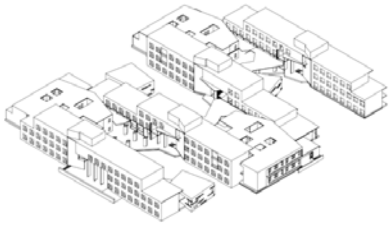

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WAYS OF INTEGRATION OF SCIENTIFIC AND TECHNICAL PROFILE SPECIALIZED PREMISES INTO THE STRUCTURE OF A COMPREHENSIVE SCHOOL

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ABSTRACT

The article states that one of the most pressing educational problems of our time is the organization of educational processes in the building of a comprehensive school, namely the combination of various functions that ensure the intellectual development of schoolchildren. One of the current trends is the cooperation of the premises of scientific and technical profile with other teaching functions of the school. The studied examples of the American, European and Oriental experience show that there are several approaches to integrating specialized facilities in a general educational institution.

Key words: premises of scientific and technical profile, research laboratories, training area, public space, general function, office structure, open planning system, research area.

1. INTRODUCTION

The education system is one of the most pressing problems of our time in Ukraine and the world. After all, education is one of the components that provide a person with a successful future. Education is a process of a person-aimed formation of certain qualities of consciousness, behavioral stereotypes, axiological orientation, which are determined by the historical and cultural specifics of each individual society, ethnic group, and social stratum [13].

In the updated law of Ukraine on education, a position on the application of the competency approach in teaching is clearly defined [4]. From a pedagogical point of view, now one of the tasks of education is to form not only a holistic system of universal knowledge and skills, but also to provide the pupil with independent experience and personal responsibility. Competence-based approach assumes not a student's mastery of knowledge and skills separate from each other, but mastering them in combination. In connection with this change the system of teaching methods is defined another way. The basis of the selection and design of teaching methods is the structure of the relevant competencies and functions that they perform in education. Ukrainian perspectives of the competence approach in modern education were studied by scientists I. Bekh, N. Bibik, O. Bykovskaya, L. Vashchenko, I. Yermakov, V. Verbitsky, A. Lokshina, A. Kononko, A. Pometun, A. Savchenko and others [14]. It should be noted that this path of development was inherent mainly for out-of-school education. But now a definite symbiosis of various pedagogical approaches is taking place, and at the same time the principles of the architectural design of educational institutions are changing.

Numerous works of architect-scientists' are devoted to the study of the problems of formation and renovation of educational institutions in today's conditions. Scientific architectural research covers many aspects related to new types of educational institutions, their structure and placement. So, for example, in the doctoral dissertation of architect G.L.Kovalskaya emphasis was placed on the existing shortage of territorial resources for the placement of educational institutions in Ukraine, especially in the areas of existing urban development [3]. The development of functional-planning organization of a network of institutions of out-of-school education is devoted to the dissertation of Merilova I.O. In this work, a new urban development object is scientifically based – a network of out-of-school education institutions. Also levels of classification of out-of-school education institutions have been developed, the network of which is built hierarchically at different levels of urban planning organization of settlements for the urban environment. [5, 6].

The architecture of schools has always focused on a specific educational program and related processes. The emergence of new types of educational institutions such as gymnasiums, lyceums, private schools, the introduction of in-depth study of individual subjects in ordinary schools, says that the educational process is changing and there is a massive reorganization. New methods of education appear, schools adjust curricula by adding new subjects. At the same time, the innovative educational process takes place in typical buildings inherited from the previous social system. There is a discrepancy between the educational process and its material shell [13].

Now, at the beginning of 21st century, many teachers are starting to face the fact that the existing school premises not only do not help, but sometimes interfere with the normal course of classes.

Since significant changes are now taking place in this area, it has become necessary to study the integration of specialized functions and premises into the structure of a traditional school.

The article further provides an overview of several buildings of educational institutions of European, American and Eastern design experience. It is proposed to identify approaches of designing of modern educational institutions, using the method of comparative analysis.

