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## Professional-Oriented Educational Environment for Supporting the Development of Children's Technical Creativity on the Basis of Network Integration of Infrastructure Resources of Educational Organizations

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The article presents the concept of network interaction of regional educational organizations within the framework of the programmes supporting children's technical creativity. The urgency of the development of mechanisms for network interaction is considered. An example of realization of network interaction within the framework of the project "Medical measuring systems and robotics" is given. The project is aimed at popularization among schoolchildren and young people of research activities in the field of electronic and technical devices.

**Key words:** technical creativity, additional education of schoolchildren, professionally oriented environment, basic technical educational platform.

### Rationale

Today one of the most priority areas for the development of additional education for children and young people is the formation of conditions for updating and supporting educational programmes of research and applied orientation aimed at popularization of blue-collar jobs and engineering professions within the priority areas of science and technology development in the Russian Federation [1]. Improving the effectiveness of educational programmes in these areas is associated with the acute shortage experienced by the additional education organizations of a region, in modern equipment and logistics, educational and methodological developments and specific information resource support. Similar problems were outlined among the most acute issues in the Concept for the Development of Additional Education for Children, approved by the decree of the Government of the Russian Federation (04.09.2014, No. 1726-p). In addition to the v logistics problems the implementation of high-tech educational programmes faces

lack of qualified personnel, who, in addition to modern pedagogical technologies, has a considerable amount of knowledge and skills in certain fields of science and technology development.

The process of learning, including the programmes of additional education, is inextricably connected with the process of learning environment development. The success of the educational process and the quality of training depend to a large extent on the degree of students' involvement in the learning environment, their individual perception or personal unacceptability of the norms and structure of the learning environment, and the ability of the learning environment to satisfy the information, legal and other needs of the learning process. In modern Russian pedagogy, the problem of creating a professionally oriented educational environment was considered in the works of B.N. Bogatyr, N.F. Maslova and V.V. Gusev, M.V. Clarin, V.A. Kozyrev, M.S. Chvanova, A.V. Khutorskoy and other scientists. For example, V.V. Gusev and N.F. Maslova within the framework of this approach

consider the formation of an educational environment based on the integration of socially developing and professionally oriented pedagogical technologies that would ensure the realization of the students' cognitive activity in various types of educational activity.

Until recently in some regions of the Russian Federation, the solution of tasks related to the involvement of schoolchildren and young people in the process of additional education was associated, to a greater extent, with the activities of non-profit organizations. However, the implementation of such programmes, especially in the field of technical disciplines and research activities turns out an impossible task for non-profit organizations due to the above-mentioned problems, related to the limited personnel and financial support, as well as lack of appropriate infrastructure. For example, in Volgograd Region, based on the Decree of the Government of the Volgograd Region No. 649-p of December 29, 2012 "On the approval of the long-term regional targeted programme "Support to socially-oriented non-profit organizations of the Volgograd region" for 2013-2015 period, the following significant problems arise [2, 3]:

- unformed system and imperfection of the mechanisms of support for NGOs from the state;
- underdeveloped system of social order;
- lack of a system registering socially-oriented NGOs – recipients of support;
- insufficient public awareness on the activities of NGOs;
- low civil activity and legal literacy of the population of the Volgograd region;
- imperfect system of interaction of executive bodies of state authorities, local self-government bodies of municipal entities with public associations.

Nevertheless, the task of attracting schoolchildren and young people in the field of applied high-tech activities, as well as research work, is considered by the state as a priority task. Overcoming these issue will promote scientific, technical

and, in particular, and military potential development.

### Professionally oriented educational environment

The most effective way to solve the above stated problems could lay in a holistic approach aimed at integrating the resource capabilities of various educational sites offering additional education programmes. At the same time, it would help to develop a unified, integrated educational environment that could activate the mechanisms to support actualization, formation and sustainable development of research and applied activities of schoolchildren in the field of technical and natural sciences, accumulating the resources of educational institutions, training centers and technological platforms available in the regions.

Assuming the accumulation of knowledge by schoolchildren as the inertial process of developing professional and social competencies [4], it is important to consider the development of an educational environment as the design of a multilevel system providing consistent support and motivation for the development dynamics of schoolchildren in the field of research, technical and natural sciences. It begins with stimulating their interest in the field and ends up with making them become young specialists.

