

Principles of Forming Educational and Research Activities in Physics Education

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Abstract:

This article discusses the stages of formation of educational and research activities in the physics course of general secondary education, the importance of educational and research activities in the formation of physical knowledge.

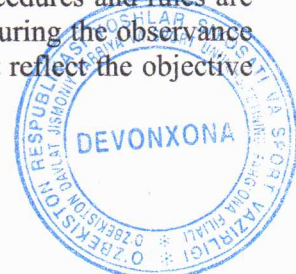
A methodical model for improving the educational and research activities of students in physics education is recommended.

Keywords: educational and research activity, principles, system of logical actions, systematicity and coherence, problematic, research.

INTRODUCTION

The idea of exploratory teaching in pedagogy is a heuristic method of education based on the acquisition of new knowledge by a person on the basis of his own research, not to give knowledge ready-made, and to acquire new knowledge in the process of analyzing cognitive activity. In the development of the idea of mastering new knowledge through the formation of educational and research activities in physics education, the correct use of educational principles is of great importance.

The basis of any theory is principles, laws and regularities. In the theory of physics education, we can observe that two types of laws appear. The first type of regularities is manifested in any form of the organization of the educational process, while the second type of regularities is followed in the educational processes organized under specific conditions, where specific procedures and rules are introduced. The manifestation of laws in the educational process takes place during the observance of the relevant principles. "Principles of education are basic didactic rules that reflect the objective



laws and regulations of education and determine the direction of development of the learner" [8,129-p].

ANALYSIS OF LITERATURE ON THE SUBJECT

One of the most important tasks in teaching physics is the formation of a set of scientific knowledge-concepts in a logical sequence. The formation of concepts based on research-based teaching and the dynamics of its development are not sufficiently covered in educational methodical literature, only examples are presented.

The use of different principles of educational research in the study of natural and scientific sciences by I.Y. Lerner, M.V. Skatkin, problems related to the system of logical actions regulating various stages of educational and research work in the scientific researches of P.M. Sadler, R.M. Abdulov, T.V. Avgusmanova, N.A. Alekseev, T.V. Alnikova and V.V. Mayer studied. V. G. Razumovsky considers the four periods of scientific research, which are called "fact - generalization - hypothesis - new facts to be verified" and form a complete cycle, to be an important factor in developing the creative ability of a person.

Analyzing the existing scientific and methodical literature, we can see that the studies devoted to the formation of educational research activities in education have not been sufficiently methodically analyzed and that many people (especially young specialists) need such developments.

RESEARCH METHODOLOGY

First of all, it should be noted that in order to carry out educational and research activities, the learner must have a certain level of research skills, at the same time, a problematic question arises: "Should research skills be developed first, or should research skills be developed during the educational and research activities?"

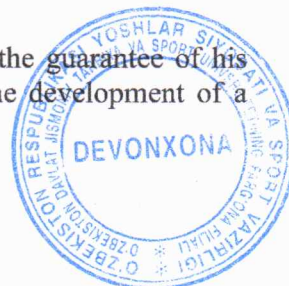
The solution to this problem can be seen in the regular involvement of students in the activity of "small research" in the educational process, thereby forming individual elements of research skills in them.

The formation of research skills of students in the physics education process of the general secondary education system should be provided for in the goal and content of each academic subject. Also, this goal should be reflected in the method of teaching one or another subject, in the combination of classroom and extracurricular activities. Independent learning of the learner is encouraged in the organized educational processes, this activity is developed on the basis of the "lesson-to-lesson" procedure, and at the same time, the learner gradually learns the norms of research activity. The teacher's skills in the classroom should help this process.

It is necessary to take into account the age characteristics, physiological and psychological development of learners when developing the sequence of mastering individual actions and practices that are part of educational and research activities.

Taking into account the individual pedagogical and psychological characteristics of students in educational and research activities is reflected in their involvement in educational and research activities at various levels. Learners are involved in the first level of educational and research activity during class sessions. Learners who are interested in the process of conducting research in physics, and therefore highly motivated, are invited to team training outside of class. Students who are active in the second-level educational and research activities are created conditions for conducting independent educational and research work: they should be given the opportunity to choose individual research topics.

