TRADITIONS AND INNOVATIONS IN TEACHING NATURAL SCIENCE AT UNIVERSITIES

TRADIȚII ȘI INOVAȚII ÎN PREDAREA ȘTIINȚEI NATURII LA UNIVERSITĂȚI

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Abstract. *Based on personal teaching experience and research in the field of natural science didactics, the author suggests paying close attention to the teaching methods that have been developed in a particular country over decades. At the same time, he does not deny the advisability of introducing new forms, methods and means of teaching.*

Keywords: *traditions, innovations, natural sciences, university, education.*

Introduction.

The word innovation has been one of the most frequently used words among teachers in most countries of the world in recent years. It is heard at meetings of scientists and specialized university councils, at pedagogical councils in secondary comprehensive schools. All Internet search engines actively respond to it, providing us with huge arrays of articles, methodological manuals and recommendations, as well as documents that are sent out by our ministries to organize innovative activities in educational institutions under their jurisdiction. The word innovation, like other words, acronyms and expressions of the active vocabulary of teachers of higher and secondary schools, for example, transdisciplinarity, STEM, STEAM, STREAM, causes some of our specialists to hope for an improvement in the quality of education (among young people), a little discomfort among middle-aged teachers, among the older, experienced generation, more often confidence that they will survive this too. They have encountered many innovations. Some of them are remembered only by their names, some of them have taken their proper, one might say, corresponding place in pedagogical practice. But in any case, experienced teachers, as they were, and remain confident that it is necessary to give students good knowledge and develop the inherited inclinations for a certain type of activity. But an experienced primary school teacher is not sure that in the first, and even in the fourth year of study, it is possible to develop mathematical competencies in a child, which is required by the program for this subject. You can try to teach him to perform simple arithmetic operations. Although even here it is not always possible to achieve the desired result. How often an excellent student cannot be taught to jump rope...

It cannot be assumed that innovations will completely replace traditional pedagogy. With a smart, balanced approach, they will together solve the problems of human education and development.

Results and discussion.

A few words about the concept of innovation. As we can see, it comes from the words novation, novelty. These words mean that something new has appeared in our world. People who have invented this new thing are called innovators. We should remember the innovative teachers who were presented to our society at the time: V.F. Shatalov, E.N. Ilyin, S.N. Lysenkova, I.P. Volkov, and others.

It would be interesting to think about why these words (innovation, novelty, innovator) have been forced out of the active vocabularies of educators. Moreover, they are extremely rarely heard in other communities of people: engineers, doctors, winemakers... Is it because the belief has disappeared that teachers of secondary schools, teachers of higher educational institutions, as well as educational theorists, are no longer capable of producing new means, methods and organizational forms of teaching? Someone believes that the former should use what is offered to them, and the latter, educational theorists, are given the opportunity to discuss what practicing teachers use, reflecting a positive attitude to all this in their numerous articles. If someone wants to object to what has been said, let him find me the corresponding critical articles regarding the innovations that have been introduced into our schools and universities in the last 30 years. I will not name the two associate professors so as not to increase their citation index, but I will say that while we were switching to distance learning, in their article they convinced their colleagues that as a result of the introduction of this type of learning, their students' academic performance in physics had increased significantly... Were there any representatives of our profession who would challenge the results of their "research"?...

As we can see, the problem of the conference is not as simple as it may seem to an uninitiated person. As a lyrical digression, we can even say how widely it is presented in the UDC catalog. In it we find "Pedagogical Climatology. The Influence of Climate and Weather" and much more, which, of course, is very important and requires close study, but for the problem we are discussing, everything is "beating around the bush" ... If we talk about innovations in the educational process, then we can limit ourselves to the following areas:

Teaching tools (didactic tools):

Teaching methods (technologies) and

Organizational forms of work with students.

All this comes from well-known concepts of didactics and is easier to perceive in such a breakdown.

So, about the teaching aids.

