ON THE DEVELOPMENT OF PHYSICS DIDACTICS

DESPRE DEZVOLTAREA DIDACTICII FIZICII

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Rezumat. În prezentul articol se discută despre dezvoltarea didacticii fizicii. Se atrage atenția asupra relației dintre didactică și dezvoltarea științei fundamentale a fizicii, inclusiv cerințele societății de a stăpâni noile cunoștințe emergente. Textul reflectă problemele dezvoltării conținutului materialului educațional, mijloacelor, metodelor și formelor organizatorice de lucru cu elevii. O cerință necesară a timpului a devenit necesitatea de a muta accentul de la transferul de cunoștințe gata făcute către studenți la stăpânirea metodelor de înțelegere a naturii, precum și la aplicarea cunoștințelor pentru a crea noi dispozitive și tehnologii tehnice. Autorul se bazează pe experiența pedagogică avansată, precum și pe rezultatele cercetării sale științifice.
Cuvinte-cheie: didactica, fizica, dezvoltare, metode de studiu a naturii, creativitate.

Introduction

Quite often you can hear the opinion that pedagogical universities do not cope with the quality training of physics teachers. As a result, students are not interested in physics. Most often, such opinions can be heard from the mouths of school education organizers.

Direct participants in the educational process in physics (teachers) do not always agree with this. They see the cause of the negative phenomena that accompany their professional activities in something else. One of them is the lack of equipment necessary for the educational process. They see another reason in the fact that the number of academic hours devoted to lessons in a given academic subject is decreasing. Teachers are also concerned about other things, in particular, that their students have a very pragmatic approach to life and can openly ask the question: “Why study physics?”

We will not discuss the salary of a physics teacher, the attitude towards him in society, etc. The subject of our research will be issues of physics didactics. First of all, our attention will be focused on the content and means of teaching, the teaching methods used and the organizational forms of working with students.

Results and discussion

It should be immediately noted that when drawing up physics curricula, its development was taken into account. New sections were included in the program. We see new topics, and even entire sections, appearing in the program. This applies, for example, to the development of semiconductor technology, which has significantly expanded the capabilities of the elemental base of computer technology. These include lasers and the development of the theory of elementary particles...

It seems to me that, getting acquainted with the content of the article, it will be interesting to see the distribution of hours for teaching physics at school (gymnasium). In our table they are presented by year, which characterize certain periods of development of physics and society as a whole (Table 1.). The table was compiled by the author based on data from the candidate's dissertation of O. V. Samoilenko [9].

Table 1. Number of academic hours per week offered for teaching physics in the 19th-21st centuries

	III (6)	IV (7)	V (8)	VI (9)	VII (10)	VIII (11)	Σ
Men's classical gymnasium, 1804			2	2	2		6
Men's classical gymnasium, 1828				2	2		4
Men's classical gymnasium, 1848			2	2	2		6
Men's classical gymnasium with a focus on natural science, 1852			2	2	2		6
Men's classical gymnasium, 1890				2	3	2	7
Nizhyn men's gymnasium, 1914				3	4	3	10
General education school, 1966	2	2	3	4	5		16
General education school, 1992		2	2	3	2/3	2/4	11/14
General education school. Level of standard (Loktev V.M.), 2017		2	2	3/2,5	3	3	13/12,5
General education school. Level of standard (Lyashenko A.I.),2017		2	2	3/2,5	3	4	14/13,5
In grades 10-11, instead of physics, you can choose the integrated course "Natural Science", 1918.		2	2	3/2,5	4	4	7/6,5

The table shows that the number of hours allocated to mastering physics material remained unchanged from 1804 to 1890. Although in the 1928 curriculum it was reduced by 2 hours, which is a third of the number of academic hours presented in a similar document of 1804. Perhaps this happened purely by chance, because we do not see any significant reasons. Although one should take into account the fact that in addition to physics, various related subjects were taught in gymnasiums, for example, physical or mathematical geography, natural science, history of natural science, physics and cosmography, etc. [9]. We have been observing an increase in the number of teaching hours per week since 1914. A sharp increase in their number is observed in the 1966 curriculum. Obviously, this was associated with the development of electronics, communications, aviation, astronautics, etc. We also find the development of educational content in the latest physics programs [10]. However, the processes taking place in society could not but lead to changes in the field of education. This is reflected in the rapid development of technology, the redistribution of the labor market, the emergence of professions related to the service sector, the formation of a consumer person, etc. This is probably where this attitude towards physics arose. The point is that instead of physics, students in the two senior classes can be offered an integrated course "Natural Science" [7].

The means of teaching did not lag behind in their development. The creation and mass production of educational equipment by the relevant factories provided them with educational institutions in such a way that, if treated with care, it can be used for many more years. Active development and production of educational equipment was observed during the development of semiconductor technology. The educational process in physics has received all the technical

capabilities to implement the experimental method of teaching it. The importance of this method lies in the fact that experiment underlies the development of physics itself.

It should also be noted about the development of other technical means of teaching. We are talking about demonstration equipment. She quickly appeared in schools. Future and existing teachers were actively trained to learn how to work on it. At this time, old movie cameras, overhead projectors, slide projectors, graphic projectors, etc. easily replaced by personal computers and specially created multimedia teaching materials. Interestingly, it is easy to involve teachers and their students in their creation. An example is the created photographs of moments of physical phenomena, which were used by the authors in the methodological manual STEM/STEAM projects in physics [1].

