

Project-based Learning Approach as a Catalyst for Raising Environmental Awareness Among Students of Engineering Classes

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Abstract—The search for new approach to organizing educational process at school, choosing forms of education, allowing to form a creative personality interested in continuous self-education and eventually interested in conscious choice of engineering qualifications (including Bauman Moscow State Technical University) is one of the main activities of " Bauman Engineering School 1580" (former Lyceum 1580 at MSTU). The school's preliminary training activities present an effective approach of project-based training for the educational process. In the article, organizational and practical elements of forming and development of a resultative educational environment in a specialized school are given and analyzed. These materials may be of interest to the heads of educational institutions as well as anyone interested in the formation and development of specialized education at school.

Keywords—*Bauman Engineering School; environmental education in engineering classes; environmental awareness; educational paths*

I. INTRODUCTION

The global ecological crisis of the 21st century which began more than half a century ago and which can only be overcome with the participation of the entire world community is of particular relevance (see "Fig. 1"). Obviously, this requires raising environmental awareness of both individuals and society as early as in secondary school [1]. This process can be viewed as the unity of three interrelated issues: explanation of the disastrous consequences of environmental pollution; building an ecological approach to the organization of the economy and to other areas of life and the activities of society; raising environmental awareness among the younger generation [2]. Raising environmental awareness among school students is closely related to the processes of "digitalization" of society. The "digitalization of life" in all its aspects poses new challenges for modern education, particularly in the field of ecology, forcing the modern educational environment to become more sophisticated and flexible.

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form a creative personality interested in continuous self-education and eventually interested in the conscious choice of engineering qualifications (including Bauman Moscow State Technical University) is one of the main activities of " Bauman Engineering School 1580" . At the same time, one of the most important objectives of modern education, which requires special attention, is a systemic approach to preparing school students for their future engineering profession. Nevertheless, the source and driving force of pedagogical knowledge is still teaching practice.

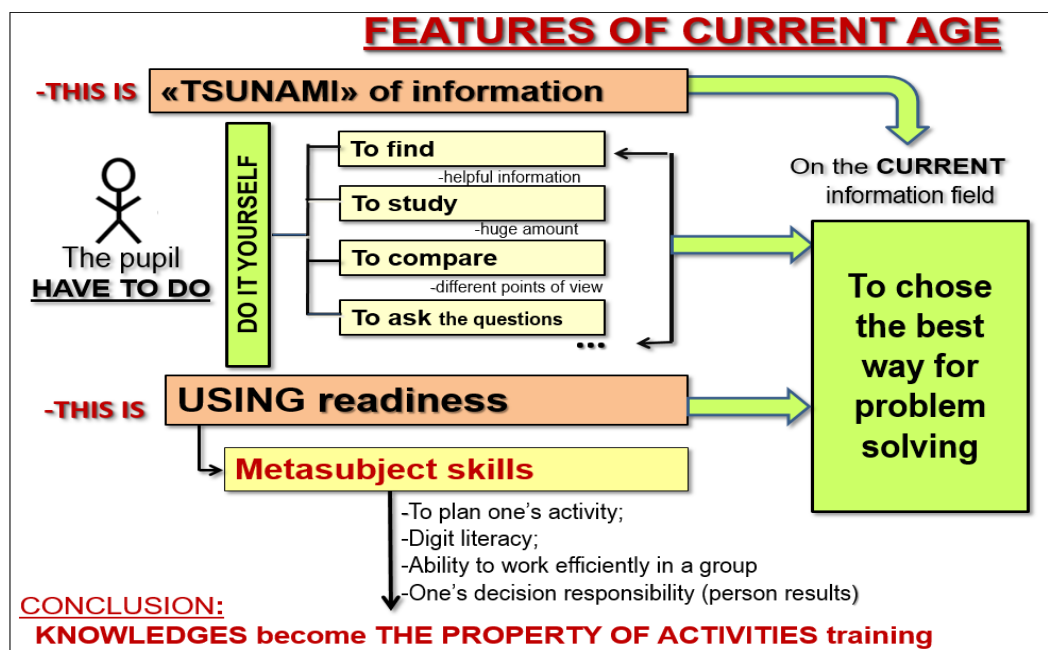


Fig. 1. Features of current age.

Let us consider the practical implementation and one of the mechanisms for raising environmental awareness among students of engineering classes — project-based learning and STEM education rules which are implemented by means of children and adults working on a project in tandem in order to address complex environmental issues [3], [4], [5]. This allows us to see the correlation between students' ways of thinking, communication, and action which are based on the processes of self-analysis and comprehension.

