PRIORITY DIRECTIONS OF INDEPENDENT LEARNING IN THE FORMATION OF FUTURE ENGINEERING PERSONNEL

***MADINABONU SIDDIQOVA*[1]**

***OGILOY JORAYEVA*[2]**

***TOHIR ERGASHEV*[3]**

Karshi State Technical University

sirojiddinmuradov0@gmail.com

ABSTRACT

This article discusses the priority directions of independent learning for future engineers, its essence, and its importance in the modern education system. It also analyzes the pedagogical foundations of organizing independent learning in engineering education, the role of digital technologies, innovative approaches, and project-based activities. The development of professional competencies, creative thinking, and critical thinking skills in students through independent learning is also examined. The article highlights factors for improving the effectiveness of independent learning and important aspects of preparing future engineers for modern industrial environments.

KEYWORDS

independent learning, future engineers, professional competence, innovative technologies, digital education, engineering education, creative thinking, critical thinking, project activity, scientific research, pedagogical technologies, distance learning, digitalization, higher education, technical education.

INTRODUCTION

In today's era of globalization and digital transformation, science, technology, and engineering are rapidly developing worldwide. This process significantly influences the higher education system as well. In particular, the automation of

production processes, the widespread use of artificial intelligence technologies, and the development of robotics and innovative systems have increased the demand for modern engineering specialists. Therefore, the task of training competitive, highly qualified specialists capable of independent thinking and applying innovative approaches in professional activities has become a priority for higher education institutions. In this process, independent learning plays a crucial role.

Independent learning is an essential component of the modern education system. It enables students to independently work on themselves, deepen their knowledge, search for new information, and apply it in practice. Its role is especially significant in engineering education, as engineering activity is closely related to complex technical processes, production systems, modern equipment, and innovative technologies. In such conditions, future engineers should not limit themselves to classroom knowledge but must continuously acquire new knowledge independently.

Today, the rapid development of technology requires engineers to have a high level of adaptability. Technologies used in production are constantly being updated, and new software and control systems are emerging. Therefore, modern engineers must be ready for continuous learning throughout their professional careers. This is directly related to competencies formed through independent learning, including analytical thinking, problem-solving, scientific research, creativity, and independent decision-making.

The introduction of the credit-module system in higher education has further increased the importance of independent learning. In this system, special attention is given to students' independent work outside the classroom. Students independently study topics, analyze scientific and technical literature, and complete projects and practical assignments. This develops responsibility, self-management, time management, and independent thinking skills.

Digitalization has also expanded opportunities for independent learning. Today, electronic libraries, virtual laboratories, distance learning platforms, artificial intelligence-based applications, and online courses are widely used. Students can access educational resources from leading universities worldwide via the internet, which broadens their knowledge base and enhances their professional training.

Independent learning also plays an important role in developing research activities in engineering education. Engineering often involves creating new technologies, solving production problems, and implementing innovative ideas. Therefore, involving students in research, project work, and experimental activities is essential. Through independent learning, students develop scientific thinking and learn to find solutions based on analytical and creative approaches.

The modern labor market also demands high-level competencies from future engineers. Employers value specialists who not only have theoretical knowledge but also possess practical skills, can work with modern technologies, cooperate in teams, and make independent decisions. Therefore, effectively organizing independent learning in higher education institutions is one of the key tasks in preparing students for real production environments.

Independent learning also develops responsibility, discipline, initiative, and self-development skills in students. During the learning process, students set goals, find ways to achieve them, and evaluate results. This prepares them for successful professional careers.

This article scientifically and pedagogically analyzes the priority directions of independent learning in engineering education, its content, organization based on modern pedagogical technologies, and factors for improving its effectiveness. It also highlights the importance of independent learning in developing professional competencies.

RESEARCH METHODS

In preparing this article, several modern scientific and pedagogical research methods were used. In particular, the analysis of scientific, pedagogical, and methodological literature related to the development of independent learning in future engineers was applied as a primary method. Through this method, scientific views on the content, essence, pedagogical significance, and modern approaches of independent learning were summarized.

A comparative analysis method was also used. Based on this, local and international experiences were studied, and effective approaches to organizing independent learning in engineering education were analyzed. The impact of digital technologies and innovative pedagogical approaches on the effectiveness of independent learning was also compared.

The pedagogical observation method was used to study how students' independent learning activities are organized in higher education institutions, their level of activity, and the formation of professional competencies. Based on the observation results, scientific conclusions were developed.

Additionally, generalization and systematization methods were used to organize the collected data scientifically and to develop theoretical conclusions regarding priority directions of independent learning. The role of innovative and digital technologies in engineering education was also analyzed.

Furthermore, the importance of project-based learning, competency-based approaches, and ICT in improving the effectiveness of independent learning was scientifically justified.

MAIN PART

Structure of Independent Learning

Independent learning is a key component of higher education aimed at developing students' knowledge, skills, and competencies. For future engineers, it is not only an additional form of education but also a primary direction for forming

professional competencies. Therefore, its structure is organized based on clear goals, tasks, and stages.

The first and most important element is its goal: to deepen students' theoretical knowledge, strengthen understanding, and develop practical application skills. It also aims to enhance creativity and prepare students for research activities.

The second element is content, based on curricula and individual learning needs. It includes studying lecture topics in depth, working with additional literature, analyzing scientific articles, and completing practical tasks such as calculations, design, modeling, and software use.

The third element is forms, including individual tasks, reports, laboratory work, course projects, presentations, and research papers. Modern digital platforms, online courses, and virtual laboratories are also widely used.

The fourth element is methods, including analysis, comparison, generalization, problem-solving, case studies, project-based learning, and ICT tools.

The process is also organized in stages: preparation, execution, and final evaluation. The evaluation system is based on rating, considering quality, independence, analytical approach, and results.

Problems in engineering education.

One of the main problems is the insufficient connection between theoretical knowledge and practical skills. Students often face difficulties applying theoretical knowledge in real production environments, reducing their competitiveness.

To solve this, integration of independent learning with practical activities is essential. Project-based tasks, virtual laboratories, internships, and industrial collaboration help develop practical skills.

Another issue is the lack of creative and critical thinking skills due to traditional teaching methods focused on memorization.

Digital competence is also a challenge, as some students lack skills in using modern software and digital tools.

Motivation is another issue; some students are not sufficiently engaged in independent learning activities.

CONCLUSION

Independent learning is an essential component of engineering education. It helps students deepen knowledge, develop analytical and creative thinking, and apply theoretical knowledge in practice. It also forms responsibility, discipline, initiative, and self-management skills.

Digital technologies play a crucial role in enhancing independent learning through electronic libraries, online courses, and virtual laboratories.

In conclusion, independent learning is a key factor in forming highly qualified, creative, and competitive engineering specialists. Therefore, improving and modernizing independent learning in higher education institutions remains one of the most important tasks of today.

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