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The School as the Technopark

A sketch of the high school model of the near future

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The Technopark as a model of the school

What is now a mass school, was created in due time "under the task" of the development of manufactory production, and then of industrial society. By itself, a school with a class-lesson based system, with subjects corresponding to the fields of science and production, with work cycles of 45 minutes with a ringing-hooter at the beginning and end of work, the conveyor transfer of students from class to class from subject to subject-not just reminds factory production, but models it and reproduces.

Until some time, such a structure of the school made it possible to solve actual problems related to the development of the industrial economy, the science and the society.

But for about the last fifty years in the world generally recognized is the task of creating and developing an innovative economy of knowledge, high technologies, and science-intensive industries. The task is to create an economy that generates and applies high technology innovations.

How can space be organized in which research, the development of appropriate technologies, the transfer of these technologies into production, the production itself and effective sales become possible? Technoparks have become one of the "answers" to these questions today.

Technopark is a way of organizing such a way. This is not only a building, a complex of structures, as often represent the technopark; this is the way to organize an innovative process - the transformation of new knowledge into a new product, the way to organize the space most appropriate to such a process, a way to combine science-education-business into a single productive system.

The International Association of Technological Parks defines the Technopark as follows: it is an organization managed by specialists whose primary goal is to increase the well-being of the local community through the promotion of an innovative culture and the competitiveness of innovative business and scientific organizations. (Epshtein & Yushkov, 2014) To achieve these goals, the technopark stimulates and manages the flow of knowledge and technology among universities, research institutes, companies, and markets. It simplifies the creation and growth of innovative companies with the help of incubation processes and the processes of cultivation and supporting of new companies.

The main activities that are combined in special spaces (technoparks) to support innovation as realized ideas are: research (including interdisciplinary); expertise of perspective developments; inventive activity and design, development of prototypes and technologies; production; marketing and sales; support commercialization of developments; management and technical entrepreneurship.

In addition to the above in those place serious attention is paid to creating a creative environment for work and leisure (in which new ideas are generated and implemented) - spaces for meetings, communication, creative activities, cafes, libraries, exhibition and conference spaces, etc.

And if today we are thinking about preparing schoolchildren for life and work in a high-tech world, then we must recognize that we need another model of the general education school, another model of additional education.

The possible hypothesis of the model of the modern school is: the educational infrastructure of the school can be built in the image and likeness of the technopark - the environment created specifically to support the transfer of scientific knowledge, the results of scientific labor into the product of industrial production, into the product.

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The School as the technopark

From the pedagogical point of view, when organizing the work of a school as a technopark means a significant restructuring of the entire infrastructure, content, methods, and means of organizing the educational process.

If today's mass school is based in many respects on the transfer of finished knowledge, then in the "school as technopark" there are other activities which come out to the first plan: the participation of adolescents in the work of research laboratories, and design bureaus, production of real products and services.

If the "factory" division of labor leads to the emergence of unrelated subjects in the "traditional" school, then the interdisciplinary knowledge, diversity, and equivalence of the capabilities of the participants in teamwork are important in the "school as technopark."

If in the mass school the educational process is closed by itself, then in "the school as the technopark" the productive activity becomes the core of educational activity, the senior pupils are going through the solution of real life (technical, economic, social, etc.) tasks, from ideas to organizing the production of useful and demanded by the surrounding product, service. It is very important, very principle moment for "the school as the technopark" to cooperation with innovative partner enterprises (professional orientation, meetings with techno-entrepreneurs, internships at enterprises, professional tests for professional tests, the participation of schoolchildren in real production projects and processes).

The opportunity (and even the need) at "the school as the technopark" to combine general education with the adolescents' gain of experience in various real industrial relations, and work experience in various professions, allows one to say about combination the school and college programs in the school-technopark.

Such a partnership of the school with real enterprises will allow in practice to realize the ideology of the STEAM approach in school education when the core of the activity will be the participation of adolescents in real technological, social, art projects initiated by scientists and innovative business and built on the basis of modern research. Adolescents, participating in solving real problems, and carried out, including for this purpose, research, receive new knowledge. On the other hand, the knowledge available for schoolchildren will find application in the course of their practical activities.

It is clear that there are still many questions on the implementation of such a model. But it is more correct to consider them not as a limitation and a deterrent to activity, but as a direction of search, trial, and practice.

In particular, it is not yet clear in what complex production processes adolescents will be able to take a real and effective part.

How to make it so that when involved in solving severe production problems, students at the same time had the opportunity to receive a systematic picture of the scientific view of the world?

