Latin American Journal of Education
www.lajoe.org

UDC: 378.57.371.3

INNOVATIVE METHODOLOGY FOR TRAINING FUTURE SPECIALISTS IN THE FIELD OF PHYSICS

https://doi.org/10.5281/zenodo.18616258

Akhmedov Akhat Akhrorovich
Khushvaqtov Bekmurod Normurodovich
[*1]*Navoi State University, Doctor of Pedagogical Sciences (DSc), Professor, axataxmedov1961@gmail.com (+998905017577), ORCID ID0009-0004-9769-5722*
[2]*Navoi State University, Doctor of Philosophy (PhD) in Pedagogical Sciences, Associate Professor*
bekmurodxushvaqtov84@gmail.com (+998973663484), ORCID ID 0009-0001-6158-2516

Abstract: *This article presents a methodology for improving the training of future physics teachers. It also provides a comparative analysis and identifies the current state of physics laboratory classes in higher education institutions, as well as opportunities for improving physics laboratory classes in secondary schools through an innovative model.*

Keywords *Laboratory training, future teacher, higher educational institutions, competence, methodology, innovative model.*

Аннотация: *В данной статье представлена методология совершенствования подготовки будущих учителей физики. Также проведен сравнительный анализ и определено текущее состояние лабораторных занятий по физике в высших учебных заведениях, а также возможности улучшения лабораторных занятий по физике в средних школах с помощью инновационной модели.*

Ключевые слова: *Лабораторная подготовка, будущий преподаватель, высшие учебные заведения, компетенция, методология, инновационная модель.*

INTRODUCTION

Today, it is impossible to imagine the development of society without physics. In all developed countries, special attention is paid to teaching physics in secondary schools. Because we all know that by improving the teaching of physics, the role of physics in training specialists in engineering and technology, astronautics and artificial intelligence, biogenetics and bioengineering, and a number of other fields is invaluable. Accordingly, it is of particular importance that the mechanism for training specialists in physics is competitive and that the specialists being trained meet world standards. We would like to draw your attention to the distribution of

Latin American Journal of Education
www.lajoe.org

teaching hours allocated for practical and laboratory classes in the Compulsory Sciences block of the Curriculum for the Physics and Astronomy education direction in higher education institutions: in 2024-25, 374 hours were allocated for practical classes and 276 hours for laboratory classes, while in 2025-26, 344 hours were allocated for practical classes and 258 hours for laboratory classes. It can be seen that while practical classes were reduced to 30 hours, laboratory classes were reduced to 18 hours. Naturally, this plays a negative role in the formation of practical skills in the training of specialists and limits their opportunities to apply practical theoretical knowledge in practice.

When developing a mechanism for training future specialists, we must start them from school desks from a young age. A future specialist begins to show his/her facets (buds) from the very beginning of his/her studies in secondary schools. From the school years, a future specialist, depending on his/her academic performance, begins to show interest in one or another field and begins to engage in research activities. Knowing the quality and level of laboratory training conducted today in the modern education system, there are shortcomings in its organization and conduct, which, of course, cannot but affect the quality of education. The structure of laboratory training, that is, the sequence of its conduct, still remains outdated. There are opportunities to improve the quality of education by switching to improved innovative models of organizing and conducting laboratory training that meet the requirements of the modern education system.

LITERATURE AND METHODOLOGY

A number of scientific and pedagogical researches are being conducted to create integrative-modular technologies for the development of research competence in future physics teachers, to improve innovative activities aimed at the formation of experimental competencies in the teaching process. In order to develop experimental competence in future teachers in the educational process in higher educational institutions, it is important to improve the methodology for organizing and conducting laboratory exercises, to develop mechanisms for ensuring the intensity of organizing experimental activities through the use of digital technologies. Also, the development of the logical-didactic, graphic preparation of future physics teachers, the didactic principles of continuous physics education, the development of logical-creative thinking, independent work and design abilities in delivering the stages of continuous physics education to students, were developed by SSKakhorov, HOJuraev, M.Kurbanov, A.A.Nazarov, ZFBeknozarova. Research work has been carried out by a number of scientists, such as Z.E. Chorshanbiyev, A.A. Akhmedov, Sh.R. Turdiyev, A.E. Ibraimov, V.G. Maksudov, B.N. Khushvaktov, etc., on the formation of professional competence