According to the active approach in education, the activity of the learner is the guarantee of his successful achievement of educational goals. According to L.S. Vygotsky, the development of a



person through education is only within the framework of activity, and activity is perfect only with a goal and motive (motivational factor, interest in carrying out this activity). Therefore, it is necessary to pay special attention to the above aspects in the design and organization of educational and research activities of students, to consider the stage that generates motivation: this stage is very important for students to "get involved" in educational and research activities [10, 179-b].

The principles of educational and research activities and the methods of organizing educational activities are of decisive importance in the development of learners as individuals and in the successful achievement of educational goals. In essence, the goal of education is to develop a person on the basis of universal ways of knowing the world, "The personal, social, cognitive development of learners is determined by the features of organizing their activities, first of all, educational research activities" [11, 66-b]. This principle is similar in content to the principles of activity applied in the didactic design of educational research activity of learners. The principle of systematicity and coherence envisages the sequential formation of individual elements of educational and research activities, while cooperation (developing relations between teachers and students in educational and research activities) is envisaged

In the teaching of physics at school, the principle of interrelationship between the educational activities and extracurricular activities of students in physics lessons is important. The essence of these principles should be reflexively analyzed. Therefore, it is important to adhere to the principle of reflexive attitude not only to the teaching content, but also to the actions performed by learners. It should be said that one of the important aspects of a teenager's age is his tendency to reflection. Through reflection, a teenager perceives and manages the intellectual action he needs to perform. Therefore, in the reflexive evaluation of the content aspect of the subject during the educational process, "What have we learned?" as well as reflexive analysis of the method of action "How did we achieve this?" should be in order.

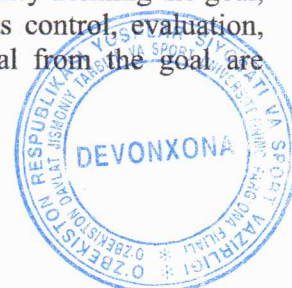
ANALYSIS AND RESULTS

The principles of formation of educational and research activities in the educational process are also shown in our recommended model for the organization of educational and research activities of students in school physics education.

"Different, multifaceted and multifaceted forms of educational and research activities must ensure the real integration of the lessons and extracurricular activities for the development of educational and research activities of learners" [6, p. 177].

In order to properly form the educational and research activities of students of general education schools, the whole set of regulatory logical actions provided by the State Education Standards (regulatory, cognitive and communicative actions) is mobilized. In the works of field researchers [8; 10.] the types of logical system of actions used at each stage of educational and research activities are distinguished. In the organization of educational and research activities, group and general forms of teaching are combined, and as a result, communicative learning activities are activated. Working in a group, the learner acquires the ability to establish purposeful relationships, cooperates with his peers within the framework of his studies, coordinates his actions, and demonstrates leadership abilities. After the stage of working in the group, the turn comes to the stage of collective discussion of the results: at this stage, the learner's skills such as being able to ask questions clearly and meaningfully, demonstrate his oratory potential, and justify his views are developed.

Regulatory actions are applied and developed at various stages of educational and research activities. For example, for the initial stage, putting forward a hypothesis - clearly defining the goal, and for the last stage of educational and research activity - actions such as control, evaluation, correction or, according to the principle of periodicity, setting a new goal from the goal are characteristic.



At each stage of the educational-research process, the process of knowing is manifested in various forms of educational activities. For example, at the beginning of educational and research work - at the stage of collecting information from various sources, logical actions such as comparison, classification, systematization, generalization, analysis, definition of contradictions, description of the problem are performed. At the end of the research process, skills such as comparison of results, classification and summarization of conclusions, analysis and synthesis of indicators are formed.

In order to clarify the specific points of the proposed model, we give an example of research on the study of atomic structure and its composition based on person-oriented and systematic activity approaches in a physics course.