How can we integrate into the productive activity the in-depth study of several languages and, in particular, mathematics - as the universal language of science and technology?

And etc.

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Some pre-project ideas

To realize this model of the school, of course, it is important to discuss the special arrangement of the architectural space and some elements unusual for the "traditional school" that reflect the characteristic feature of "the school as the technopark": the tight intertwining of the actual "school function" and the various "extracurricular" projects, without which the activity of such a school does not seem to be effective.

Probably, when designing a building of such a school, it is important to provide:

• premises for groupwork and frontal lectures, with sliding walls, allowing to transform the volume of premises,

• appropriately equipped premises for research laboratories (physics, chemistry, biology, computer classes),

• equipped premises for workshops - handicrafts, design, for working with various materials - from wood to modern fabrics, design bureaus, art studios - sound, photo, video, etc.,

• workshop with the modern mini-machines and other equipment,

• covorking space (mini-offices), which can be used by students for independent study and group work on projects.

• an open library,

• space for exhibitions, expositions (in particular, for the presentation of projects of schoolchildren).

It is supposed that youth start-ups will be able to use the coworking space, the technical equipment, exhibition spaces. They will have the opportunity to work in the spaces of the Technopark, provided, in particular, those schoolchildren will be included in their projects.

For public use, it is proposed to provide the following premises:

• cafe and dining room,

• conference halls,

• a hotel, which can be used for children living in a boarding school, and for guests (groups of children coming to participate in additional education programs, adults, conference participants, etc.).

In separate rooms connected with the main building of "the School as the Technopark," it is planned to place the "Interactive museum of science (mathematics)", which will work:

• as a "modern science museum" (with incoming individual visitors, school groups from other schools, visiting groups from other cities),

• as a research methodology center for the development of programs, resources, manuals for the popularization of "science (mathematics) for all" (including the development of logic and the program of teaching science and mathematics in the school);

• as a training center, where not only children can be engaged, but also teachers who want to improve their skills in the field of teaching mathematics.

Also, the "Museum of Science (Mathematics)" will act as an "object of application of forces" for the students of "the School as the Technopark", as schoolchildren will be able to develop manuals, "artifacts" for the museum as productive activities, and conduct educational programs on its basis.

On the other hand, the regular activity of such a "research center" and the availability of high-quality infrastructure will allow holding international conferences, seminars, internships and other educational programs for teachers, attracting colleagues from other cities and countries on the basis of "the School as the Technopark". Thus, it will allow the school to be open to cooperation, enrich itself with ideas and projects, infect colleagues with its experience, involve partners and experts in the public examination of its activities.

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Summer school "Nanograd" as a prototype of the "school-as-technopark"

(Connecting high school STEM education to high technology business and science)

In this part we want to present experience of the Summer School «Nanograd» (NanoCity), which runs from our participation every summer, start with 2011.

The participants of this school are high school students of secondary schools and their teachers. This summer school is a possible model of connecting high school STEM education with high technology business and science.

The summer school «Nanograd» is a space for understanding what high technologies are, how they are developed, what are they for and how all who are assembled at the summer school relate to them. To realize it is very challenging for the pupils as well as for their teachers.

What is important is that the introduction to the high technologies in Nanograd takes place not only at the level of lectures about them, but also through direct contact with the representatives of science and industry, through however short but deep immersion in the real work with high technologies, through the organization of all life activities in the formats specific for the high technologies infrastructure.

We mean that Nanograd summer school is largely constructed after the model of science park, a modern infrastructure designed for the support on new ideas' creation and practical implementation.

In this context we can speak both of Nanograd as the modern educational space and of science park as a model for the modern school.

Some more details about structure of summer school "Nanograd" ("NanoCity")

Summer School "Nanograd" organized annually under the federal program "School League RUSNANO"*. Participants of the Summer School "Nanograd" each year about 250 students are 14-18 years old and school teachers participating in the program " School League RUSNANO" from more than 30 regions of Russia.

Summer school lasts 10 days and is organized on a country basis each time in different regions near large industrial and scientific center in collaboration with the management of the economy, innovation, science and education in the region.

As the name reflects the Summer School - "Nanograd» (Nanocity) - work, school, life in it is constructed in a role (the game) model of a modern city.

Residents of "Nanograd" create themselves its aesthetics, toponymy, control centers and, finally, the very events of the Summer School – intellectual, creative, sports.

In order to become residents of "Nanograd" schoolchildren in Russia take part in qualifying competitions. The adult population of "Nanograd" is presented by school teachers, a team of students, postgraduate students from various universities, specialists-consultants in high-tech and "nano"-science – students, postgraduates, representatives of design companies, scientists from various universities and research centers of the country, a team of teachers and scientists – organizers of the Summer School.