2. EXAMPLES OF EUROPEAN EXPERIENCE

Oslo Cancer Cluster designed by two Norway architectural burros Dark Arkitekter & Arkitektpartner is one of a bright example of cooperation of standard school function and premises with specialized rooms of the scientific profile. Dark and Arkitektpartner won the concept competition back in 2011 for Oslo Cancer Cluster Innovation park (OCCI), a building that opened its doors in the autumn of 2015 to the Norwegian Radium Hospital and the Institute for Cancer Research, as well as Ullern High School, a magnet school for students of biomedicine [7].

Fig.1. Oslo Cancer Cluster Innovation Park / Dark Arkitekter + Arkitektpartner. Source: the scheme developed by Mariia Khmel according to [7,11].

In Norway there is an old tradition of combining high-schools with the opportunity to train for a career as an athlete. The OCCI park, and particularly Ullern High School here installed, aims to do the exact same with students in scientific fields (see Fig. 1). Text description is provided by the architects. The building houses the Oslo Cancer Cluster, an organization integrated in a global network of research institutions that intends this project to be a highly skilled cluster of professionals, start-up businesses and research facilities in close dialogue with the Norwegian Radium Hospital. This meeting point between scientists, students and investors is bound to generate new ideas, capital and solutions in the fields of biomedicine [11].The challenge of combining teaching (Ullern high-school), research facilities and office spaces for health and cancer research related startups gave this project an extra layer of complexity. [7,11]. The school occupies the base, on the ground and first floors, and it is organized around two important common areas: the cafeteria and the mediatheque. Also a multipurpose arena is placed in the base that features a telescopic tribune enabling it to be used as a grand auditorium for school gatherings and conferences.[11] Common areas are accessible by both students and researchers, and were conceived with the aim to encourage dialogue and collaboration between the two. The building volumes, placed over the horizontal base, host the workspaces where laboratories and offices complement each other. This is a so called business incubator where science and creativity meet each other. The young students will have access to laboratories and the knowhow of companies at the forefront of research and development in medicine and cancer treatment. The idea is that concentrating these programmes in one building - where the common facilities are shared by all - will enable the exchange of ideas and inspire entrepreneurship and thirst for knowledge in young people. [11]

The outdoor landscape plan on the building's west side is based on the contours of the surrounding terrain, and stands in contrast to the tight structure of the building's volumes. The pedestrian path south of the building connects to the Radium Hospital and the Research Institute with OCCI (see Fig.1).[7]

So, analyzing the experience of Norwegian architects, the following trends regarding the integration of specialized premises into the school building can be identified:

– integration of the high school into the structure of the research laboratory using vertical blocked zoning;
– combination of cabinet structure and open planning system;
– connection between public and private space;
– organization of classrooms around two central common spaces (cafeteria and library)
– Availability of all facilities for students and scholars;
– communicative planning structure;
– adaptive working places;
– promotion of interest to research activities in young people.

Thus, the research area in relation to the educational premises can be built-in, as the one part of the laboratory premises is integrated into the common space, and the other part is built on.

Another example of a combination of study space with laboratories is the Faerder Technical College, designed by the Norwegian bureau White Arkitekter.

Another example of a combination of study space with laboratories is the Faerder Technical College, designed by the Norwegian bureau White Arkitekter. The Faerder Technical College has combined three existing training centers into one to provide vocational training to various technical subjects in the industrial port town of Tonsberg in Norway (Fig. 2) [2,10].

The new technical academy stands between Tønsberg's town center and its main port. In an area that has seen the slow demise of the use of its industrial buildings, this new technical school provides the perfect opportunity and an ideal location to symbolically rejuvenate the area, specifically in the types of practical trades that the area was once widely known for, like carpentry, welding and mechanical engineering.

White Arkitekter, with a competition winning proposal was commissioned Færder technical high school in order to redefine not only the perception, but the reality of how one pursues a practical education. The vision is to create a vibrant interplay between the school, the town and the region's enterprises; not just allowing, but inviting an intermingling of the non-student population to share in the new space that is created.

