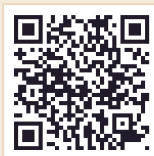




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THE MICRO-RESEARCH METHOD FOR ORGANIZING INDEPENDENT RESEARCH ACTIVITIES IN PHYSICS LESSONS

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Abstract: This paper proposes the Micro-Research method aimed at organizing students' independent research activities in physics lessons. The essence of the method lies in creating a small-scale scientific research environment in the classroom, where the teacher acts as a scientific supervisor and the student becomes an independent researcher. The Micro-Research method consists of three stages: terminological search, conceptual analysis, and systematization with deep understanding of logical connections. The theoretical foundations of the method are discussed, and a sample lesson plan on the topic "Ohm's Law" for the 8th grade is presented. The results indicate that this approach contributes to the development of students' independent thinking, analytical skills, and ability to form new knowledge.

Keywords: Micro-Research method, independent research, physics education, terminological search, conceptual analysis, logical connections.

Introduction

One of the most important tasks facing the modern education system is the development of students' independent thinking, critical analysis, and research skills. Today's society demands not merely the passive acquisition of knowledge, but the ability to independently seek, analyze, and apply it in practice. In the traditional lesson model, the student often remains in the role of a passive listener, which limits their active cognitive engagement. Therefore, the need to shape the student as an active discoverer of knowledge has become highly relevant.

The development of independent thinking and research skills has been widely studied in modern pedagogy. J. Dewey, in his work *Democracy and Education*, emphasized the necessity of students' active participation in the learning process and the independent discovery of knowledge [1]. J. Bruner, in *The Process of Education*, substantiated the importance of activating students' cognitive activity and discovery-based learning [2].

In recent years, the inquiry-based learning approach has received particular attention. D.D. Minner et al. demonstrated in their research that inquiry-based science instruction increases students' cognitive engagement and leads to deeper understanding [4]. B.A. Crawford analyzed the complexities and effectiveness of teaching science as inquiry in practice [5]. The 5E Instructional Model developed by R.W. Bybee is also recognized as one of the effective ways to engage students in active inquiry [3].



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In the field of physics education, a number of studies have focused on organizing students' independent research activities. A. Tursunov studied the effectiveness of using interactive methods in physics lessons [7]. M. Abdullayeva addressed the issues of organizing students' independent research activities in education [6]. However, most of these works are devoted to project-based or problem-based learning methods. A structured "micro-level" research methodology that can be implemented within a single lesson in a step-by-step manner has not been sufficiently developed. In particular, systematic approaches based on the redistribution of roles between the teacher and the student in secondary school physics lessons remain relatively rare.

Therefore, this paper proposes the Micro-Research method aimed at creating a small-scale scientific research environment within the classroom.

Main Part

Developing students' independent thinking and research skills is one of the priority tasks of modern pedagogy. In the traditional lesson model, the student remains a passive recipient of ready-made information. Moving away from this approach and transforming the student into an active discoverer of knowledge significantly increases the effectiveness of education. For this purpose, the Micro-Research method, based on the redistribution of functional roles between the teacher and the student, is proposed.

The essence of this methodological approach lies in creating a small-scale scientific research environment in the classroom. In this process, the teacher steps away from the traditional role of a lecturer and assumes the functions of a scientific supervisor and guide. The student, in turn, is no longer a passive listener who memorizes ready-made information, but acts as an independent researcher exploring a specific topic. The teacher does not present the new topic in a ready-made form, but assigns a research task to the student and guides the process from a scientific perspective.

The Micro-Research method consists of three sequential and logical stages:

1. **Terminological search.** The student independently identifies and records the key concepts and keywords related to the given topic.
2. **Conceptual analysis.** Students independently define the identified terms using various textbooks, information sources, and digital resources.
3. **Systematization and deep understanding of logical connections.** Students develop a deep understanding of the logical relationships between concepts and independently formulate formulas and rules.

As an example of a lesson plan based on the Micro-Research method, we will consider the topic "Ohm's Law" from the 8th-grade physics curriculum. The aim of the lesson is for students to study Ohm's Law through independent research, to gain a deep understanding of the relationship between current, voltage, and resistance, and to develop skills of independent thinking, analysis, and formula formulation. The educational objective is to reveal the essence of Ohm's Law and to formulate the formula independently; the developmental objective is to foster skills of independent research, identification of logical connections, and analysis; the educational

(nurturing) objective is to cultivate students' curiosity, responsibility, and sense of cooperation.

The lesson lasts 45 minutes and consists of three main parts. In the organizational part, the teacher announces the lesson and assigns the research task to the students. It is explained that today the students will work not as passive learners, but as young researchers who are expected to independently discover the topic of "Ohm's Law."

The main part consists of the Micro-Research process and includes three stages. The first stage is called terminological search. In this stage, students are tasked with identifying the most important key concepts and keywords related to the topic and recording them in their notebooks. Students independently identify concepts such as current, voltage, resistance, conductor, and electric circuit. The teacher circulates around the classroom, asks guiding questions, and monitors the process.

The second stage is conceptual analysis. Students independently define each of the identified concepts. To do this, they use textbooks, the internet, or other sources and write the definitions in their own words. For example, current is defined as the amount of charge passing through a circuit per unit of time; voltage as the force that causes charges to move; and resistance as the property of a conductor to oppose the flow of current. If necessary, the teacher guides students to compare and refine their definitions.

The third stage involves systematization and deep understanding of logical connections. Students are given the task of identifying the relationships between the concepts and formulating the law themselves. They answer questions about what current depends on, what happens to the current when voltage increases, and how an increase in resistance affects the current, and then express this relationship in a single formula. As a result, students conclude that current is directly proportional to voltage and inversely proportional to resistance, and independently formulate the formula $I = \frac{U}{R}$ or $U = IR$. At the end, the teacher writes the formula on the board and emphasizes that it is the students' own conclusion.

In the final part of the lesson, consolidation takes place and conclusions are drawn. Students briefly present their research findings. The teacher summarizes the work and emphasizes that the students themselves discovered Ohm's Law during the lesson. As homework, students are asked to explain Ohm's Law using simple examples, such as its application in the operation of a lamp or a heater.

Through this lesson plan, students do not merely memorize Ohm's Law but understand it, independently formulate the formula, and acquire skills of independent research and identifying logical connections.

Conclusion

In conclusion, the Micro-Research method makes it possible to transform students from passive listeners into active researchers. By redistributing the roles between the teacher and the student, it turns the lesson process into a scientific research environment. The three stages of the method — terminological search, conceptual analysis, and systematization with deep understanding of logical

connections — contribute to the development of students' independent thinking, analytical skills, and ability to form new knowledge. This approach can serve as an effective tool for improving the quality of education, enhancing students' cognitive activity, and preparing them to meet the demands of modern society.

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