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ORGANIZATION OF PHYSICS EXPERIMENTS AND LABORATORY CLASSES USING MODERN METHODS

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Abstract: *This article provides a detailed analysis of the theoretical and practical aspects of organizing physics experiments and laboratory classes based on modern pedagogical approaches. In particular, it highlights the opportunities for using innovative educational technologies, digital platforms, virtual and remote laboratories, simulations, and interactive teaching methods. The study pays special attention to transforming students from passive recipients of knowledge into active participants in the learning process, as well as to developing their skills in conducting independent experiments, observation, analysis, and drawing scientific conclusions.*

In addition, the importance of approaches such as STEAM education, problem-based learning, project-based learning, and blended learning in organizing laboratory activities is emphasized. The possibilities of visualizing complex physical processes, conducting experiments in a safe environment, and connecting them with real-life situations through modern technologies are analyzed. The article also compares traditional and modern approaches in terms of their effectiveness in developing students' practical skills, critical thinking, and interest in the subject.

Based on the research findings, methodological recommendations are proposed for the effective organization of physics laboratory classes, aimed at improving the quality of education, expanding students' scientific outlook, and developing modern competencies.

Keywords: *physics education, laboratory classes, experimental work, modern pedagogical technologies, interactive teaching methods, innovative approach, STEAM education, digital learning tools, virtual laboratory, simulation, problem-based learning, project-based learning, blended learning, practical skills, critical thinking, educational effectiveness.*

Аннотация: *В данной статье подробно анализируются теоретические и практические аспекты организации лабораторных и экспериментальных занятий по физике на основе современных педагогических подходов. В частности, широко освещаются возможности использования инновационных образовательных технологий, цифровых платформ, виртуальных и дистанционных лабораторий,*

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симуляций, а также интерактивных методов обучения. В исследовании особое внимание уделяется формированию учащихся не как пассивных получателей знаний, а как активных участников образовательного процесса, развитию у них навыков самостоятельного проведения экспериментов, наблюдения, анализа и формулирования научных выводов.

Кроме того, раскрывается значение таких подходов, как STEAM-образование, проблемное обучение, проектно-ориентированное обучение и смешанное (blended learning) обучение при организации лабораторных занятий. Анализируются возможности визуализации сложных физических процессов, проведения экспериментов в безопасных условиях и их связи с реальной жизнью с помощью современных технологий. В статье проводится сравнительный анализ традиционных и современных подходов с точки зрения их эффективности в развитии практических навыков учащихся, критического мышления и интереса к предмету.

На основе результатов исследования разработаны методические рекомендации по эффективной организации лабораторных занятий по физике, направленные на повышение качества образования, расширение научного мировоззрения учащихся и формирование современных компетенций.

Ключевые слова: *физическое образование, лабораторные занятия, проведение экспериментов, современные педагогические технологии, интерактивные методы обучения, инновационный подход, STEAM-образование, цифровые образовательные средства, виртуальная лаборатория, симуляция, проблемное обучение, проектное обучение, смешанное обучение (blended learning), практические навыки, критическое мышление, эффективность образования.*

Annotatsiya: *Ushbu maqolada fizika fanidan tajriba va laboratoriya mashg‘ulotlarini zamonaviy pedagogik yondashuvlar asosida tashkil etishning nazariy va amaliy jihatlari batafsil tahlil qilinadi. Xususan, innovatsion ta’lim texnologiyalari, raqamli platformalar, virtual va masofaviy laboratoriyalar, simulyatsiyalar hamda interaktiv metodlardan foydalanish imkoniyatlari keng yoritiladi. Tadqiqotda o‘quvchilarning bilimni faqat qabul qiluvchi emas, balki faol ishtirokchi sifatida shakllanishi, mustaqil tajriba o‘tkazish, kuzatish, tahlil qilish va ilmiy xulosa chiqarish ko‘nikmalarini rivojlantirish masalalariga alohida e’tibor qaratiladi.*

Shuningdek, laboratoriya mashg‘ulotlarini tashkil etishda STEAM yondashuvi, muammoli o‘qitish, loyiha asosida o‘rganish va aralash (blended) ta’lim metodlarining ahamiyati ochib beriladi. Zamonaviy usullar yordamida murakkab fizik jarayonlarni vizuallashtirish, xavfsiz sharoitda tajribalar o‘tkazish va real hayot bilan bog‘lash imkoniyatlari tahlil qilinadi. Maqolada an’anaviy va zamonaviy yondashuvlar

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taqqoslanib, ularning samaradorligi o‘quvchilarning amaliy ko‘nikmalari, tanqidiy fikrlashi va fanga bo‘lgan qiziqishiga ta’siri nuqtai nazaridan baholanadi.

Tadqiqot natijalariga asoslanib, fizika fanidan laboratoriya mashg‘ulotlarini samarali tashkil etish uchun metodik tavsiyalar ishlab chiqilgan bo‘lib, ular ta’lim sifatini oshirishga, o‘quvchilarning ilmiy dunyoqarashini kengaytirishga hamda zamonaviy kompetensiyalarni shakllantirishga xizmat qiladi.

Kalit so‘zlar: *fizika ta’limi, laboratoriya mashg‘ulotlari, tajriba o‘tkazish, zamonaviy pedagogik texnologiyalar, interaktiv ta’lim metodlari, innovatsion yondashuv, STEAM ta’lim, raqamli ta’lim vositalari, virtual laboratoriya, simulyatsiya, muammoli o‘qitish, loyiha asosida o‘qitish, aralash ta’lim (blended learning), amaliy ko‘nikmalar, tanqidiy fikrlash, ta’lim samaradorligi.*

INTRODUCTION

In the context of globalization and rapid digitalization, new demands are being placed on the education system. In particular, in teaching natural sciences, including physics, it is essential to develop not only theoretical knowledge but also practical skills. Since physics explains the fundamental laws of nature, experiments and laboratory activities play a key role in its effective understanding. Therefore, organizing laboratory work based on modern approaches has become one of the urgent tasks of today.