The three existing buildings have been integrated alongside other activities. The spatial plan is based on a vertical sequence. A main large multifunctional space functions as an entrance lobby, dining hall, auditorium and gallery; somewhere the entire school can gather under one roof. This was in stark contrast to before, where students were restricted to allocated, separate school buildings. Four levels of glazed workshops and rehearsal rooms sit adjacent to this core space. Instead of being hidden away in dark rooms, their activities are visible to the students inside, as well as the world outside [2,10].

Fig.2. Færder Technical High School / White Arkitekter. Source: the scheme developed by Mariia Khmel according to [2,10].

The open campus pathways provide a number of innovative mechanisms which encourage the public to interact with, and experience the academic pursuits of the school, including what is called the “Hangar”. With open workshops, mechanical garages and lecture halls, the Hangar is an open expanse at the center of the converging public and student pathways; allowing the people of Tønsberg to be drawn into the work the students are doing while on their way to grab a morning coffee or while walking the dog. By exposing the next generation tackling new problems within the openly displayed classes, the school, and all 750 students that the school enrolls actively feel more like a part of the community. Intertwining what resembles a school and a factory workspace, the design of Færder also focuses on the use of materials; the school was primarily built using concrete and wood. Showing excellent heat retention, these materials also show exceptional efficiency with the building’s cooling strategies; utilizing the adjacent canal water in the summer time, alongside a highly reflective rooftop that reduces initial heat build up. Furthermore, incorporated into the concrete, modern workshop like design are thermal exchangers, efficient climate-change strategies that guarantee low energy consumption; no small feat in institution that uses a high volume of energy hungry machinery [2,10].

The Hangar is a semi-enclosed superstructure at the heart of the college, where student and public walkways converge. Bridging the main entrance, its vast proportions emulate the shipbuilding facilities that once stood on the site. This covered outdoor space can host student and public concerts and exhibitions, anchoring the college within Tønsberg’s community life. Above The Hangar, the library offers students a tranquil place to read and study, with views across the water and town centre.

Faerder Technical College has an open-access policy; anyone that wants to learn here can enrol. Inclusivity was therefore essential; the campus was designed to be fully accessible throughout and transparent in its activities, encouraging an interplay with the wider community [10].

So, having considered the project of the Norwegian technical college Faerder, the following key methods of organizing the internal space can be identified:

– a separate unit for workshops;
– the resurgence of practical professions; spatial plan is based on vertical sequence;
– common space that includes (lobby, dining room, gallery)
– transparency of working workshops;
– openness to society;
– open space for public meetings;
– close communication link between the inhabitant and the student.

This example shows how the research area, such as the laboratories, can be integrated into the system of classrooms. This area is located in the attached building block.

3. AMERICAN EXPERIENCE

An example of the American experience of integrating specialized facilities into a general education institution is the Crossroads School for Arts and Sciences, which was designed by the American Bureau Frederick Fisher and Partners. There is a text description provided by the architects: „Our collaboration with Crossroads began as a conversation. We held open brainstorming sessions with students, alumni, faculty, staff and leadership and together envisioned a fluid, dynamic environment that would realize Head of School Bob Riddle’s vision to “reinvent the way science is taught in secondary school.”[9]. Frederick Fisher and Partners was selected to design the new Science Education & Research Facility for the Crossroads School for Arts & Sciences in Santa Monica. As the first new building to be constructed at the school’s main campus in nearly 20 years, the Science Education & Research Facility is 25,000 sf and serves the school's Upper and Middle School students as their primary science facility (Fig. 3) [1, 9].

The Science Education and Research Facility looms over the 10 freeway, two miles from the Pacific Ocean, an inspiring location for a learning center. The architecture integrates the school's urban reality with its naturally dramatic surroundings. The new building, with its iconic tower-like special projects pavilion, is the focal point of the school's unusual alley-centered campus.

FFP led the design effort, which was a community effort that involved Crossroads alumni, students, faculty, staff and administrators every step of the way.

