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CONTENT AND METHODS OF DEVELOPING STUDENTS' PHYSICAL-TECHNICAL ABILITIES IN PHYSICS TEACHING

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Abstract:
This article addresses the issues of developing students' physical and technical abilities in teaching physics at secondary schools. The study experimentally examined the effectiveness of interactive methods, laboratory activities, and collaborative work forms. The results confirm that interactive and practical approaches significantly enhance students' analytical thinking and practical skills. The conclusions of the study include recommendations for further improvement and wider implementation of pedagogical technologies.

Keywords: Physical-technical abilities, interactive methods, laboratory activities, collaborative work forms, pedagogical technologies.

Introduction

In the current era of rapid technological advancement, society demands that young people acquire modern scientific knowledge and skills. This necessitates paying special attention to developing students' physical-technical abilities when teaching physics in general secondary schools. Physical-technical abilities enable students not only to master theoretical concepts in physics but also to effectively acquire practical skills related to technology and engineering. This, in turn, provides a solid foundation for their future scientific, technical, and innovative activities.

However, in today's educational practice, there is insufficient use of effective pedagogical technologies and methods aimed at developing students' physical-technical abilities when teaching physics in general secondary schools. In many educational institutions, physics education is primarily limited to providing theoretical knowledge, with insufficient attention given to practical laboratory

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work, interactive, and collaborative activities. As a result, students perceive physics as a purely theoretical subject, leading to decreased interest in science and technology and limited development of practical skills.

Based on the above issue, the main objective of this research is to identify the most effective pedagogical technologies and methods that promote the successful development of students' physical-technical abilities when teaching physics in grades 7-9 of general secondary schools and to experimentally substantiate their effectiveness.

The primary scientific question of this research is formulated as follows: What pedagogical technologies and methods are most effective in developing the physical-technical abilities of students in grades 7-9 during physics lessons in general secondary schools?

The scientific hypotheses of the study are defined as follows:

1. If interactive methods (such as electronic simulation programs, interactive textbooks), laboratory experiments, and collaborative activities are systematically used in teaching physics, students' physical-technical abilities will develop more effectively compared to traditional methods.
2. Pedagogical technologies based on interactive and practical activities not only strengthen students' theoretical knowledge but also enhance their analytical thinking and independent problem-solving skills.

In this study, the above scientific questions and hypotheses will be examined using practical and experimental methods, and the results will be scientifically substantiated.

Material and Methods:

The study was conducted at School No. 293 in the Bektemir district of Tashkent City during the first half of the 2023–2024 academic year (for 5 months). A total of 203 students participated in the study. The students were randomly divided into two groups: an experimental group (102 students) and a control group (101 students). The groups were formed with equal distribution based on age and initial knowledge level (Table 1).

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Table 1

Classes	Program	∑
7th grade	Experimental group	37
	Control group	33
	Total	**70**
8th grade	Experimental group	30
	Control group	33
	Total	**63**
9th grade	Experimental group	35
	Control group	35
	Total	**70**
Total		**203**

The following specific pedagogical methods were applied in the experimental group:

1. Interactive Methods:

- Modeling physical phenomena virtually using the *PhET Interactive Simulations* program.
- Visual explanation of topics through electronic presentations and the use of interactive textbooks.
- Interactive assignments and exercises on various topics.

2. Laboratory and Practical Experiments:

- Conducting laboratory work once a week.
- Allowing students to experimentally verify physical laws and draw conclusions through hands-on experiences.
- Recording laboratory results in a dedicated workbook.

3. Collaborative Work Forms:

- Dividing students into small groups to solve physical problems and technical tasks.
- Sharing experiences and collaborating through group discussions and presentations.
- Regularly evaluating the results of group work.

In contrast, the control group followed a traditional pedagogical approach, consisting of topic explanations, exercises based on theoretical knowledge, and homework assignments. At the beginning and end of the study, both groups'

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knowledge and skills were assessed using a specially developed test, and the results were statistically analyzed.

