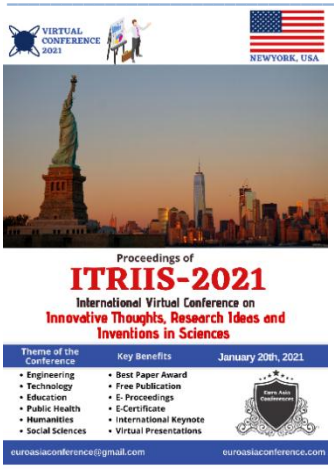

DEVELOPMENT OF SCIENTIFIC RESEARCH ACTIVITIES IN STUDENTS IN TEACHING MOLECULAR PHYSICS

Kamalova Dilnavoz Ikhtiyorovna
NavSPI, Associate Professor of "Methods of teaching physics and astronomy", PhD of technical science
Bisenova Bakit Tobakabulovna
NavSPI, Associate Professor of "Methods of teaching physics and astronomy"

Annotation.

In the article "Development of research activities in students in the teaching of molecular physics" one of the most pressing issues today is the solution of a priority task in teaching methods, such as the formation of a scientific worldview in students. The article deals with the use of visual aids in achieving a combination of theory and practice. While focusing on the consistency presented in the article in achieving a combination of practice and theory in improving the content of the learning process, the aspects of achieving the goal through the development of links between lectures, practice, laboratory classes are shown.

Keywords:

Demonstration, experiment, independent experiment, demonstration experiment, scientific research, scientific hypothesis, virtual laboratory, animation, learning experiment, active activity, independent activity, observation, basic hypothesis, basic hypothesis testing, event, object idealization, mathematical writing, theory, conclusion

Nowadays, a certain system has been developed in the practice of teaching physics. This system includes:

1. Demonstration experience of the teacher;
2. Independent experience of students (frontal laboratory work, laboratory practicum, extracurricular experiments and research work).

Each component of the teaching experience has a complex structure. The elements of the education system are interconnected and complementary, of course. In the process of teaching physics, theoretical physics and experimental physics should be inextricably linked. The purpose of this article is to show the development and management of research activities in students in certain examples in the teaching of physics. For example, the content of teaching materials should include tasks and issues that develop students' research activities (experimentation, explanation and prediction of events, comprehension and verification of hypotheses, research and design work).

It is possible to manage and develop research activities in students on the basis of teaching experience, that is, through the concepts of introducing logical (logical) connections of problem situations with each other. At the heart of this, for example, is a demonstration experiment. Its schematic appearance is as follows:

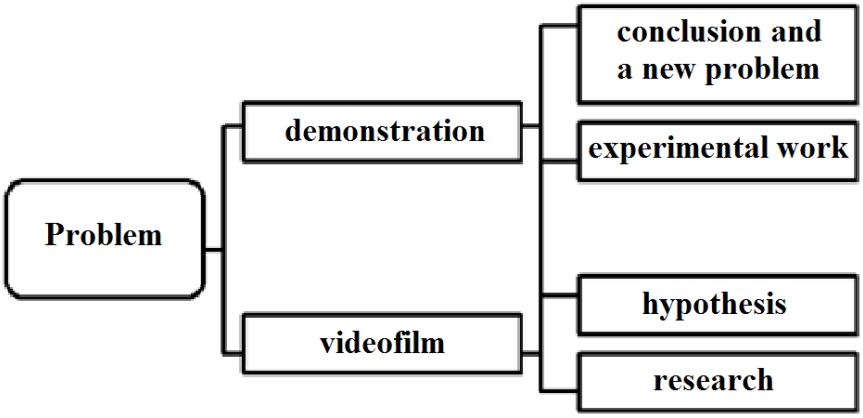

Figure 1.

This method allows modeling the content of the learning process and activates the research activities of students. After the demonstration experiment, if the teacher uses animations and a video showing the topic of the lecture, the students will be more interested in mastering the topic and doing research.

Given that in some educational institutions it is not possible to demonstrate experiments in physics on devices and equipment, then it would be expedient to show events and processes in the natural sciences in the form of animations through virtual laboratories using information and communication technologies.