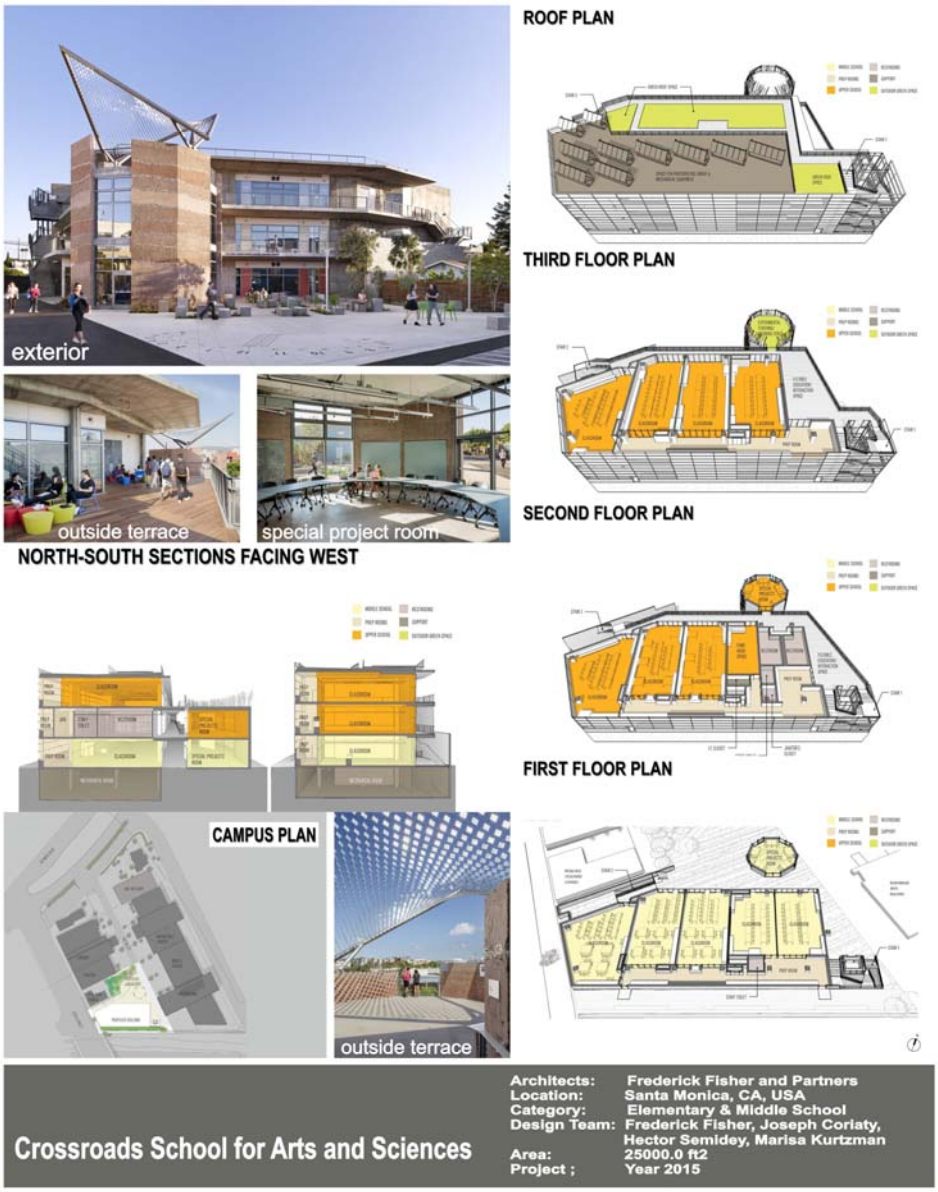

Fig.3. Crossroads School for Arts and Sciences / Frederick Fisher and Partners. Source: the scheme developed by Iryna L. Kravchenko according to [1,9].

The facility includes seven Upper School science classrooms, five Middle School science classrooms, three faculty prep rooms, one student study area, a fume hood room and a Projects Pavilion that features two project classrooms and one outdoor living laboratory. Exterior hallways and public terraces featuring slate blackboards extend the learning environment outside the classrooms. To the north of the building, a new plaza serves as an all-school gathering place for events and recreation. The plaza features a solar clock and a butterfly garden by Landscape Architect Pamela Burton. Garden habitats growing on the Projects Pavilion's rooftop intentionally intersect with the migration paths of Monarch butterflies, offering a rare urban safe harbor for the species. Students requested this garden and the other gardens are spread across the grounds.