In this context, the process of mastering new knowledge is viewed as a continuous nonlinear change in the competence of the trainee, characterizing the qualitative transition from one level of competence to another [5].

The main problems that could be solved thanks to emerging of such an integrated educational environment deal with:

- the need to ensure the interaction of the developed educational environment with other non-governmental, legal and other institutions of the society;
- the need of infrastructure support for the interaction of the subsystems of the educational environment itself.

Ensuring interaction of the developed educational environment with other non-

governmental, legal and other institutions of society [2]:

**Administrative and economic issues:**

- organization of legal and financial interaction with authorities, search for sources of co-financing;
- activities aimed to select the “territorial base” of training events;
- organization of administrative, financial, legal support for ongoing training activities.

**Personnel issues:**

- Top management: creation of an educational structure – the training administration, selection of the leading teachers (instructors), interaction with the leadership of the leading universities in the region, Russia and foreign countries, organization of internships and master classes for leading teachers.
- Staff: selection and training of personnel responsible for organizing and holding of cultural, entertainment and socially significant events with students (when implementing the training in the format of a children camp – creating uniform requirements and rules for organizing intra-group work, selection and training of instructors of primary level, elaborating rules for cultural and entertainment sphere.

**Organizational and training:**

- development of the structure of the educational process;
- logistics and facilities for laboratory workshops, providing measures to ensure high safety level within training sessions;
- elaborating of internal regulations (when implementing the training in the format of a children camp).

Ensuring interaction between the sub-systems of the educational environment [2]:

**1. Organizational:**

- Solution of organizational and territorial problems connected with joint use of territorial resources of educational platforms. At the same time, by optimizing the territorial, administrative, and specific human

resources, it is possible to reduce the cost of participation in educational programmes, which allows expanding the range of social coverage in the region.

- Ensuring socially responsible behavior of existing and newly created educational centers in the region (technological platforms, hobby groups, etc.).
- Ensuring interaction with regional resource centers to support educational programmes as a possible way to solve personnel, territorial, information and other tasks related to the implementation of interregional projects.

**2. Information:**

- Creation of a regional information portal to support the activities of educational platforms relating to formation of a knowledge base (development of programmes, teaching aids and methodological recommendations), interaction management (including various joint events: conferences, meetings, academic competition).

**3. Scientific and educational:**

- Implementation of relay training is now one of the most promising directions that allow combining the harmonious development of the trainee, the rationality and predictability of the training centers activities. The goal of forming a “big” project is to attract NGOs (and not just regional ones) with a different focus of training in a single educational process. The most promising, from the standpoint of a “big” project, are educational tourism projects.

**4. Financial, economic and logistical support:**

- Participation in federal and regional target programmes.
- Financial support for regional training centers.
- Creation of a basic technological platform – educational, laboratory and other technical support of educational projects.

- In framework of an integrated educational environment, the activities of regional NGOs can be consolidated in order to assure their participation in interregional projects. Such activities of the Center are considered as a tool of the “social elevator” for gifted children and talented teachers.

**5. Testing and measuring:**

- Development and implementation of a unified system of rating control - the implementation of a rating system for assessing the activities of educational platforms will reduce the impact and / or exclude the possibility of dishonest work and improve the status of effective organizations. Rating evaluation is mainly aimed at informing potential participants of educational projects, but it can also be considered as one of the criteria for evaluating the effectiveness of educational programmes when assessing their applications for their financing.
- Implementation of a “feedback system” – a system of interaction with consumers of services of educational centers organized on the principle of “all services at one place”. Organization of this work is aimed at prompt resolution of issues related to improper performance of one or another educational platform, as well as for accumulation of incoming recommendations and suggestions for optimizing the activities of educational centers and the implementation of educational programmes.

**The programme of network interaction of educational institutions of the Volgograd region**

Considering the system of additional education for children as the most flexible educational platform, which in fact is an innovative platform for working out effective educational models and promising technologies for the future, the project implemented in the Volgograd region is aimed at developing and improving the structure, information, personnel, material and other support for high-tech educational

programme. It is designed to ensure advanced updating of the content in accordance with the strategic tasks of the country development.

The main applied areas of practical implementation of the proposed professionally oriented educational environment are:

- robotic drone devices and robotics;
- electronic and electrical devices;
- technical modeling and prototyping of technical devices;
- organization of regional competitions, exhibitions, meetings, conferences in the technical field.