In "Nanograd" there are **eight-ten "training sites" –** according to the number of nanotechnology (hay-technology)-based enterprises, which became partners of the Summer school. Each resident of the city has the right to be elected to the City Council, to participate in city meetings, to discuss city laws, to make proposals about operational planning of the city life.

Every resident of "Nanograd" becomes an employee of the **"GRADNANO Corporation"**. It is the main work in the city, consisting of development (analysis) and implementation of the projects (cases), which are aimed at the use of appropriate high technologies for the sake of humanity, nature and culture. All "cases" are created on the basis of perspective scientific directions and real innovative productions. The task of every team of each "training site" is to suggest its own complete solution of scientific development, market promotion, use of relevant ideas, materials, technologies and to present it in a format of a detailed presentation. Representatives of partner companies advise students in the process of work and participate in the acceptance of the "final product" as well.

Residents of the city (both, school students and adults) will be able to enter **the Academy of Nanograd** for training, they will have to build their educational route, which will include: lectures, workshops, participation in discussions and round tables, business games. Among the teachers of the Academy there are scientists, experts in their fields, representatives of successful enterprises of the "high technologies" field, skilled managers and consultants. 10-15 workshops represent almost unlimited opportunities for creative self-realization both in the field of high technologies, and in the sphere of popular arts (music, dance, design, multimedia, etc.). Each workshop in the end represents a product, the result of its work, at the final festival.

Creative life of "Nanograd" is organized by its **Festival Center**. The following events take place in Nanograd during a week of city life: the Opening and Closing ceremonies, the Musical festival, the Film festival, the Tournament of Intellectual Games, "Nano-night of advertising", the Sports contest of the districts for the Prize of the Council of Old Residents and... whatever Nanograd's residents will think up and decide to carry out.

All cultural Nanograd's events related to science, modern technology and art, largely built on the initiative of the citizens themselves and authorship.

Decoration of "Nanograd" is a joint creative design project of all its inhabitants. Among the symbols of "Nanograd" there are Miracle-Tree, Cat-Scientist, a monument to the largest "nano-particle" in the world...

One of the days of the Summer school is fully devoted to **acquaintance with the host city**. Playing the roles of journalists and travelers, students visit unique enterprises, organizations, places of the city and create texts (works) of various formats about it.

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Summer school "Nanograd" as Technopark

Why do we believe it is possible and important to talk about the idea and structure of Technopark wich based educational model as summer school and / or secondary school?

Science park is an environment specially designed in order to support the process of the transformation of scientific knowledge and results of research work into an industrial product, a commodity. Most often science parks are created for the support of high technologies which have a high share of surplus value in the form of intellectual labour. And this condition crucially affects how the science park is organized. Smart production is usually organized in the other way, goes a different way than industrial one and it demands special conditions for its actualization. A specially organized environment is necessary for the emergence and actualization of new ideas. Moreover science park is a kind of organisation of such a production method; essentially it is not only a building or complex of buildings but an organisation method of an innovation process, that of the new knowledge transformed into new product.

Let us designate main areas of activity which are united in the special environments (science parks) for the support of innovations as ideas actualized.

- Research activity (including interdisciplinary); expertise of the advanced developments;
- Inventive activity and designing, development of prototypes and technologies
- Production
- Marketing, sales, administration
- Support of developments' commercialisation

What is important is that, except for the putting together in the single environment all the work cycle from the idea to the product sales, in a science park much attention is given to the production of the creative environment for work and leisure (which stimulates the emergence of new ideas and their actualization), a space for the meetings, creative activity, café, library etc.

In this context the Nanograd summer school is such a science park where the different activities and environments are dovetailed with each other: education and research (during the classes of Academy), modelling and designing (in Workshops and Laboratories), production and communication with business (at the activity of Corporation), healthy lifestyle and creative leisure (organized by Festival centre).

And since Nanograd organizes its work according to a science park model, we hope that the participants of the summer school (both teachers and pupils) will manage gradually to transfer the science park model to their schools.

In this sense, it is crucial participation of teachers in organizing the Summer School. Because such participation is in fact a new model of their training. During the summer school organized specifically for teachers such as, seminars and training courses : «STEM and Next Generations Science Standards in USA», «Using Emerging Computer Technologies in Science and Mathematics Education», «Project-Based Learning - Developing STEM Projects», «Business Games in Pre-College Education», «Edutainment - Invitation to Discussion, Learning, and Collaboration», «Developing Interdisciplinary Lessons».