Ceramic tiles outside the gender-neutral bathrooms depict the human body's molecular structure[1,9].

Atop the Pavilion rests a hyperbolic paraboloid sculpture by the esteemed environmental artist Ned Kahn, who created the piece as a visual reminder of the hidden interplay between wind and gravity. A hyperbolic parabaloid made with wind vanes mounted to cables, it casts light patterns onto the rooftop plaza and provides shade on sunny days. In addition to meeting Crossroads' strict sustainability guidelines, the facility also features energy-generating photovoltaic panels embedded into the glass curtain wall, recycled denim insulation throughout, LED light fixtures and ample natural light, a storm-water filtration system and energy-efficient plumbing and a roof garden.

Colored concrete walls modeled after rock strata, large storefront windows, terraces and open-air hallways emphasize the connection between inside and out. Fossil patterns, designed by students and imprinted into walls, turn the building's facade into a teaching tool [1,9].

So, after analyzing the American experience of integrating research facilities into the learning space, the following key points can be identified:

– a separate block with laboratories of the training center complex includes: 7 academic classrooms of the high school, 5 classes of secondary school, 3 classrooms of the faculty of preparation;
– pavilion for presentations and outdoor experiments.
– the presence of slate boards outside the audience encourages spontaneous generation of ideas;
– the presence of recreational space allows for school activities;
– the facade of the building as an educational tool;
– garden on the roof;
– modularity of school furniture;
– ventilated facade with energy-generating photovoltaic panels;
– use of recycled materials for insulation;
– the „tower" includes rooms for special projects and green roof space for learning.

This building of the training center is an example of integration of specialized premises in the renewed educational campus with the help of a separate building containing laboratories.

4. EASTERN EXPERIENCE

By analyzing the experience of organizing the interior space of educational institutions of scientific and technical profile, one cannot ignore the work of the Indian Architectural Bureau of DCOOP Architects, the School of Sciences in Kadappa, Andhra Pradesh, YVU, 2006 - 2008.

With its varied courtyards, terraces, columned halls, entries and playful shapes, the School of Sciences is a journey of discovery. These rich experiential encounters - realized without compromising on function or formal identity - create an architecture that goes beyond the visual and is experienced viscerally through the movement of the body in space (Fig.4).

The School of Sciences has been designed to house multiple post-graduate departments of science with teaching and research facilities. The success of the building lies in its control of scale and the complexity of spaces achieved while beginning from a logical analysis of program. The organization allows for tremendous flexibility of function while taking into account the climatic factors and maximizing indirect natural light and minimizing direct exposure to the scorching sun [8]