A logical stage in the development of physics didactics was a shift in emphasis from transferring ready-made knowledge to students to developing their research and creative abilities. A huge role in this was played by the research of V. G. Razumovsky with the subsequent publication of several teaching aids for physics teachers [8]. His ideas were developed in the doctoral dissertation of the author of the article [6]. They are reflected in several of my manuals and articles [1, 4, 5, etc.].

It is impossible not to notice the emergence of new types of educational tasks for students. If earlier the corresponding collections contained problems, the result of which was to find the value of a certain physical quantity, then recently schoolchildren are invited to study the dependence of any physical quantity on the external factors influencing it or to create a useful technical device. Several examples of such tasks. The first of them is research, and the next ones are creative (inventive).

Problem 1. Look carefully at the snapshot of spark discharge trajectories (Fig. 1) and try to find answers to the following questions: How can you get such a snapshot? Why do discharge trajectories look like broken lines? Why are the discharge trajectories merged into one line near the right electrode (ball)? What needs to be done to ensure that the discharge trajectories do not have kinks?

Problem 2. Quite often, the bottom of the pan in which soup or porridge is cooked on a gas or electric stove burns. This happens due to the boiling of liquid (water or milk). Suggest a device that would signal when a liquid has boiled over or protect the pan from burning.

Problem 3. Replacing electric lamps that are located high under the ceiling is a simple operation, but requires the use of a folding stepladder, table, chair, etc., which is associated with certain inconveniences. Propose a simple and safe device that would allow replacing base electric lamps while standing directly on the floor.

Problem 4. After locking or unlocking a door, people quite often leave their keys in the lock slot, which can lead to negative consequences. Suggest a device that would notify the owner of the premises that he has left the key in the lock slot.

The author provides a solution to only one problem 2, and even then with “greed”. The fact is that any of them can be offered by us to participants in the international competition of young researchers and inventors “Edisons of the 21st Century” established by us. The tasks of the first competition have already been announced and the jury is waiting for the participants to solve the problems.

Fig. 1. Trajectories of spark discharges

I also ask you not to judge strictly the solution to one of the creative problems. It was made by students from an ordinary rural school. The figure (Fig. 2) was scanned directly from the decision text. It shows how the counterweight (a bottle of water) will lift the pan from the stove when some of the water has boiled away from it. A significant part of such tasks is contained in my methodological manual [4].

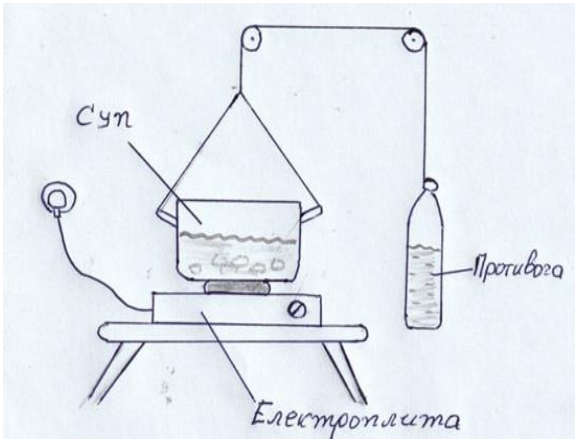

Fig. 2. Anti-stick device of students of the Krasnosilska school in the Chernihiv region

If we talk about organizational forms of working with students, they have also developed. Group forms and corresponding teaching methods were successfully introduced into the educational process. It should be taken into account that in the West, groups are often called teams.We have especially developed tournaments for young inventors and innovators. 23 such events have already been held across Ukraine, and they have taken a reliable place in physics didactics. On the initiative of the author, the above-mentioned competition was established. Now it has been transformed into international. An organizing committee and jury have been created for this purpose. As we can see, physics didactics has always developed and responded to the needs of the educational process. School teachers made a significant contribution to its development. Methodologists provided assistance to the school and pedagogical universities. It seems to me that certain conclusions can already be drawn.

Currently, changes are taking place in the education of our countries. In this regard, I would like us to more often turn to the teaching experience of teachers who show serious results

in their work. Have previous generations of teachers and methodologists really done nothing useful for education?

We need to think more about training the younger generation and developing the abilities of each child who has inherited the corresponding inclinations. Some teachers consider it a great achievement to be able to create tests to monitor students' knowledge. Controlling, as it turns out, is easier than teaching and developing a child! We must not forget that all this is not new [2, 3]. At the moment it has simply acquired a new quality. Thanks to information and communication technologies, of course.

It would be nice if a teacher's work was assessed not by his ability to demonstrate mastery of various and often ineffective techniques, but by the results of his work. After all, not a single mechanic who comes to fix a faucet will be paid by the owner if he fails to do the job. No matter how much he shows how he can remove the faucet, replace the liner in it, etc. We should not assume that pedagogical universities and teachers are to blame for all the ills of our education. If a student feels that he needs knowledge of physics, then he will again "gnaw at science." Perhaps we should return to the idea that physics is the theoretical basis of technology, and technology is necessary for the development of production. I almost missed one more thing: production is necessary for economic development.

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