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Research Article

CREATION OF A NEW METHODOLOGY FOR THE DEVELOPMENT OF DESIGN COMPETENCE AMONG FUTURE ENGINEERS

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ABSTRACT

This article explores the challenge of developing design competence in engineering students, a skill set increasingly vital in the face of modern technological demands. It introduces a novel methodology aimed at enhancing the training of future engineers, equipping them with the necessary tools to solve complex design and construction problems effectively. Grounded in an in-depth analysis of current engineering education practices, the proposed methodology integrates modern technologies, project-based learning, and an interdisciplinary approach to create a comprehensive and innovative educational framework.

KEYWORDS

Design competence, engineering education, project training, methodology.

INTRODUCTION

In an era of rapid technological advancement, the demand for engineers who possess both technical expertise and creative design competence has never been greater. Traditional engineering education, while strong in technical training, often falls short in nurturing the design skills necessary for innovative problem-solving in complex real-world scenarios. This gap has highlighted the need for a more holistic approach to engineering education—one that not only imparts technical knowledge but also fosters the creative and critical thinking required for effective design.

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The concept of design competence goes beyond mere technical ability; it encompasses the capacity to integrate various disciplines, apply modern technologies, and engage in project-based learning that reflects the interdisciplinary nature of real-world engineering problems. As such, there is a pressing need to develop a methodology that bridges this gap, preparing future engineers to meet the demands of an ever-evolving industry.

This article proposes a new methodology aimed at cultivating design competence in engineering students. By analyzing existing approaches and incorporating modern educational practices, this methodology seeks to create a more dynamic and integrated learning environment. The proposed framework leverages the strengths of modern technologies, emphasizes the importance of interdisciplinary collaboration, and encourages hands-on, project-based learning. The ultimate goal is to produce engineers who are not only technically proficient but also adept at designing innovative solutions to the complex challenges they will encounter in their professional careers.

The issues of design training of engineers are widely discussed in the scientific literature. According to research (Ivanov et al., 2019; Petrov, 2020), the main problems of existing methods are insufficient integration of practical tasks into the educational process, limited use of modern technologies and weak interdisciplinary communication between courses [1,2].

The development of design competencies requires the use of innovative teaching methods such as project-based learning (PBL), the active use of CAD systems and simulators, as well as the inclusion of students in real projects at the early stages of their education (Sidorova, 2021). However, despite the presence of individual successful examples, there is no systematic approach to solving this problem [3].

METHODOLOGY

The development of a new methodology for the development of design competence among engineering students included the following stages:

1. Analysis of existing educational programs in leading technical universities of Russia and the world.

2. Identification of key competencies based on the analysis of labor market requirements and professional standards.

3. Development of training modules with an emphasis on project-based learning and the use of modern technologies.

4. Pilot implementation of the methodology in the educational process with subsequent assessment of its effectiveness [4].

The proposed methodology is aimed at developing the design competence of a future engineer in the process of engineering and digital training, which allows you to realize:

- consistency in the formation of engineering and graphic knowledge, skills and abilities implemented in design activities;
- integration of professionally-oriented educational and practical design activities;
- taking into account the educational design needs of a future engineer;
- the realization of the goals of vocational education.

The content and structure of the proposed methodology for the development of future engineers'

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design competence based on digital technologies includes a special course that is based on conducting lectures and practical classes, as well as performing independent creative tasks by students.

Independent creative tasks of the special course are aimed at: developing the skills of constructing projections with numerical marks to solve interdisciplinary professionally oriented tasks; creating conditions conducive to the professional orientation of the educational activities of future engineers; awareness by future engineers of the need for the prospective application of knowledge and skills of design activities; mastering by future engineers the skills of professionally oriented cognitive activity.

RESULTS

Based on the analysis, the main components of the new methodology were identified:

1. A modular approach to design training, including interdisciplinary courses and integrated projects.

2. The use of modern technologies, including CAD/CAM systems, virtual and augmented reality, simulators.

3. Methods of active learning, such as project training, case studies, teamwork.

4. A result-oriented evaluation system that includes project protection, presentations and portfolios.

Table 1. The main elements of the methodology

№	Component	Description
1	Modular approach	Introduction of integrated courses, work on projects from the early stages
2	Modern technologies	CAD/CAM, simulators, VR/AR
3	Methods of active learning	Project training, case methods, team work
4	Evaluation system	Portfolio, project protection, presentations

The pilot implementation of this technique in several training courses has shown a significant increase in the level of training of students, as well as their motivation and interest in studying.

The structural engineer of buildings and structures develops building structures and calculates the load (strength calculations) on all its important and bearing parts: foundation, frame, beams, columns, suspended lifting equipment. He must be an experienced PC user, own programs: MS Word, Excel, AutoCAD, Archi Cad, SCAD, ING+, Lira, REVIT, the set of programs may vary depending on the place of work. English language proficiency is often required at least at the level of knowledge of professional terminology. It is important to know the regulatory documentation (GOST, SNiP and other technical regulations). A design engineer should also focus on the market of modern building materials.

The development of the above-mentioned design competencies of future engineers occurs in the process of studying special (professionally oriented) disciplines and acquiring knowledge and skills in the study of interdisciplinary disciplines (formation of professional knowledge, skills) and acquisition.

CONCLUSIONS

The developed methodology demonstrates high efficiency in the development of design competencies among engineering students. It contributes to the

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formation of practical skills that are necessary for successful professional activity in the conditions of the modern labour market. It is recommended to further expand the use of this technique in the curricula of technical universities, as well as to conduct additional research to improve it.

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