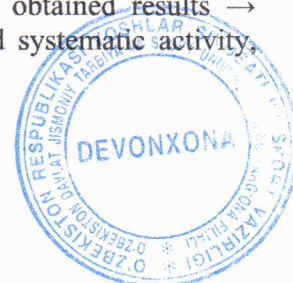
At the initial stage of the training, which is suitable for educational research, the learner acquires knowledge and skills about the structure of the atom with the help of the teacher in the system of logical actions of hypothesizing, predicting and goal setting, correction or regularization: while answering the teacher's consistent questions, the basic concepts (the atom size, mass, electron motion, atomic nucleus, etc.) understands its essence.

At the middle level of interactive presentations, i.e., at the "research-lesson" level of the lesson, it is organized as heuristic research based on the demonstration experiments and laboratory educational experiments conducted (being conducted) during the lesson. Heuristic conversations based on interactive presentation experiences, gathering information from various sources, comparing, classifying, systematizing, summarizing, analyzing, defining contradictions, and based on problem description, the ability to deeply understand educational information and draw conclusions based on models that explain the structure of atoms is envisaged. At the so-called final stage, through laboratory research conducted on the scale of small groups, they independently learn that the internal structure of the atom is complex.

At this stage, during the comparison of results, classification and generalization of conclusions, analysis and synthesis of indicators, the goal is to study not only the structure of the atom, but also the filling of the internal states of the atom with electrons, the difference of the elements in Mendeleev's periodic system according to the atomic structure.

Students are given an independent task to analyze the atomic structure and study the fundamental properties of each of its individual particles. They are also assigned the task of independently studying the composition of the atoms of the equipment they use and their physical properties as a result of various observations.

The scientific-methodical analysis of the level of effectiveness of teaching-research activity in physics education regarding the mastery of the structure of the atom and its composition showed that at the initial stage of the education - the promotion of the hypothesis, the internal states of the atoms of all the elements in the periodic system are filled in the same way, but due to the unpaired electrons in their outer shells, their physical- they study the reason why their chemical properties are fundamentally different from each other. For this reason, they use the law of conservation of charge in their work within the framework of research education, taking into account the fact that the atom is an electroneutral system and lives for a long time. At the next, hands-on stage of the study, students "discover" the complexity of atomic composition when they begin to learn to analyze the model of the atom proposed by Thomson and Rutherford. In this situation, the teacher should evaluate the situations that arise during the lesson and present only the options that the learner can handle as tasks. At this stage, the following chain of educational and research activities is followed: creating a problem situation based on a demonstration experiment, setting a research task → gathering facts based on the results of the experiment → analysis of the obtained results → conclusion. In this order, based on the principles of individual-oriented and systematic activity,



educational and research activities related to mastering the atomic structure and its composition are organized and their effectiveness is scientifically and methodically analyzed.

CONCLUSIONS AND SUGGESTIONS

Summarizing the above points, it can be concluded that educational and research activity is presented as a complex of various steps, stages, phases, practical and intellectual activities. In our opinion, this situation can be explained by the uniqueness of the principles of educational and research activity and their essentially different nature.

Considering the educational and research activity of learners as an object of research, we suggest taking the following sequence as a basis. This sequence looks like this:

- Development of a theoretical model for the formation of educational and research activities of students in the teaching of physics in the general secondary education system;
- On the basis of this model, to build an algorithm for forming educational and research activities of students in learning physics.

The next stages (that is, the stages of applying the educational and research activities of students to practical educational processes) are carried out by the physics teacher. From this it can be concluded that the physics teacher should be sufficiently prepared for this activity. The teacher's professional competencies include research competence, that is, the teacher should be ready to carry out research activities while solving professional problems, because as V. A. Belyanin noted, "It is important to recognize the teacher's readiness to develop research skills and abilities in students as one of the components of his professional competence." [9, p. 134].

Proper organization of educational and research activities of students in physics education is a guarantee of systematic learning of physics and ensuring educational efficiency.

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