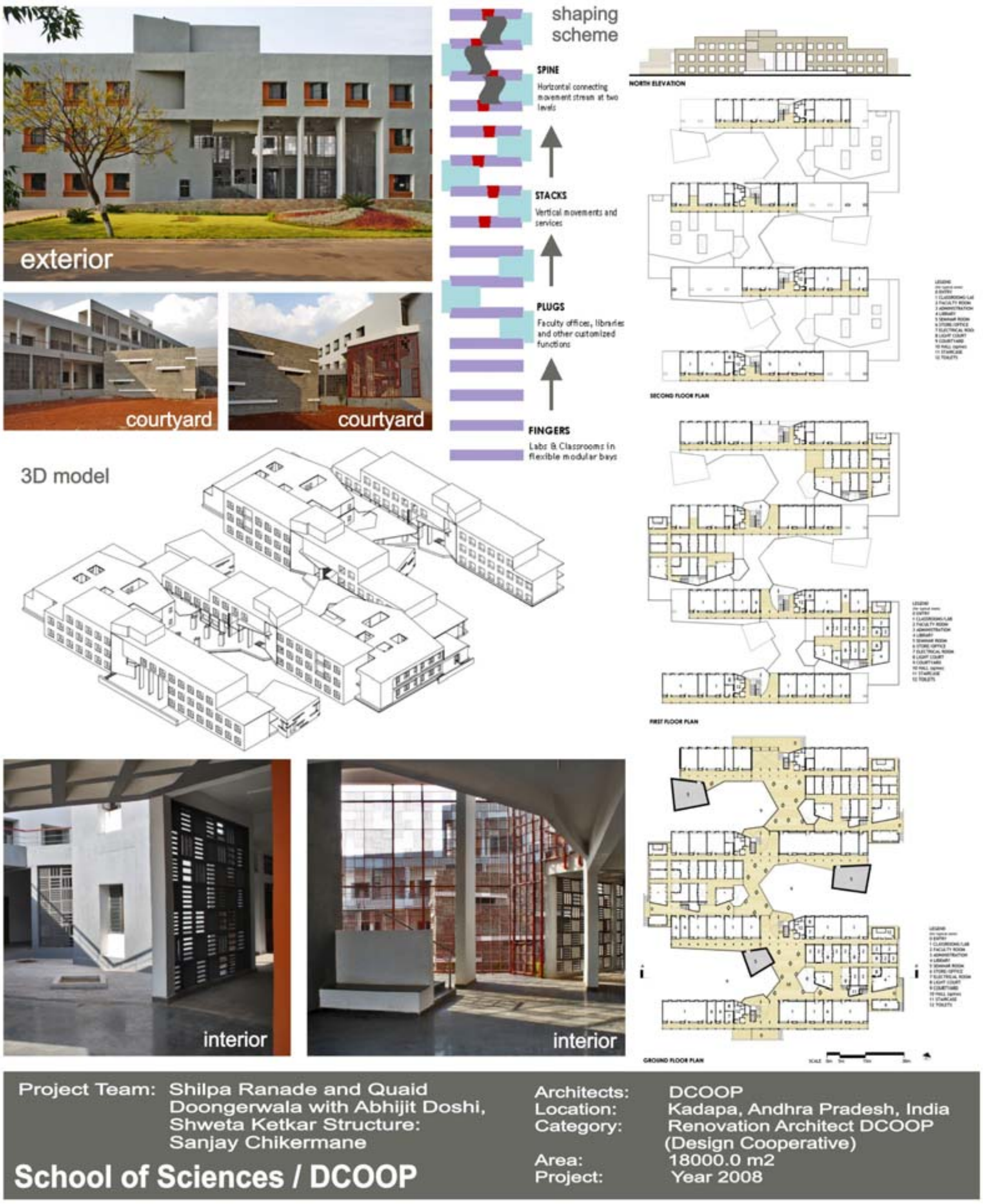

Fig.4. School of Sciences / DCOOP. Source: the scheme developed by Iryna L. Kravchenko according to [8,13].

While the solemn front of the structure conveys the image of serious academic pursuit that the university stands for, the building itself is centered around its users–faculty and students.Given the dynamic nature of education today where disciplines are fluid and responsive to the demands of the market, the building had to be inherently flexible to adapt to future changes.

The building is part of a larger 420 acre campus plan designed by the architects for a post-graduate university near the town of Cudappah. The design is based on a rigorous analysis of the program where functions are categorized into flexible/specific functions. Along with functional analysis, a key stimulus for the design has been the re-interpretation of thematic elements of traditional Indian architecture such as the jali, the courtyard and vast columnar halls (of temples and mosques for example). These elements stand as examples of a sensitive and tested response to context and climate. Moreover, they are also successful illustrations of how public buildings can be scaled to a personal intimate scale without losing their symbolic gravity [8,13].

The resulting organization rests on four organizational strategies- the FINGER, the PLUG, the STACK and the SPINE. The FINGER is made up of modular bays which house the labs and classrooms with service ducts in every alternate bay. The orientation of the FINGER is climate-responsive with minimum exposure to east-west radiation, natural north-lighting for all workspaces, and a south façade buffered by movement corridors with screens.