Today these areas are the most demanding in terms of the required for their implementation technical, technological, information, human and other resources. The proposed directions are presented in the list of priority directions for the development of science and technology in the Russian Federation.

One of the main tasks in the implementation of this project is the formation of the condition for the effective use of the infrastructural educational resources of its participants. The solution of this problem is seen in the formation of an integral system of an educational elevator capable of supporting the steady interest of schoolchildren in the field of technical sciences and research, forming creative teams at the level of primary sites, which are subsequently involved in regional educational programmes and competitive activities implemented jointly with the flagship university in Volgograd region – Volgograd State Technical University and Volgograd State Medical University.

In this regard, a pilot project which was launched and implemented during the 2015/16 academic year, was the inter-university educational project “Medical measuring systems and robotics” (fig. 1.).

Its participants are schoolchildren of the 6<sup>th</sup> and 9<sup>th</sup> grades of Volgograd secondary schools, mastered the theoretical foundations of electrical engineering and electronics, as well as the physiology of biological objects, and acquired skills in the development and manufacture of printed circuit boards for electronic devices.

Fig. 1. Regional competition of projects in children's technical creativity for students and schoolchildren in Volgograd region "Robotics and radio electronics for health, biotechnology and pharmaceuticals".



The Faculty of Pre-University Training of Volgograd State Technical University took part in this project together with Volgograd State Medical University (VolgSMU), represented by the Department of Biotechnical Systems and Technologies and the Department of Clinical Pharmacology and Intensive Therapy with courses of Clinical Pharmacology, Clinical Allergology, as well as Volgograd Center for Children's Technical Creativity and Children and Youth Center of Volgograd. The project was launched, also thanks to assistance of the Interregional non-governmental organization "Association of Clinical Pharmacologists".

This project has found its continuation in the implementation of the educational programme within summer regional camp for gifted high school students "Integral".

At the moment, the structure of the project has been significantly expanded due to the participation of regional educational platforms.

The result of the pilot project of the integrated educational environment in the field of medical measuring systems and robotics was the regional competition of

projects in children's technical creativity for schoolchildren of Volgograd region "Robotics and radio electronics for health, biotechnology and pharmaceuticals".

#### Expected performance indicators of the professionally oriented educational environment

The main results of the programme implementation are:

1. Development of the structure of network interaction and proposals on the administrative regulation of the primary educational areas of children's technical creativity in the region in the development and implementation of programmes for children's technical creativity.

1.1. Indicator: number of educational platforms – participants in the programme implementation of a professionally oriented educational environment supporting the development of children's technical creativity based on the network integration of the infrastructure resources of educational institutions and full coverage of Volgograd region by the programme.

2. Increase in the level of popularization of additional general education programmes

in the technical field.

2.1. Indicator: number of students taking part in additional general education programmes focused on the development of children's technical creativity.

2.2. Indicator: number of students participating in additional general educational programmes of children's technical creativity who have chosen technical directions of training in higher educational institutions of Volgograd region and Russian Federation to continue their educational trajectory.

2.3. Indicator: number of students participating in the field-oriented regional camp for gifted high school students "Integral", who selected as priority educational programmes of the camp "Integral" in the field of physics, mathematics and natural sciences.

3. Development of the structure of network interaction and administrative rules regulating primary regional educational platforms for children's technical creativity relating to the development and implementation of competitions in the field of technical sciences and research.

3.1. Indicator: number of competitions.

3.2. Indicator: number of students who took part in the competition.

4. Development and implementation of the basic measures for staff acquisition for

additional general educational programmes of technical orientation and the system of professional development of pedagogical workers in the field of physics, mathematics, technical and natural sciences and pedagogical workers who mastered the teaching methodology in interdisciplinary fields.

4.1. Indicator: number of pedagogical workers retrained in the field of physics, mathematics, technical and natural sciences.

4.2. Indicator: share of pedagogical workers who completed advanced training programmes in teaching methodology in interdisciplinary fields and implemented this methodology in educational process.

4.3. Indicator: number of pedagogical workers who took part in conferences, scientific and methodological seminars and competitions within additional general educational programmes in the field of technical sciences and research.

5. Development of information educational resource for support and remote assistance of additional general educational programmes in the field of technical sciences and research.

5.1. Indicator: number of educational content units offered on the resource.

5.2. Indicator: number of resource users.

5.3. Indicator: number of correspondence educational programmes available on the resource.

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