Results and Discussion:

At the start of the study, the knowledge level of the experimental and control groups was examined using Pearson's Chi-square test, which confirmed that the difference between the groups was not statistically significant. This indicates that the initial knowledge levels of the groups were equal (Table 2, Figure 1.).

Table 2

Secondary school No. 293, Bektemir district, Tashkent city										
The level of development of students' physical and technical abilities	High level	Medium level	Low level	Total	Mean	Variance	Coefficient of variation	Confidence interval	Xi -square statistic Critical value	Efficiency
Experimental group	16	35	51	102	3,656	0,544	20,1778	3,605-3,708	0,01	1,0009
Control group	16	34	51	101	3,653	0,548	20,2753	3,601-3,705	7,815	
Conclusion	Hypothesis H_1 is accepted.									

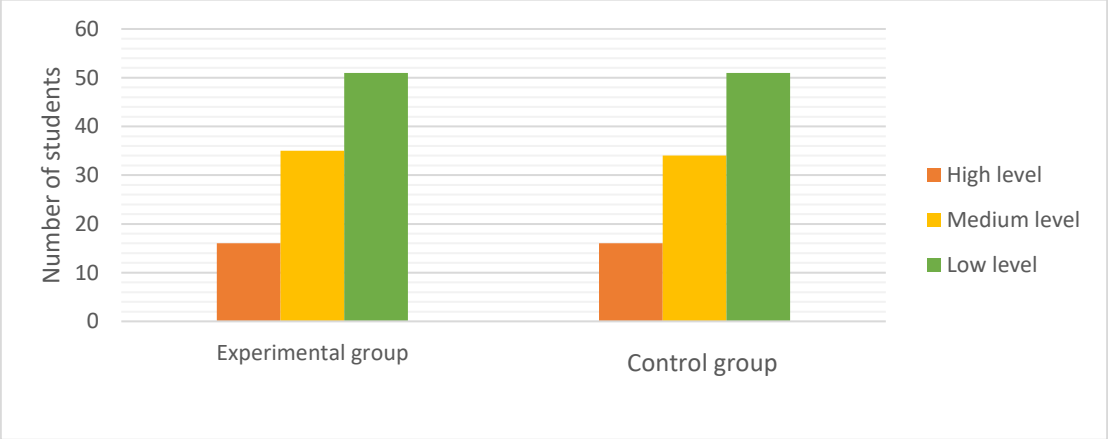

Figure 1. Histogram of students' achievement indicators at the beginning of the experimental trial

At the end of the experiment, significant differences were recorded. The level of theoretical knowledge in the experimental group increased by an average of 10.08%. Re-analysis of the final results using Pearson's Chi-square criterion

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confirmed that the difference between the groups was statistically significant (Table 3, Figure 2.).

Table 3

Secondary school No. 293, Bektemir district, Tashkent city										
The level of development of students' physical and technical abilities	High level	Medium level	Low level	Total	Mean	Variance	Coefficient of variation	Confidence interval	Xi -square statistic Critical value	Efficiency
Experimental group	33	46	23	102	4,098	0,544	18,0103	4,047-4,149	13,05	1,1008
Control group	18	37	46	101	3,722	3,722	20,1441	3,669-3,775	7,815	
Conclusion	Hypothesis H_1 is accepted.									