II. STAGES OF PROJECT-BASED LEARNING IN ENGINEERING CLASSES

It is obvious that any educational organization is a complex multi-parameter system that functions within the field of both research and innovation activity. Let us look at how performance management in the educational process in the organization of environmental education in engineering classes takes place as exemplified by project-based learning. The system of supplementary education and extracurricular activities also stimulate harmonious intellectual, physical, moral and social development of school students. This system is aimed at creating conditions for their full development, identifying their talents and reaching personal fulfilment while maintaining and strengthening their health, helping them to adapt to learning at a more difficult level [6].

Let us consider in detail the main reference points of this technological chain. Traditionally, the main objective of secondary school has been to impart knowledge to students, but due to external factors, the school cannot assess their abilities in the professional field and in environmental research to the full extent. That is why, from the early days, in Bauman School 1580, great importance has been attached to educational research activities of students in the framework of project-based learning as one of the innovative

forms of organization of the educational process, and with the introduction of the Federal State Educational Standard (ФГОС) in high school, this work has been paid special attention to. Let us examine the sequence diagram in operation.

The work begins with the definition of strategic goals and objectives which are clarified in the quantitative definition of the criteria for the final product which are relevant for the academic year. The organization of work is defined in main directions.

The first direction is projects on training programs of a partner university — Bauman MSTU (scientific and educational competition "Шаг в будущее" ["Step into the Future"], practical classes in laboratories and research centers of the university, scientific and educational practices, etc.). In general, an institution of secondary vocational education can also be considered a social partner.

The second direction is the use of the urban resources: interaction with technology parks, "Quantoriums", projects of "The School of New Technologies", etc.

As for the first direction, there is an extensive system of interaction with prospective students at Bauman MSTU, the main purpose of which is mutual familiarization, which allows us to avoid mistakes and failures in the future. On the one hand, prospective applicants — students of engineering classes — familiarize themselves with the history of Bauman MSTU, the system of engineering training, including particular training programs, with requirements for students, study conditions, etc. On the other hand, such long-term cooperation with potential applicants allows us to systematically evaluate their inclinations and abilities, their diligence and interest in both engineering and environmental spheres. Clearly, such cooperation stems from a systematic

approach, and as it is known, it can only be successful if the educational institution offers an integrative environment of education, creativity, science, culture and production. A necessary condition for such integration is the conclusion of trilateral agreements between the school, the university and the enterprise. Designing your own research and working on a project involves the implementation of the entire methodological chain of educational research technology: defining goals, objectives and principles for method selecting, planning the course of the research, formulation of expected accomplishments, evaluating the feasibility of research, determining the necessary resources, etc. In this case, the meaning of this work of school students is that such research is educational. The main objective of this type of work is not so much to get a new result in researching a problem (a negative result is also a result), but rather to develop the learner's personality, to acquire practical skills, to develop research mindset, and to enhance their personal position.

An essential element of the technology of such work is the formulation of expected accomplishments — the result of the project work (defining the concept and the objectives of the project, finding optimal resources, creating the plan and implementation of the project) and its implementation, including the analysis of the results.

The main principle of such practice is forming individual educational paths for school students in order to create a student-centered environment where students can efficiently use their spare time to develop their full potential. The content and organization of the educational process are determined by mechanisms contributing to the development of talent among potentially gifted students.

Needless to say that a modern school student can only be competitive under the condition of a complex integration of well-qualified faculty and modern technological support of the educational process, which is precisely the defining feature of environmental education in the engineering classes of School 1580. The conditions governing the development of talent, self-development and self-fulfillment of our students are defined by the following components: Federal State Educational Standard (ФГОС); implementation of multi-level meta-subject programs at all levels of education; staff assistance (in collaboration with higher school) and innovative educational technologies. All this is practically implemented within well-equipped laboratory facilities of the school and the city.

Both the school staff and the faculty of the universities provide invaluable assistance. An example of such fruitful cooperation is the cycle of vocational guidance activities "Bauman School of Young Engineers" which consisted of 14 modules in the year 2018. By completing project-based tasks, students become familiar with engineering training programs, including specific ones. All this allows students to better assess their inclinations and abilities, their diligence and interest in the sphere of research. The result of such practice-oriented cooperation is the traditional conference of lyceum students' research works held at the end of the school year. Students report on their research, conducted both at school and in the framework of supplementary education. Such a

report serves as a means of preparation for scientific and educational competitions held by universities and giving preferences for admission. For instance, the "Step into the Future" programme at Bauman MSTU.

III. CONCLUSION

Thus, in the process of working on a project, raising environmental awareness contributes to the development of students' ability to apply cross-functional skills and abilities, independently combine them and use both external and internal environmental action plans. Consequently, all students of School 1580 will be able to adapt to the intensive learning process at Bauman MSTU gradually and without pressure. It is obvious that such an approach to the organization of the educational process also helps to effectively address the problem of imparting theoretical knowledge in the educational process and eliminate the so-called "educational deadlocks" which are of crucial relevance nowadays.

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