Latin American Journal of Education
www.lajoe.org

in future teachers in the process of teaching physics, improving their professional training in an electronic learning environment [1,2,3,4]

RESULTS AND DISCUSSION

The following problems exist in the organization and conduct of laboratory trainings that are currently being conducted:

The scope of the work is not clearly indicated in the laboratory work description. It is difficult to know what the quality and level of laboratory training currently being conducted in the modern education system is. There are shortcomings in its organization and conduct, which, of course, cannot but affect the quality of education. The structure of the laboratory training, that is, the sequence of its conduct, has not changed. There are opportunities to improve the quality of education by switching to improved innovative models of organizing and conducting laboratory training that meet the requirements of the modern education system. The following problems in organizing and conducting laboratory training today are listed below:

1. The purpose and scope of the work are not clearly indicated in the laboratory work description. After giving the name of the laboratory work, it is important to clearly indicate the scope of its use and describe the possibilities of its application.

2. In laboratory development, control questions are still used in the order of execution, but their alternatives have not yet been replaced by test options for the laboratory exercise being conducted, the methodology for using the test has not yet been formed, improved technologies have not been used and the transition to automated laboratory exercises has not been introduced.

3. The development of the laboratory exercise did not pay attention to the theoretical and practical aspects of the methodology used in independent learning.

4. In the training of future physics teachers, a "school physics cabinet" was established at pedagogical universities, and methodological guidelines for organizing and conducting laboratory classes at school were not developed. Methodological recommendations, instructions for improving laboratory work, and developments were not developed as methodological assistance to future physics teachers.

5. Nowadays, when information and communication technologies are developing rapidly, the methodology for organizing training using innovative programs for their use in laboratory training is not up to the required level.

6. When organizing and conducting laboratory exercises, it is not required that the student conduct similar laboratory work that he or she can conduct independently.

7. Experimental training and competence of a future physics Teacher- Insufficient competence in using measuring instruments or devices used in the laboratory.

Latin American Journal of Education
www.lajoe.org

The shortcomings mentioned are of great importance in developing the experimental competence of future physics teachers in the development of practical competence in the teaching process today. Therefore, in general education schools, in addition to providing students with the foundations of theoretical training in various fields of science, they also prepare them for work in the current era of rapidly growing information flows. Based on this, high requirements are placed on the methodology of conducting all classes in physics (lectures, laboratory work, problem solving), which are constantly being improved. This is especially true for the content of laboratory work, the equipment of which changes in connection with scientific and technological progress.

Performing laboratory work involves students acquiring the following theoretical and experimental knowledge: familiarizing with the basics of physical phenomena and their laws, developing skills and qualifications in working with modern physical measuring instruments, and performing physical measurements. It introduces methods and methods of processing experimental results. In addition, it performs the tasks of generalizing, consolidating, developing, and ensuring in-depth mastery of the main concepts of the theory, closely related to lectures and other forms of physics education.

Laboratory exercises in physics solve a number of educational problems:

- introduces students to the methodology of physics in a practical and theoretical way (unity of theory and experiment, measurement theory, calculation of absolute and relative errors, etc.);
- teaches how to plan and conduct experiments, develops students' research skills;
- summarizes and systematizes the student's knowledge of major sections of the physics course;
- maximally individualizes students' activities in the physics laboratory, forms independent work skills;
- develops students' creative abilities (designing, assembling technical devices, studying the principle of their operation, leveling devices, etc.).

In order for students of general secondary schools to acquire the minimum knowledge, skills and competencies that correspond to the State Educational Standard (SES) in general education physics, it is necessary to create opportunities for students to acquire knowledge, skills and competencies that will consistently continue in accordance with the SES in the lower education system, in accordance with their abilities. Improving the educational process involves not only revealing to students the essence of the research methods used by teachers, but

Latin American Journal of Education
www.lajoe.org

also mastering methods that will develop in their minds, the skills of explaining and teaching the theoretical and practical knowledge they have acquired to others.