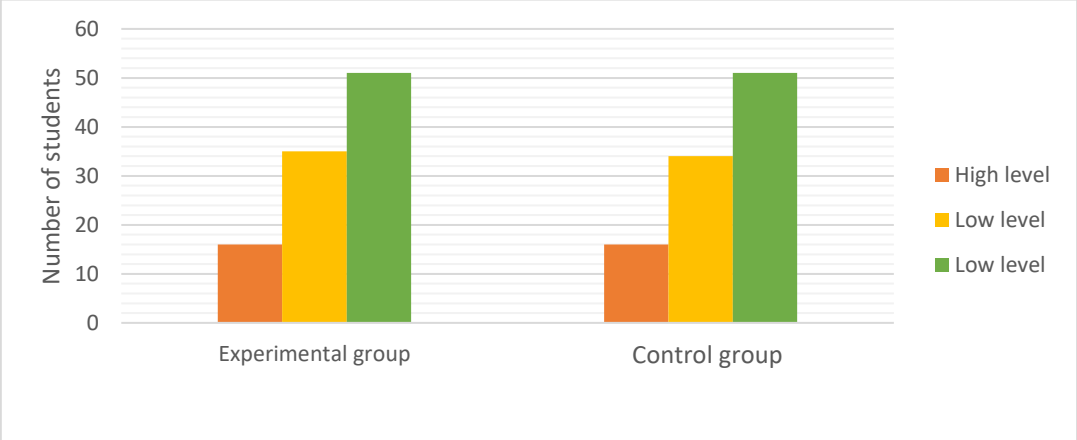

Figure 1. Histogram of students' achievement indicators at the end of the experimental trial

Additionally, the analytical thinking skills and problem-solving abilities of students in the experimental group significantly improved. According to the final control tests and exercises, these indicators increased by an average of 10.08% in the experimental group.

The obtained results indicate that interactive methods, laboratory activities, and collaborative work forms are more effective in developing students' physical-technical abilities compared to traditional methods. It is recommended to apply these pedagogical methods more widely in the future.

The findings confirm the effectiveness of interactive methods, laboratory experiments, and collaborative work forms in developing students' physical-

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technical abilities. The interactive methods used during the study not only allowed students to understand physical phenomena theoretically but also helped them develop practical skills. In particular, the use of virtual simulation programs enabled students to observe complex physical phenomena interactively, leading to a deeper understanding of the topics.

Through laboratory and practical experiments, students were able to link theoretical knowledge with practice, reinforcing their understanding. This approach not only increased their knowledge but also contributed to the development of analytical thinking skills.

Collaborative work forms created an environment of cooperation and collective discussion among students. During this process, students shared their experiences and acquired new knowledge more quickly and efficiently. The results align with the findings of V.A. Shumirin [1], T.P. Volkova [2], A.V. Petrov [3], and A.N. Ernazarov [4,5], confirming that interactive and practical pedagogical technologies are significantly effective in enhancing students' knowledge and skills.

It is recommended to apply these methods and technologies more broadly within the general education system in the future.

Conclusion:

The research results show that the use of interactive methods, laboratory activities, and collaborative work forms is of great importance in the effective teaching of physics in general secondary schools. These conclusions are based on pedagogical experiments and diagnostic assessments of students' knowledge and skills.

Firstly, interactive methods actively engage students in the educational process. For example, techniques such as debates, discussions, problem-solving questions, and "brainstorming" help develop critical and analytical thinking skills. As a result, students learn to deeply understand physical phenomena and apply theoretical knowledge to practical problems.

Secondly, conducting laboratory activities regularly allows students to link theoretical knowledge with practice. They develop skills in planning, performing experiments, and analyzing results independently. Consequently, they develop a scientific worldview and technical thinking, and their practical approach to physical phenomena becomes stronger.

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Thirdly, the use of collaborative work forms fosters communicative, creative, and teamwork skills among students. Group projects, joint problem-solving, and small group discussions teach students to understand collective responsibility and exchange knowledge and experience within the group.

Thus, the application of these methods significantly improved students' analytical thinking, problem-solving, and the ability to apply practical knowledge in real life. This is confirmed by the results of control-test trials and diagnostic evaluations conducted during the experiment.

In the future, it is recommended to make wider use of interactive methods, laboratory activities, and collaborative work forms in teaching physics in general secondary schools. Systematic implementation of this pedagogical approach will help further develop students' physical-technical abilities, shape their professional orientation, and ensure effective preparation for the next stages of education.

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