NETWORKING «SCHOOL – HOME OF PHYSICS»

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ABSTRACT

The article describes a successful approach to interaction of schools and a university, which is implemented in MIIT. Further development of a student is mostly predetermined by his academic scholar level. Special attention is given to physics which has enormous effect on training of further engineering skills. A particular attention is given to special learning opportunities, provided by the House of Physics of MIIT.

ENGLISH SUMMARY

Background. *To achieve success in a career a person needs to have: creativity (creative thinking), intelligence (high level of education), skills of practical independent activity (a special type of training), and conditions for implementation of the knowledge gained.*

If the latter is a prerogative of the state, the first three components are largely determined by the organization and content of a learning process.

In this case, the prospects for development and infrastructure level of a world transport depend strongly on a number of qualified personnel in the industry. It is necessary to start solving this problem from the school level, constantly replenishing specialized higher education institutions with intellectually prepared students.

Objective. *The objective of the authors is to investigate interaction of schools and Moscow State University of Railway Engineering (MIIT), which is carried out with use of special facilities of the House of Physics of MIIT.*

Methods. *The authors use descriptive method and analysis.*

Results

House of Physics

Potential opportunities for successive connection with the school are owned and operated for more than one year by MIIT House of Physics [1]. This is a three-storey building, specially designed and put into operation in autumn 2010. Its distinguishing feature is the presence of audiovisual complex, which includes three lecture halls with preparation rooms and educational laboratory of innovative technologies. The complex provides:

- *complete translation matrix from one audience to another with on-screen in a different scale of individual objects in the system;*
- *all digital signals using fiber-optic cables, which creates a high resolution image (1920x1080);*
- *maximum luminous flux for such systems – 12000 lm;*
- *use of any data media (disks, flash cards, notes, journals, books, etc.);*
- *supporting work of plasma panels in the classrooms and corridors;*
- *ability to broadcast films in the latest formats, including «blu-ray» discs;*
- *fully automatic touch control, easy to operate.*

The laboratory of innovative technologies is equipped with a computerized practicum (with access to the local network of House of Physics and the Internet), can serve as a computer class and an electronic library and, in fact, becomes a perfect testing ground for the creation and testing of advanced education technologies [2].

An audiovisual complex is complemented by numerous «live» lecture demonstrations (about two experiments at the time), which significantly increases the interest in the subject under study. Preparation rooms of lecture halls are equipped with a lift, allowing moving the equipment from one floor to another.

Furthermore, House of Physics includes:

- *six thematic teaching laboratories;*
- *two computer classes, designed for centralized protection of laboratory works and testing, as well as performing a role of a digital library and a film library;*
- *four multimedia classrooms for practical training;*
- *rooms of lectures;*
- *education and research Center «Photonics of multicomponent systems and tools of information and analytical technologies' (ERC PIAT), equipped with a complex of spectroscopic analytical equipment purchased abroad [3].*

ERC PIAT conducts research work [4], takes part in numerous exhibitions and presentations, implements training courses for teachers and specialists, offers students specialized practicum on the basis of small fiber-optic models of firm «Avantes BV» (textbook for the workshop «Modular multifunctional fiber optic spectrometer system» is presented on the site www.avantes.ru), etc.

Given this wide range of technical potential, the House of Physics Engineering has received a task to involve into an educational process, not only students, but also a broad segment of population of the city (pupils, teachers, college students, etc.). And in fact, to continue raising the traditions established by the founders of a physical branch of the Institute of Transport Engineers professors P. N. Lebedev and A. A. Eikhenvald.

Now this work has been supported by a permanent physical workshop for schoolchildren, further education courses for school teachers and university lecturers, as well as study groups «This simple innovative physics», «Photonics and Nanotechnologies», studio school «Physical demonstration», etc.

Pre-university as it is

The next important step is learning in school under the tutelage of teachers of high schools, the creation of the so-called pre-universities, the organization of which attracts special attention of the government of the city of Moscow. Located in the territory of its region, city, district, university can (and should) take a direct part in the «settling» of a surrounding life. In MIIT this work began with the organization of a close interaction with the teaching staff of the North-Eastern Administrative District, where the university itself is located.

The aim of cooperation is methodological, technical, information and educational support for the Physics and Mathematics education of schoolchildren of the North Eastern Administrative District, the formation of the medium of creative communication of teachers in schools and universities, the development of common concepts and mechanisms of interaction, joint implementation of innovative educational technologies into the learning process, methods of development of individual students' abilities.

