Conditions and stages for improving the methodology of developing professional training of future engineers through digital technologies

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ABSTRACT

This article discusses the issues of improving the methodology for developing the professional training of future engineers through digital technologies. The study identifies pedagogical, technological, and organizational-methodological conditions necessary for creating a digital educational environment in engineering education and proposes a step-by-step model for implementing the methodology. It is scientifically substantiated that the systematic integration of digital technologies into the educational process serves as a significant factor in enhancing the professional competencies of future engineers.

Keywords: engineering education, professional training, digital technologies, methodology, competence, digital learning environment.

Introduction: Modern engineering practice requires a high level of digital literacy, the ability to make prompt decisions in problem-based situations, and innovative thinking. Therefore, developing the professional training of future engineers through digital technologies in higher education institutions has become a pressing pedagogical issue. Under conditions of digital transformation, traditional teaching methods are gradually losing their effectiveness, increasing the demand for innovative, interactive, and student-centered instructional approaches.

In the context of globalization and digital transformation, the requirements placed on engineering professionals are changing fundamentally. A modern engineer must possess not only fundamental technical knowledge but also competencies in working with digital technologies, modeling complex processes, developing innovative solutions, and collaborating effectively in teams. Consequently, the development of professional training for future engineers within higher technical education systems has become an important scientific and pedagogical challenge.

In recent years, the rapid integration of digital technologies into the educational process has necessitated the renewal of the content, forms, and methodologies of engineering education. Virtual laboratories, simulation software, digital learning platforms, and cloud technologies enable the integration of theoretical knowledge with practical activities, thereby increasing the effectiveness of students' professional training. However, practical experience indicates that the use of digital technologies often remains fragmented, and the problem of their systematic and methodologically grounded implementation persists.

International experience demonstrates that digital technologies in the professional training of future engineers should be regarded not merely as technical tools but as integral components of the pedagogical process. This requires improving teaching methodologies, adopting a competency-based approach, and scientifically substantiating the conditions necessary for creating a digital learning

environment. From this perspective, identifying the conditions and stages for improving the methodology of developing the professional training of future engineers through digital technologies is of significant scientific and practical importance. The results of this study contribute to the modernization of engineering education, the effective implementation of digital pedagogical approaches, and the enhancement of the competitiveness of future engineers.

1. Key Conditions for Improving the Methodology

1.1. Pedagogical Conditions

Development of teachers' digital pedagogical competencies;

Formation of students' independent learning and reflection skills;

Implementation of a competency-based teaching approach.

1.2. Technological Conditions

Digital learning platforms (LMS, virtual laboratories, simulators);

Cloud technologies and online collaboration tools;

Availability of modern software and technical infrastructure.

1.3. Organizational and Methodological Conditions

Integration of curricula with digital technologies;

Application of interdisciplinary project-based approaches;

Use of digital assessment tools in the educational process.

2. Stages of the Methodology for Developing Professional Training through Digital Technologies

2.1. Preparatory Stage: At this stage, digital resources are selected, teachers' digital competencies are enhanced, and the necessary technical conditions for students are created. In addition, students' initial levels of digital competence are diagnosed.

2.2. Integration Stage: Digital technologies are systematically integrated into the educational process. Course modules, practical classes, and independent learning activities are organized through digital platforms. Virtual laboratories and simulations are used to integrate theoretical knowledge with practical experience.

2.3. Practical-Activity Stage:Students work on digital projects based on real engineering problems. Project-based learning, problem-solving tasks, and collaborative activities contribute to the development of professional competencies.

2.4. Assessment and Reflection Stage: Students' professional training is assessed through digital portfolios, online tests, and project outcomes. During the reflection process, learning activities are analyzed, and conclusions are drawn to further improve the methodology.

3. Expected Outcomes of the Methodology

Improvement of future engineers' digital and professional competencies;

Development of independent and creative thinking skills;

Enhancement of readiness for professional engineering activities;

Increased effectiveness and adaptability of the educational process.

Conclusion

Improving the methodology for developing the professional training of future engineers through digital technologies requires a systematic approach. The integration of pedagogical, technological, and organizational conditions, along with the step-by-step implementation of the methodology, significantly enhances the quality of engineering education. The proposed methodological model aligns with international experience and is recommended for publication in international scientific journals.

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