If we talk about textbooks, teaching aids and scientific literature, we do not see any special changes. Perhaps, electronic textbooks have appeared. In addition, there are libraries with previously existing paper books converted into electronic versions (scanned). This has made the work of students easier and can be considered a positive phenomenon. Queues in libraries have disappeared, and it has become possible to work with such books at any convenient time.

The expansion of the arsenal of technical means, in particular, due to personal computers, projectors, new sound-reproducing equipment made it possible to abandon the previously existing film projectors, overhead projectors, slide projectors, tape recorders and other things that created significant inconveniences in the educational process.

Instead of educational films recorded on a plastic base, they were recorded on electronic media. It is hardly possible to overestimate their convenience (at the moment). In addition, an opportunity has appeared for participation in the creation of new multimedia didactic tools by direct participants in the educational process: teachers and students. For example, we have created a significant number of multimedia didactic tools that demonstrate high efficiency during classroom lessons, and also form the basis for the creation of research (STEM/STEAM) projects in physics and other natural sciences [1]. In addition, methodological recommendations have been written and published, which contain specific proposals for photographing moments of rapidly occurring physical phenomena [6].

The photograph (Fig. 1) shows an interesting phenomenon of snow sagging from a thin branch. This phenomenon can form the basis of a research project on natural history.

The role and other possibilities of ICT cannot be overestimated. First of all, they allow modeling certain phenomena and processes that take place in nature. And their second advantage is communication capabilities. In recent years, teachers and students have been able to use mobile communication devices (smartphones) for educational purposes. Manufacturers have begun to place various auxiliary devices in their cases: sensors for measuring magnetic field induction, vibration

sensors, temperature sensors. Microphones and light-sensitive elements traditionally placed in them, for example, the same matrices of their photo and video cameras, after installing the appropriate software, turn mobile communication devices (smartphones) into various indicators and measuring devices. The figure (fig. 2) shows a diagram of the spectrum of certain sound vibrations.

As we can see, innovations in the development of teaching aids, which over time have become innovations, have a positive impact on the development of the educational process at the university. At the same time, a negative trend is also observed: students of physics departments are rarely involved in inventive and design activities aimed at creating educational devices, which ultimately

Figure 1. Sagging snow on a tree branch

does not contribute to the development of their corresponding abilities. A graduate of a pedagogical university who is a potential teacher of physics or technology will not be able to develop the above-mentioned abilities in their students, which may ultimately affect the choice of professions related to technology and production by school graduates. Here it should be recalled that this is precisely what worries representatives of science and production in developed countries. It was in this connection that it was proposed to group natural sciences to implement appropriate approaches in teaching students [2].

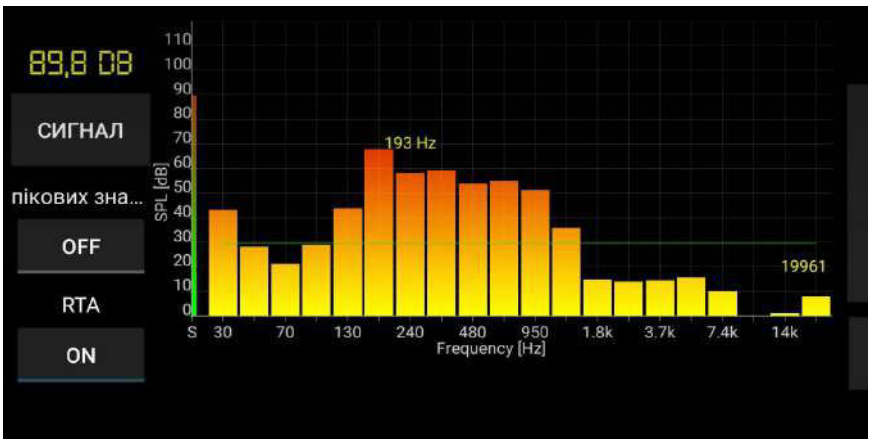

Figure 2. Sound vibration spectrum diagram

Innovations and innovations in teaching methods at universities and schools are much more modestly represented. Although it cannot be said that the methods that have long been entrenched in the educational process work perfectly here. Is it possible to oppose anything to the methods of demonstrating a phenomenon by a teacher with the simultaneous observation of this phenomenon by a student? Experiments play a huge role. For example, I do not know what can replace them in the teaching of natural sciences. Of course, we cannot leave aside other methods, for example, such as “brainstorming” or “synectics” [3], used to solve creative problems. The named methods are quite

productive, however, as practice shows, they are rarely used in the educational process. It is possible that this is due to the difficulties that arise when processing the results obtained during their use.