With regard to the detailed tasks, then came to the fore:

– Creation of conditions for deep physical and mathematical training of schoolchildren, improvement of their natural science outlook and focus on technical disciplines of higher education institutions, development and improvement of quality of professional education;

– Exchange of experience of school teachers and lecturers of MIIT House of Physics, conducting problem seminars and round tables, analysis of the problems of teaching physics in schools, increased interaction of physics community of schools in the North Eastern Administrative District, the use of unique classroom and laboratory facilities of MIIT for the benefit of schoolchildren;

– Development and implementation of the work programs in Physics (Advanced Course: 9–11 grades) and a system of their modular filling for networking following the scheme «school – higher education institution».

Meetings and classes in the House of Physics are supported by a network interaction through the portal of MIIT. In particular, this portal (www.svao-school.ru, section «My Learning») shows a module «Classical Mechanics». It is developed by the department of physics and includes six sections:

- *theoretical material;*
- *standard and non-standard tasks;*
- *laboratory practice;*
- *preparing for the state exam (EGE);*
- *video materials;*
- *mutual consultations.*

Section «Theoretical material» is presented by textbooks of the department of Physics published in paper and electronic form, special distance courses and video lectures.

The section «Standard and non-standard tasks» contains basic formulas and laws of classical mechanics, the details of elementary mathematics needed for the study of physics.

The section «Laboratory practice» includes three laboratory works of the House of Physics on classical mechanics adapted to the schoolchildren: «Error detection of time measurement by a human operator», «Study of rotational motion on the flywheel Oberbeck» and «Determination of the acceleration of gravity using a simple pendulum». A specially crafted film about a university laboratory of innovative technologies is offered in this regard.

Section «Preparation for the state exam (EGE)», provides a guidance on the work with site of National Accreditation Agency (www.i-exam.ru), allowing schoolchildren to compare their knowledge with the requirements of the state exam. The system of training and testing of schoolchildren in the mode of EGE is provided, including showing of demos, involvement in the training mode, self-control, etc. An example shows how the algorithm and recommendations can be used to solve typical tasks in the section «mechanics». Their subject matter is chosen according to the codifier for the unified state exam (EGE) in Physics.

The section «Video materials» demonstrates examples of the main approaches to the collection and development of the illustrations that accompany the course of physics. The Appendix gives a catalog of films by «Kvart» firm for lecture halls of the House of physics.

The section «Consultations» is designed to gather and discuss issues relating to the module.

The proposed work programs are designed in such a way as to make it convenient to split them into thematic modules: classical mechanics, molecular physics and thermal phenomena, electricity and magnetism, oscillations and waves, optics, elements of the special theory of relativity and the structure of matter. Each module is supported by educational-methodical complex, which is divided into sections as described (blocks). With the accumulation of intramodular educational-methodical material a number of modules and sections can be increased, forming an elaborated and convenient system of representation of the course. Moreover, the module usually meets the needs of graduate and complex departments – for example, «Theoretical and structural mechanics», «Electrical engineering», etc.

From the outset, in the developed program schoolchildren study in depth the elements of vector analysis, and their application to the description of kinematics and dynamics, Newton's laws and conservation laws. Visibility of mechanics makes it possible to learn a vector description of the physical processes on simple examples and to apply it in the study of circular motion, mechanical vibrations, transmission of mechanical and electromagnetic waves, the phenomena of electromagnetism, geometrical optics.

Considerable time is given in the program to relative motion in the processes of mechanics, the introduction of inertial forces, in particular, the Coriolis force, which is manifested in rotating non-inertial reference frames, to which the Earth belongs. The latter is impossible without the vector analysis.

Another aspect is the use of additional sources of information, a list of which is formed by lecturers of the department of Physics of the Faculty of Pre-university preparation and physico-mathematical school of MIIT. This list has been tested in work with applicants.

Simplicity, accessibility, convenient forms of information allow to initiate execution of additional works, assignments of practical (experimental) nature, individual tasks.

Conclusions. *At the example of the House of Physics of MIIT it is shown that thoughtful equipping of departments with modern education technologies and equipment, supported by enthusiastic teachers and the organizational support of the leadership of schools of the district and the university may establish centers of creative activity, attracting the youth to technical specialties and to their future university in particular.*

Information and training materials (tasks, examples, video lectures), presented at the training portal of MIIT complement the experience of the application of knowledge and methods of learning in familiar situations. At the same time a bridge (gradual transition) is created to self-activity, while giving the possibility of a creative approach to achieve basic knowledge of physics. The correctness of such a direction is confirmed by a similar experience of access to the net on the portal with materials in mathematics and computer science [5].

Key words: pre- university training, physics, entrant, enrollee, transport education, MIIT.

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