Fingers are held together by PLUGS housing more specific functions such as faculty rooms, libraries, and admin offices; that are intimately scaled with multiple small courtyards. The STACKS house the main services of the building - staircases, toilets and lift blocks and also connect the vertical and horizontal movements. Tying the entire group together is a movement SPINE with its vast halls of massive diamond 'columns' and an eccentric waffle slab.

Three large public courtyards formed between the fingers house trapezoidal seminar rooms that create interesting points of focus. Screens in metal and concrete add the necessary texture and protection to the common spaces along the courtyards. The staggering of the mass in section creates terraces at all three levels.

Given the remote location of the site and government patronage, a limited repertoire of construction skills and materials (with a keen preference for brick and concrete) was available for building. The design works towards pushing the boundaries of this existing paradigm of building to create a contemporary and dynamic structure. The success of the School of Sciences lies in its layered control of scale and the complexity of spaces achieved while beginning from a pragmatic and logical analysis of program. These rich experiential encounters - realized without compromising on function or formal identity - create an architecture that goes beyond the visual and is experienced viscerally through the movement of the body in space [13].

Thus, the main features that distinguish this building are:

– modularity of the functional organization;
– sensitivity to the changes;
– adaptive planning structure;
– the preservation of regional traditions and the response to the urban context;
– "intimacy" of the scale of the building.

After analyzing the School of Science, it can be concluded that the integration of specialized premises into the school building is carried out with the help of modular units that create certain clusters (that are independent from each other), the number of which can increase further, expanding the building's potential.

5. CONCLUSIONS

The actual problem of the education system is one of those factors that induce to rethink the processes that occur in the educational institution. This factor also directly influences the function of the building of the educational institution. So, the main aim of present-time architects becomes the design and organization of buildings of educational institutions as an informational and learning space. According to the results of a comparative analysis, it can be noted that in the world experience of designing educational institutions of a new type there is a fairly wide palette of methods for organizing the learning space.

An interesting fact is that more and more architects and designers are guided by the opinion of the community during the development of the projects of modern educational institutions, as the community is a potential user of the object. Pupils and students also have a direct influence on the creation of learning space. The newest educational institutions are now not only traditional comprehensive schools, but are being transformed into cultural and educational centers for learning, communicating and receiving various additional qualifications or acquiring new ones.

Actually, this trend that exists within the process of communication and learning itself has a direct impact on the architecture of educational buildings. Broadly speaking, this is the modern social factor of influence. This influences the formation of the architecture of the object of educational institution not remotely and not in general, but directly and is based on close cooperation of society and the architect. This is how the most diverse architectural objects of educational institutions emerge, that combine traditional educational functions with scientific and technical specializations and communicative public spaces.

A school building should not only be equipped with comfortable school premises, but also with a developed public space to complement the learning process, this helps to develop pupils' communication skills. The school building should have a large information area and access to information should be possible at all times, including an Internet center, library etc.

According to the authors of this article, this is how a powerful global trend towards cooperation of functions manifests in the architecture of educational institutions. But, besides the functional combination, various combinations of space-planning methods are widely used in such objects. Thus, the use of the “flowing space” is clearly reflected in all the above objects. In the educational buildings of European experience that are presented for consideration, such technique is expressed in the creation of general educational and communication space of the media library and also serves as the main recreational premise of the school, functionally connecting all the streams. In the American experience there are recreational spaces out in the fresh air. In the Eastern experience, the “flowing space” in general unites all four educational clusters and is saturated with communicative-educational function.

In addition, having considered these objects, it is possible to identify the main methods of integrating the research area into the structure of the educational institution, namely the premises of laboratories and special classrooms, that can be located in relation to the general block of traditional educational premises go as follows: built-in; superstructure; annex; separately located on the common territory of the educational campus; ready modular blocks, that are located in different parts of the building.

Further research should be carried out in the plane of identification of the typological correspondences of the newest educational institutions to the modern requirements for the educational process, and in the plane of searching for practical methods of formation of the internal space of specialized educational institutions.

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