Students have a sufficient level of knowledge of the basic laws and regulations related to each topic of the physics course. In order for this to happen, the teacher, in addition to verbally presenting the lesson materials, must conduct experiments on the topic, help them visualize the phenomenon being studied and develop their thinking skills in this regard.

Each laboratory work has its own unique character and has a specific goal. Therefore, laboratory work should allow a clear understanding of the essence of physical phenomena and processes on the topic being studied or newly described and should confirm theoretical knowledge in practice. There are also topics in the physics course that require the use of not a single device, but devices consisting of several components and details when conducting experiments with them. Almost all of the experiments conducted on many topics related to the "Electrodynamics" section (especially electric current) are of this type. In the training of future physics teachers, it is necessary to review the hours of physical education classes and laboratory classes allocated in secondary schools and adapt them to modern requirements, so that, the future generation can integrate modern technological achievements into the educational process and achieve results.

Topics of laboratory work in physics in general secondary schools based on integrated curricula

Class	No	Laboratory work topics
7th grade	1.	***Determining the average speed of uneven motion***
	2.	***Determining the densities of objects of various shapes***
	3.	***Measuring current and voltage in an electrical circuit***
	4.	***Studying Ohm's Law***
8th grade	1.	***Assembling an electrical circuit, measuring current and voltage in its various parts***
	2.	***Studying Ohm's Law***
	3.	***Studying series and parallel connection of conductors***
	4.	***Determining the electrical power of a consumer device (light bulb)***
	5.	***Assembling the simplest electromagnet and learning how it works***
9th grade	1.	***Determining the specific heat capacity of solids***
	2.	***Comparing the amount of heat released when mixing water of different temperatures***

Latin American Journal of Education
www.lajoe.org

	3.	***Determining the coefficient of surface tension of a liquid***
	4.	***Determining relative humidity of air***
	5.	***Determining the refractive index of glass***
	6	***Determining the optical power of lenses***
10th grade	1.	***Determining the useful work coefficient of a slope***
	2.	***Determining the acceleration of free fall using a mathematical pendulum***
	3.	***Determining the internal resistance of a current source***
	4.	***Studying the volt-ampere characteristic of a semiconductor diode***
11th grade	1.	***Study of resonance phenomenon in alternating current circuit***
	2.	***Determining the wavelength of light using a diffraction grating***
	3.	***The dependence of illumination on the power of light***

CONCLUSION

Based on the above discussion, if we take into account the development of a mechanism for training future physics teachers begins in secondary schools, we can arouse interest in fundamental sciences in our students from a young age and also we will create an opportunity for the rapid development of technology and engineering in our republic.

REFERENCES:

1. A.A.Akhmedov, Bozorova L.Sh. Modern methodological and experimental possibilities of

training future physics teachersPEDAGOGICAL SKILLS Scientific-theoretical and methodological journal Issue 4 (April 2025)Pages 38-41.

2. A.A.Akhmedov,Soliyeva NA Possibilities of improving laboratory exercises in developing experimental competence of future physics teachers Scientific and methodological journal PHYSICS, MATHEMATICS and INFORMATICS 2025/2,Pages 131-138

3. Kamolov I.R, Akhmedov AA, Izbosarov BF, Idiboyeva SB, Kahhorova ME Development of practical competence of students of physics education in the subject of electromagnetism. Scientific-theoretical and methodological journal "Pedagogical skills". 2025, No. 9, pp. 64-68.

4**.** Akhmedov AA, Izbosarov BF, Kamolov IR Development of experimental competence of physics students in molecular physics. Journal of Physics, Mathematics and Informatics. 2025, No. 5, pp. 148-156.

Latin American Journal of Education
www.lajoe.org

5. Khushvaqtov BN The use of interdisciplinary integration in solving problems in geometric optics. Scientific-theoretical and methodological journal of pedagogical skills. 2024, No. 11. – P. 82-86

6. Khushvaqtov BN Analysis of the corpuscular wave dualism of light in physics education. Scientific-theoretical and methodological journal "Pedagogical skills". 2025, No. 11. – P. 232-236

7. Khushvaqtov BN Development of teaching methods for optics based on an integrative approach. Current problems of training future teachers in the context of a pedagogical education cluster TerDPI International Scientific and Practical Conference October 15-16, 2025. P. 455-458.