One of the main components of the system of teaching experience is the student experiment (learning experiment), that is, it pays great attention to the active and independent activity of students in the learning process. The topic of a new lecture can also be applied to students doing simple laboratory work during the transition period. If the teaching process is organized as in the above scheme, it will give effective results in the acquisition of science by students and further develop the research activities of young people. The main factors that shape the scientific outlook of students are:

1. To study the causes of the occurrence of physical processes;
2. Reach the essence of what law is reflected;
3. Mathematical modeling of physical laws (detection of errors, graphical representation, tabulation);
4. Calibration of analog devices (model or mock-up) manually or on a computer;
5. Investigate the sample under study and determine its place in practice;
6. To bring the studied process to the animated representation;

It is expedient to organize students' research activities in the following logical chain:

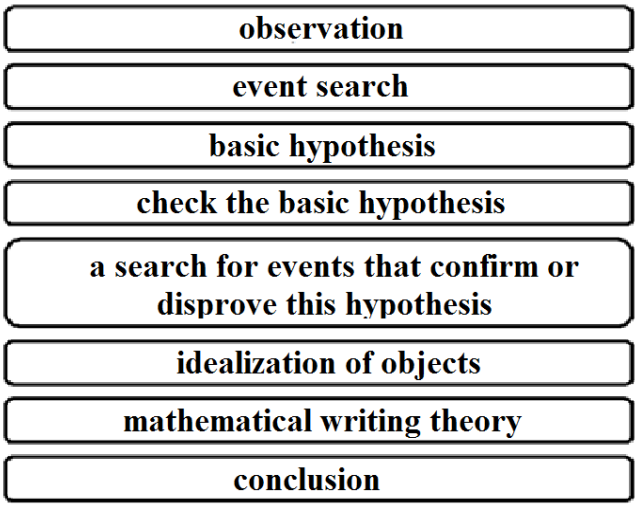

Figure 2.

We will show the above ideas in the following topics that will be covered in the general physics course: the structure of the fluid, surface tension, wetting, the organization of training on the example of capillary phenomena. The course can take the following schematic form:

1. Demonstration experiments on liquid surface layer and surface phenomena;
2. Demonstration experiments on the observation of surface tension forces;
3. Introduce physical concepts on these phenomena and write formulas in mathematical form;
4. In frontal or demonstration experiments to study the surface tension of liquids, students learn by observation what surface parameters the surface tension depends on;
5. Conducting frontal experiments on wetting and non-wetting liquids;
6. Conduct demonstration experiments on this event;
7. Demonstration experiments on capillary events;
8. Determining the height of the rise of the liquid in the capillary tubes;
9. Make mathematical conclusions about the event;

For example, in laboratory observations, the student observes how the surface tension depends on the physical parameters by placing a needle, coin, or water and mercury in a container filled with water.

Figure 3.

Computer-generated videos, on the other hand, allow students to develop skills and competencies to understand some of the ambiguities in demonstration experiences. In the final part of the learning process, students perform frontal laboratory work.

In this case, the coefficient of surface tension of liquids is measured in the following ways:

1. Determination of the coefficient of surface tension of various liquids by the drop method;
2. Determination of the coefficient of surface tension by cutting the ring from the surface of the liquid;
3. Determining the coefficient of surface tension based on the height of rise of liquids in capillary tubes.

Students independently draw and compare results and draw their own conclusions. Independent performance of laboratory work under the guidance of students develops their research activities. Therefore, we need to pay special attention to the fact that students perform independent laboratory work in the laboratory rooms of physics. In the process, the following research skills are developed:

1. The purpose of the inspection and the setting of the issue;
2. Relevance of the issues raised;
3. Existing hypotheses on the issue;
4. Observation of the hypothesis being tested and data collection;
5. Select the verification method for the event;

6. Conduct experiments and get results;
7. Analysis of experimental results;
8. Conclusion;
9. Apply the results in practice.

Thus, students will have a number of information on the properties of liquids in this lesson. They will gain interesting information on the properties of liquids by conducting a series of studies on wetting phenomena outside of class.

While focusing on the above-mentioned consistency in achieving a combination of practice and theory in improving the content of the learning process, achieving the goal through the development of links between lectures, practice, laboratory classes has a specific effect. As a result of combining the above links with the demonstration in the development of education, we can achieve the goal of the training.

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