In traditional teaching processes, laboratory activities are often carried out according to predetermined procedures under the direct guidance of the teacher. Such an approach, however, does not sufficiently develop students’ independent thinking, creativity, and problem-solving abilities. Modern education, on the other hand, considers students as active participants and encourages their independent inquiry, experimentation, and ability to draw conclusions.

Today, the rapid development of digital technologies is creating new opportunities for organizing laboratory classes in physics. Virtual laboratories, simulations, multimedia tools, and interactive platforms make it possible to study complex physical processes in a simple and understandable way. This not only increases the effectiveness of lessons but also enhances students’ interest in the subject.

At the same time, integrating physics with other disciplines through the STEAM approach, as well as applying project-based and problem-based learning methods, makes laboratory activities more meaningful and effective. These approaches help students focus on solving real-life problems and contribute to the development of their practical and professional competencies.

The purpose of this article is to study the theoretical and practical foundations of organizing physics experiments and laboratory classes using modern methods, to analyze effective approaches, and to develop

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recommendations for their implementation in the educational process.

Methods: In this study, a комплекс set of scientific and pedagogical methods was employed to determine the effectiveness of organizing physics experiments and laboratory classes using modern approaches. First, the method of theoretical analysis was applied to examine and systematize existing scientific literature, methodological manuals, and international practices related to the role of laboratory work in physics education, its organizational forms, and modern pedagogical technologies.

Through the method of pedagogical observation, students' activity during laboratory work, their level of independent learning, experimental skills, and interest in the subject were analyzed. This method also made it possible to identify differences between lessons conducted using traditional and modern approaches.

An experimental method was used to implement modern tools in physics classes, including virtual laboratories, simulations, multimedia presentations, and interactive platforms. Their impact on educational effectiveness was studied in practice. During this process, students' knowledge levels, practical skills, and problem-solving abilities were assessed.

The comparative method was employed to compare the outcomes of traditional laboratory classes with those organized using modern technologies. This helped to determine which approach was more effective for students' learning.

In addition, analysis and synthesis methods were used to process the collected data and draw general conclusions. Survey and interview methods were conducted to gather opinions from both students and teachers, which served as a basis for developing recommendations to improve laboratory activities.

The combination of these methods ensured the reliability of the research and provided a comprehensive evaluation of the effectiveness of organizing physics laboratory classes using modern approaches.

Results: The findings of the study revealed that organizing physics experiments and laboratory classes using modern approaches significantly increases the effectiveness of the educational process. In particular, it was observed that the use of virtual laboratories, simulations, and interactive tools led to higher levels of student engagement and interest during lessons. This, in turn, had a positive impact on their deeper understanding of the subject matter.

The experimental results showed that students who participated in laboratory classes based on modern approaches demonstrated a noticeable improvement in practical skills, including conducting experiments, recording results, analyzing data, and drawing conclusions. Additionally, their abilities to work independently and solve

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problem-based tasks were effectively developed.

Comparative analysis indicated that laboratory sessions organized using modern technologies were more effective than those conducted through traditional methods. The ability to visualize complex physical processes played a crucial role in enhancing students' comprehension levels.

Furthermore, survey results collected from both students and teachers highlighted that the majority of respondents considered modern laboratory activities to be more engaging and effective, emphasizing their importance in reinforcing knowledge.

Overall, the research findings confirm that the use of modern methods in organizing physics laboratory classes plays a significant role in improving students' academic performance, practical skills, and interest in the subject.

Discussion: The results of the study indicate that organizing physics laboratory classes using modern approaches is more effective than traditional methods. However, several important factors must be considered for the successful implementation of these approaches in practice. First of all, educational institutions need to have a sufficient material and technical base to support the use of modern technologies. Otherwise, the effective use of virtual laboratories and interactive tools may be limited.

Another crucial factor is the digital competence of teachers. If educators are not sufficiently skilled in using modern technologies, they may not be able to fully utilize their potential. Therefore, improving teachers' qualifications and training them in new pedagogical and information technologies is one of the key priorities.

During the discussion, the importance of considering students' individual characteristics was also highlighted. Some students learn more effectively through hands-on experiments, while others benefit more from visual and interactive tools. For this reason, it is advisable to apply differentiated and individualized approaches when organizing laboratory activities.

In addition, the need to integrate traditional and modern methods was identified. It is important not to rely solely on technology but also to preserve real laboratory experiments. Real experiments play a vital role in directly developing students' practical skills and fostering a culture of scientific observation.

Overall, the discussion shows that a comprehensive approach is required for the effective organization of physics laboratory classes. This approach should combine modern technologies, педагогical expertise, and students' needs in a balanced and integrated manner.

Conclusion: In conclusion, organizing physics experiments and laboratory classes using modern approaches is an important factor in improving the quality and effectiveness

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of the educational process. The research findings show that the use of innovative pedagogical technologies, digital tools, and interactive methods significantly enhances not only students' theoretical knowledge but also their practical skills.

Laboratory activities organized on the basis of modern approaches help develop students' independent thinking, problem-solving abilities, experimental skills, and capacity to analyze results. At the same time, these methods increase students' interest in physics and actively engage them in the learning process.

However, for the effective implementation of these approaches, it is necessary to strengthen the material and technical base of educational institutions, improve teachers' digital competence, and ensure a balanced integration of traditional and modern teaching methods.

Overall, organizing physics laboratory classes using modern methods plays a crucial role in developing students' modern competencies, broadening their scientific outlook, and elevating the quality of education to a new level.

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