But the model itself Technopark, relating not only to the pursuit of science and technology, but also with providing an open, creative and comfortable environment, the interaction of a particular culture, requires the provision of one more fundamental learning environment teachers - their direct participation in the Summer School as participants , along with students solving cases coming up with creative events, working and leading workshops, listening to lectures of scientists and entrepreneurs.

It allows to talk about the possibility of their participation in the future transfer model, technology, atmosphere prevailing at the summer school, the practice of secondary schools in which they work.

It is the fact that after the summer holidays in their schools will return a new model inspired by the life , study and work students and teachers , allows us to hope for gradual appearance model and technology park in the secondary schools in different regions of the country .

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To the portrait of the graduate of "the School as the Technopark."

The pedagogical landmarks in the preparation of a graduate of the senior classes

Let's try (as a first approximation) to designate a possible "portrait of the graduate" of "the School as the Technopark". More correctly - some pedagogical landmarks that will help to competently build the process of interaction with high school students of "the School as theTechnopark":

- the values that are important for the community involved in the life of such a project,
- the skills and the habits, which, we hope, can develop in adolescents who have lived in this community for 2-3 years,
- the abilities that we think the future graduates of the School-Technopark will be able to develop from themselves,
- the experience, the acquisition of which by the adolescents in the process of training (work, life) in "the School as the Technopark" is important to organize.

Values

• The value of a competent, responsible attitude toward a happy future (of one's own and those around them) with respect for the past.

• The value of personal meanings, positive relations between people - something that can not be automated in the era of "digitalization and robotization".

• Understanding the value and effectiveness of any technology in terms of its ability to help people build relationships, not destroy them.

• The value of freedom, and the importance of personal self-determination in various situations of unfreedom.

• The value of self-esteem and respect for others, understanding the importance of caring for yourself and others, mutual assistance.

• The value of diversity, understanding the importance of diversity, including in collective work, cultural diversity and self-determination in one's own identity.

• The value of caring for the environment, studying and improving life in the surrounding space, both natural and sociocultural.

• The value of intellectual activity, and the understanding of the diversity of styles of thinking.

The Skills and The Habits

• Desire and ability to realize and build their trajectory of life, defend their independence; faith in one's own strength.

• Ability and willingness to make strenuous efforts in the chosen field.

• Ability to analyze and synthesize information, use critical thinking skills.

• The literacy, which makes available various cultural spheres and aspects of human life.

• Ability to live cheerfully and do so that other people also live interesting, perspective, joyful.

• Ability to work in a team (in different team roles).

• Ability to live (survive and develop) in different worlds, spaces, environments (natural, cultural, linguistic, industrial ...).

The ability to continue education, to the transition to the desired next stage of biography

• Ability to make decisions in terms of professional and / or educational interests.

• Ability to achieve skills and knowledge, which allow to moving to the next desired level of education or professional activity.

• Ability to orient in practical opportunities for further education in the international educational space.

An experience

• Experience of creative self-realization in many activities at various levels.

• Experience of living (survival, work, development) in various environments and spaces (natural, cultural, linguistic, industrial ...).

• Implementation experience (in different teams and team roles, including individually) projects "from idea to product".

• Experience of civil independence, participation in self-managment projects.

• Experience in various business projects (in particular, related to modern technologies), in various professional roles, together with adult professionals, including work with money.

• Experience in making decisions and responsibility for them.

• Experience of success in school education.

• Experience in solving various intellectual problems.

• Experience in creating and implementing interdisciplinary projects in science, technology and business.

REFERENCES

Epshtein, M., Yushkov, A. (2014) Shkola I bisness. 4 shaga k technopredprinimatelstvu. St.Petersburg: Shkolnaya liga [School and business: an experience of interaction. Four steps to tech entrepreneurship. St.Petersburg: School league]

Epshtein, M. (2018) Business Community Engagement for Educational Initiatives. USA: IGI Global

* "School League RUSNANO" - a network program, which aims to promote in the schools of the Russian Federation of ideas aimed at the development of modern education in the first place - science education. Combining the one hand, schools and teachers, and on the other - the scientists and academics , industry representatives and business (including nanotechnology), the League organizes their cooperation in order to achieve its main objective . Participants School League for 2010-2020 steel more than 300 schools from more than ***4***0 regions of the country. The program is implemented with the support of the Fund for infrastructure and educational programs (RUSNANO).

ROSNANO is a group of companies "ROSNANO" that implements the state policy if the Russian Federation on the development of nano-industry, working as co-investor in nano-technological projects with essential economic or social potential. (http://www.rusnano.com/infrastructure)