The artificially created techniques (they cannot claim to be methods) introduced into pedagogical practice, such as “openwork sawing”, “cubing”, “associative bush” and the like, did not leave even a trace for subsequent generations of teachers. It should be noted that teaching methods are closely intertwined with organizational forms of work with students. That's where they are used.

N. V. Elashkina and R. F. Rokhvadze note that lectures remain the basic forms of classes to this day [7]. Indeed, lectures, like lessons at school, have many positive qualities, and I see no reason to abandon them.

A few words about video lectures. I believe that in this case it would be useful to consider an example from the practice of my former dissertation candidate P. I. Naumchik. Teaching physics at one of the lyceums in Chernigov, he conducted the following experiment. While conducting a lesson with one group of students, he recorded it on video. This happened at a time when video began to be introduced into pedagogical practice. Students in the "parallel" group were given the opportunity to watch a video of a pre-recorded lesson. The same topic. Students of the same level of preparation. After watching the video lesson, they had the opportunity to ask any questions they had, and the teacher summed up the results of such a lesson.

It should be noted that the positive attitude of the second group towards this type of classes lasted for 2-3 lessons. Later they expressed a desire to return to traditional lessons. It is clear that based on this example, it is unlikely that any unambiguous conclusions can be made, except for one: students strive for direct communication with the teacher. The independence in the perception of educational material by lyceum students does not correspond to their age. Remembering this small experiment, I increasingly think about the effectiveness of such presentation of material to university students. Moreover, replacing the work of a teacher with students in the classroom requires no less time to prepare video lectures with subsequent discussion of their content, which is similar to seminars. Even more disappointments arose after the forced introduction of distance learning, built on the same video lectures ...

N. L. Antonova and A. V. Merenkov present a model of “flipped learning” in the higher education system in a way that is understandable to us [4]. For those who have not tried to apply this in their practical activities, everything may seem quite simple. Prepare a video lecture, conduct preliminary instructions for students and get to work. Indeed, their research showed that students are happy to independently watch the corresponding lecture outside of the classroom (96%). This should be followed by a discussion of what they saw…

The problem arises in the lack of time for "careful preliminary preparation", "material selection", and even more so "high-resolution video recording". Even a teacher of natural sciences is not always able to be a video and audio operator, a video editor, in order to prepare the appropriate package of materials without missing the corresponding meaning, the "highlight" of the lesson in each video lecture. For me, this is not so difficult, because I have significant experience in filming and preparing videos for international photo stocks (https://www.pond5.com/ru/collections/776758-stem-physics-nature-and-physical-experiments).

Of course, after this, there should still be preparation for the subsequent discussion of the content of the video lecture with the students. Although, I admit that in my practice this preparation, with the formulation of the relevant questions, is carried out simultaneously with the direction of the video lecture.

We all know other organizational forms of work with students [5, 7].

Worthy of attention are work in groups (teams) and various trainings. Here students acquire the appropriate skills for future professional activity.

At the same time, we must not forget everything that was set out by Jan Amos Komensky in his "Great Didactics" [8]. All means, methods and forms of work should not complicate, but simplify the work of the teacher and turn the students' activities into a pleasant and useful activity.

Conclusions.

The educational process in higher education has its own traditions and ethnic characteristics. By abandoning them, we risk disrupting the entire system of training personnel who will not meet the demands of their country.

It is necessary to use what has been developed in other countries, which may be an innovation for us. However, before introducing them into practice, they must be tested and experimentally verified.

It is necessary to encourage our teachers and methodologists for work that is focused on finding new methods, organizational forms of work with students and didactic tools in their educational institutions.

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