over 100 macro-educational communities that provide research training, cultural development, and social development of young people. It should be noted that the idea of university complexes was obliged in many ways to the successful activities of these associations, which de facto became their prototypes. Today the system of coordination centres of "The Step into the Future" Programme is a complex network of integrated educational systems with multilevel hierarchies of regional networks.

## 6. Conclusion

Integrated educational systems organized in the form of network partnerships, provide effective schemes of sharing knowledge, enhance the access of outside environment agents to the results of research and development, promote the inflow of investments in scientific and technological research, stimulate the development of new training programs, including the corporate ones.

Integrated educational systems, acting as a distributed cognitive complex, introduce the architecture of network structures into educational communities; contribute to overcoming their socio-cultural isolation (Len'koff 2015). The network configuration creates socio-cultural clusters providing cognitive mobility of schoolchildren in the conditions of freedom of choice of cognitive activity. Thereby the paradigm of research education constitutes a *valid educational equality*.

The experience of "The Step in the Future" Programme shows that it is through the creation of integrated educational systems that an educational institution existing today is able to meet the challenges of the modern educational process providing the entry of its pupils into social reality and forming psychosocial correlates of the knowledge society in individual students.

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