

STEM APPROACHES IN EDUCATION: DYNAMICS OF DEVELOPMENT**Andrey DAVIDENKO**, Doctor of Pedagogical Sciences (Habilitation), Professor<https://orcid.org/0000-0003-1542-8475>

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Rezumat. Articolul este dedicat problemelor introducerii STEM în procesul educațional. Pe baza rezultatelor cercetării științifice și a bogatei experiențe didactice, autorul analizează abordările propuse în educație. Aici el oferă viziunea sa asupra modalităților de a rezolva problemele apărute. Conținutul articolului ar trebui să trezească interes în rândul comunității pedagogice generale.

Cuvinte cheie: STEM, învățare, dezvoltare, profesor, elevi, cercetare, creativitate, școală

Abstract. The article is devoted to the problems of introducing STEM into the educational process. Based on the results of scientific research and rich teaching experience, the author analyzes the proposed approaches in education. Here he offers his vision of ways to solve the problems that have arisen. The content of the article should arouse interest among the general pedagogical community.

Keywords: STEM, learning, development, teacher, students, research, creativity, school.

Many people are ready to give advice on how to teach children. Although, these “many” are not directly related to teaching activities. They don't know how complicated everything is in this matter. How complex is the person himself, in particular his psyche. It's much simpler in technology. In order to connect to a specific technical device, you just need to select a cable with the appropriate connector. In order to establish contact with a child, there may not be a ready-made connector. And the teacher has to “make” it himself. Not only beginners, but also experienced teachers face this problem.

To improve the qualifications of teachers, appropriate courses and seminars (webinars) are held, and a lot of literature is published, in particular, methodological recommendations. Outwardly, it looks as if all conditions have been created for the teacher to be able to successfully cope with the tasks assigned to him. In fact, quite often this is not entirely true. Education organizers comply with the formal side of teacher training, but the content part does not always satisfy the teacher. Especially during the introduction of pedagogical innovations.

The above is directly related to STEM. All participants in the pedagogical process know the meaning of this acronym. What's next? And no one really explained to them what to do with it. Some say that since it contains the concept of science (although it would be more correct - science), then everything should come down to the implementation of long-known interdisciplinary connections. Although I would like to ask: “Who forbade doing this before, before we started talking about STEM?” Others argue that STEM will teach students to work in teams. Still others suggest making the

learning process reverse. The student, according to their opinion, should work with “constructors”. By assembling certain mechanisms from their parts, the child will acquire new knowledge, for example, in physics. And all this is considered almost revolutionary, because before he was given theoretical knowledge, and then demonstrated its application in practice. At the same time, these “third people” do not forget to indicate where such “Constructors” can be purchased. The situation is similar with 3D printers. It is believed that the presence of such a printing device in the corresponding laboratory makes it a rank higher than those where it is not...

For more than ten years the author worked as a physics teacher in a high school. For more than thirty years he has been a member of the jury of all-Ukrainian Olympiads in physics. He is a member of the jury of the national stage of the international competition Inetel-Tehno. On his initiative, the All-Ukrainian Tournament of Young Inventors and Innovators was established. And he is also the chairman of its jury. 23 such tournaments have already been held. In addition, since 1990 he has been working in the teacher training system. This is written to ensure that the author looks at everything that happens from different points of view. And in most cases, his opinion is clear: during the introduction of STEM, no improvement in the quality of student training was noticed. Let this be a personal opinion, but this is confirmed by the results of testing schoolchildren in physics, the results of their participation in various competitions and tournaments, as well as their attitude towards the subject. An example available to everyone. It concerns the participation of schoolchildren from the Republic of Moldova in the competition for young inventors, which was included in the program of the International Salon of Inventions and Innovative Entrepreneurship (October 2023). It presented the developments of students from the Lyceum “K. Stere”, city. Magpies. But this took place before talking about STEM...

STEM does not deny or propose to remove from teaching practice everything that has proven positive in the past. His approaches do not deny the use of any new technical devices and technologies. It is unlikely that any pedagogical innovation can do without the use of information and communication technologies. In the acronym it is the letter "T". Robotics has become a reality. But it will not replace what already exists in the didactics of physics, chemistry, and biology. It can only complement. But intellectual and creative competitions in physics and robotics will also continue separately. Robotics is more of a technical subject rather than a physics subject. Based on this, the author is unlikely to agree with the proposal to study the laws of physics while creating something from designer parts.

But, nevertheless, if we turn to the content of this acronym, then from it we can extract what needs to be done in the process of teaching schoolchildren and students. This is also not new. But STEM focuses on it. And it consists of the following.

The letter “S” in it stands for science. So, the development of science does not happen without the study of certain phenomena and processes. This is precisely what is missing in the educational process in natural subjects.

For comparison, an example from the educational process in physics. You can give the formulation of Ohm's law in its existing form. Or you can invite schoolchildren to carry out research, as is done in one of the textbooks from the Republic of Moldova [1] and invite them to formulate it themselves. In which case is there more benefit? Of course in the second. Schoolchildren not only gain new knowledge, but also become familiar with methods of studying nature.



Figure 1. Deflection of a candle flame in an electric field

Or another example. During a physical experiment, students saw that a candle flame deviated from the charged electrode of an electrophore machine (fig. 1). A hypothesis is immediately put forward: “The flame of a candle contains charged particles.” The hypothesis needs to be tested! This is what the methodological manual we wrote [3] focuses on.

The second important aspect of STEM is represented by the letter “E.” This is its engineering component. It should not consist not only and not so much in familiarizing students with existing technical devices, technologies, and substances, but in attempts to create new ones. The author saw a good example at the above-mentioned International Salon of Inventions and Innovative Entrepreneurship. Students of the Lyceum "K. Stere" made a proposal to increase the efficiency of the Stirling engine, and a student (I only remember her name - Yulia) from one of the Chisinau lyceums presented to the jury an antibiotic she had invented.

And the last letter of our acronym is “M”. How can we do without mathematics? No way!

The author's thoughts are more widely presented in his other publications [2,5,6]. The article by Marii Xanthoudaki [4] is quite interesting in this context.

Our conclusions and proposals may be just as simple.

Before introducing any innovation into teaching practice, educational organizers need to consult with relevant experts in the field of psychology and didactics.

The teacher must have a clear idea of what he is obliged to do during the implementation of innovation.

Institutions that are engaged in advanced training of teaching staff need to study the positive experience of teachers and, after scientific review, publish about it in the accessible pedagogical press.

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