

Technology Of Training Future Physics Teachers Through Stem Education

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Abstract: This article provides methodological recommendations on the technology of training future physics teachers in pedagogical higher education institutions through STEM education. The presented recommendations serve to expand the knowledge of school students and university students in physics and STEM. It also emphasizes the importance of linking the study of physics with the STEM education program.

Keywords: STEM, logical thinking, experiment, physics, virtual laboratory, teaching, educational technology, engineering, artistic exploration, teaching mathematics, knowledge, ability, skill, competence.

Introduction: Physics education within the system of continuous education is an integral component of the pedagogical process, serving the general goals of education by fostering the upbringing and comprehensive development of the individual. Since the early years of our republic's independence, as a result of reforms in the education and upbringing sector, the accumulated experience and a number of conclusions have highlighted the urgent need to elevate and improve the current education system to meet the level of present-day development and future demands. This necessity, rooted in ensuring the continuity of education, led to the adoption of the new edition of the "Law on Education," which is particularly important as it encompasses all directions of today's developmental era.

Today, integrative models of the pedagogical process aimed at improving the theoretical and practical foundations of the use of advanced innovative technologies in world higher education institutions are being widely implemented in the educational process. Special attention is paid to improving the mechanisms for forming professional training in students by effectively utilizing the socio-pedagogical parameters of innovative technologies. In this regard, the scientific results of prestigious research centers such as the UNESCO Institute for Education (Hamburg, Germany), the International Institute of Education (USA), and European Integration (ECSA-Austria) hold a significant place.

These studies address tasks such as identifying mechanisms to improve the quality of education through the use of innovative technologies and enhancing the training process of future specialists based on competency-based approaches. Therefore, the rapid introduction of innovations into education is of vital importance in finding practical solutions to issues related to the development of professional skills and competencies among specialists in the field, by engaging them in independent work and active participation in scientific research activities.

One of the main tasks of the STEM education program is to enhance learners' logical thinking abilities. Therefore, special attention is given to the implementation and adoption of the STEM program in education, focusing on openness, flexibility, individualized learning, and the use of modern educational technologies. By teaching physics based on the STEM education program, future teachers are expected to carry out their activities creatively, relying on existing conditions and acquired experiences, while expanding their scope of logical thinking. In particular, under the STEM education program, students (future teachers) are assigned the following tasks during practical and laboratory physics classes:

- To increase their interest in studying global technical and communication changes;
- To develop inventive and engineering skills by studying the progress of science, technology, and engineering;

- To observe and analyze physical phenomena and to study the relationships between the phenomena being studied and other phenomena;
- To develop methods for experimentally verifying phenomena and laws, which plays an important role.

The STEM (Science, Technology, Engineering, and Mathematics) education system changes our interest and perspectives towards education. In this system, students not only gain practical skills but also enhance their willpower and technical creativity. Because when a student can visualize the knowledge gained from lectures and practical work and build equipment with their own hands, it leads to increased self-confidence. The STEM education system is a logical outcome of combining theory and practice.

In the process of developing the logical thinking of future physics teachers, the development of their reasoning and thinking skills holds a significant place. Today, special attention is paid to the implementation and adoption of the STEM education program in the field of education, with a focus on openness, flexibility, individualized learning, and the use of modern educational technologies. This approach is demonstrating positive results in the learning process. By teaching physics based on the STEM education program, future physics teachers, relying on existing conditions and work experience, can carry out continuous creative activities, which leads to an expansion of their logical thinking. For this purpose, studying and preparing virtual laboratories is of great importance.

A virtual laboratory is a newly developing complex technology that allows a person to sense an object without physically touching it, providing a realistic experience. Physics experiments conducted by future physics teachers are considered the most visual and intuitive method of learning physics. Moreover, it is also the best way to stimulate future physics teachers' interest in physics.

The physics laboratory is based on the STEM concept, which is a new educational approach that integrates several curricula. Combining learning in STEM education with virtual experiments provides opportunities for students to perform experimental operations at different levels and times; this, in turn, helps improve students' ability to grasp knowledge, their practical skills, and supports the development of competencies while enhancing students' literacy.

With the development of virtual laboratory technology, the importance of virtual laboratories in learning has grown significantly. For future physics teachers, virtual laboratories related to the subject can be completed

conveniently anytime and anywhere, making these technologies highly accessible.

The development of logical thinking and creative reasoning requires inquiry in physics education. This involves discussing general methods of logical thinking and broadly applicable algorithms of mental activity. However, this also implies that future physics teachers must conduct active research themselves and find heuristic solutions. The pursuit of consciousness is a characteristic feature of every future teacher's personality and is cultivated through teaching methods.

The main goals of STEM education include "teaching science," "learning technology," "engineering," "exploring art," and "studying mathematics," and virtual physics laboratory work fully supports these leading objectives of STEM. "Teaching science" means that future physics teachers should pay attention to scientific experimental relationships while conducting and managing virtual physics laboratories, actively acquire relevant scientific and cultural knowledge, and carry out each part of the virtual experiments with scientific rigor step by step. "Teaching technology" signifies that STEM education's main feature is its multidisciplinary nature. Future physics teachers should not only master core physics knowledge but also possess the ability to program computers and create models to enable students to learn various technologies comprehensively. "Engaging in engineering" in STEM education implies practicality. "Studying mathematics" requires students to master good thinking and learning methods during experiments. For example, conversion methods, analog methods, inverse methods, and others are effective teaching techniques that greatly contribute to the success of experiments. In summary, integrating the virtual physics laboratory with the STEM education concept provides theoretical support for the virtual physics laboratory and serves as a practical educational tool for STEM education.

The establishment of virtual physics laboratories is based on the rapid development of modern science and technology and significant achievements in the history of education within traditional physics laboratories. This helps future physics teachers to acquire scientific and cultural knowledge faster and better, as well as develop their cultural literacy. The STEM education concept creates a strong theoretical foundation for the virtual physics laboratory. It is important to emphasize that the goal of the STEM virtual physics laboratory is to ensure the comprehensive development of future physics teachers.

In the process of developing logical thinking among future physics teachers, it is important to develop students' reasoning and thinking skills. Exercises and activities related to analysis and synthesis, comparison, generalization, identifying cause-and-effect relationships, classification and systematization, as well as observation and analysis of phenomena, the relationship of studied phenomena with other phenomena, and the development of experimental methods to verify phenomena and laws play a significant role in enhancing the thinking abilities of future physics teachers.

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