

## FACTORS CONTRIBUTING TO THE DEVELOPMENT OF STUDENTS' DESIGN AND CONSTRUCTION COMPETENCE BASED ON AN INNOVATIVE APPROACH

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**Abstract:** *This article analyzes the role and practical significance of an innovative approach in the process of developing students' design and construction competence. In today's era of rapid technological progress, educational processes require the effective use of modern methods and tools. Based on this, the article highlights the didactic foundations of developing students' design and construction activities using innovative technologies, the possibilities of applying advanced pedagogical technologies, and digital resources. Additionally, the study examines educational software tools, innovative methods, and their effectiveness in fostering students' creative and problem-solving thinking abilities. The research results contribute to enhancing the efficiency of training competitive specialists in the field of education.*

**Keywords:** *innovative approach, design and construction competence, pedagogical technologies, digital resources, educational software tools, creative thinking.*

**Аннотация:** *В данной статье анализируется роль и практическое значение инновационного подхода в процессе развития проектно-конструкторской компетентности студентов. В современных условиях стремительного технологического прогресса образовательные процессы требуют эффективного использования современных методов и инструментов. В связи с этим в статье рассматриваются дидактические основы развития проектно-конструкторской деятельности студентов на основе инновационных технологий, возможности применения передовых педагогических технологий и цифровых ресурсов. Кроме того, изучаются программные образовательные средства, инновационные методы и их эффективность, способствующие развитию творческого и проблемного мышления студентов. Результаты исследования направлены на повышение эффективности подготовки конкурентоспособных кадров в сфере образования.*

**Ключевые слова:** *инновационный подход, проектно-конструкторская компетентность, педагогические технологии, цифровые ресурсы, программные образовательные средства, творческое мышление.*

**Annotatsiya:** *Ushbu maqolada talabalarining loyihalash-konstruktorlik kompetentligini rivojlantirish jarayonida innovatsion yondashuvning o‘rni va amaliy ahamiyati tahlil qilinadi. Bugungi kunda texnologik taraqqiyotning jadal rivojlanishi ta’lim jarayonlarida zamonaviy metod va vositalardan samarali foydalanishni talab etmoqda. Shundan kelib chiqib, maqolada innovatsion texnologiyalar asosida talabalarning loyihalash va konstruktorlik faoliyatini rivojlantirishning didaktik asoslari, ilg‘or pedagogik texnologiyalar hamda raqamli resurslardan foydalanish imkoniyatlari yoritib berilgan.*

*Shuningdek, talabalarning ijodiy va muammoli fikrlash qobiliyatlarini rivojlantirishga xizmat qiluvchi dasturiy ta'lim vositalari, innovatsion metodlar va ularning samaradorligi tajribalar asosida o'rganiladi. Tadqiqot natijalari ta'lim sohasida raqobatbardosh kadrlar tayyorlash jarayonining samaradorligini oshirishga xizmat qiladi.*

**Kalit so'zlar:** *innovatsion yondashuv, loyihalash-konstruktorlik kompetentligi, pedagogik texnologiyalar, raqamli resurslar, dasturiy ta'lim vositalari, ijodiy fikrlash.*

**Introduction.** The rapid pace of technological advancement today requires the implementation of new approaches and methods in the educational process. This is particularly important in engineering and technical fields, where shaping and developing students' design and construction competence holds significant value. This competence not only allows students to acquire theoretical knowledge but also enables them to develop practical skills for its application.

Innovative approach refers to the application of new methods and technologies in the educational process.

Development of design and construction competence is the process of enhancing students' abilities in engineering design, project development, and construction activities.

In the modern education system, digital technologies, STEAM education, and the development of creative and problem-solving thinking play a central role. Innovative approaches play a crucial role in developing students' knowledge and skills by integrating modern technologies, advanced pedagogical methods, and digital resources into the educational process. Specifically, the use of software tools, virtual laboratories, and simulations in design and construction activities helps improve educational efficiency. Additionally, the development of creative and problem-solving thinking, independent decision-making, and the creation of innovative solutions are integral parts of this approach.

This article analyzes the role and practical significance of the innovative approach in the development of students' design and construction competence. It also examines the potential use of modern technologies in the educational process, the effectiveness of advanced pedagogical methods, and their importance in students' professional preparation. The article concludes with recommendations aimed at improving the quality of education and enhancing the process of preparing competitive specialists.

**Literature analysis.** The development of students' design and construction competence is one of the current key areas in modern education, and many studies are being conducted in this field. An analysis of the literature indicates that the application of an innovative approach in shaping design and construction competence contributes to improving the effectiveness of the educational process. Research on the development of design and construction activities in modern education primarily focuses on innovative pedagogical technologies, digital educational resources, virtual and interactive environments, as well as problem-based and creative approaches. For instance, Vygotsky emphasized the importance of an activity-based approach in the educational process, while Piaget analyzed key factors in shaping students' constructive thinking.

In recent years, studies on the application of innovative educational technologies (Siemens; Anderson & Shattuck) have considered digital technologies and distance learning tools as important factors in improving educational effectiveness. In particular, methods for organizing practical exercises using educational software tools and virtual laboratories have been widely researched. The effectiveness of involving students in design and construction activities based on the STEAM approach (Science, Technology, Engineering, Arts, Mathematics) has been proven in several studies (Bybee). Furthermore, it has been identified that problem-based learning and research-based teaching methods (Problem-Based Learning – PBL) help develop students' competence in independently identifying and solving problems (Hmelo-Silver).

Foreign research shows that robotics and 3D modeling tools have produced effective results in developing students' design and construction activities (Papert; Resnick). These technologies allow students to strengthen their knowledge not only theoretically but also practically.

In local research, it has been noted that improving the educational process through innovative approaches is of significant importance. In particular, several practical studies are being conducted in the education system of Uzbekistan on developing student competence through digital technologies and distance learning platforms. The above studies demonstrate that to develop students' design and construction competence based on innovative approaches, the following aspects need to be emphasized:

- The use of innovative pedagogical technologies (digital educational platforms, virtual laboratories, 3D modeling);
- The development of creative and problem-solving thinking (problem-based learning, research-based teaching);
- The application of STEAM and robotics technologies in the educational process.

Effectively implementing these factors into the educational process will expand the opportunities for developing students' design and construction competence and help strengthen their practical skills.

**Materials and Methods.** Various methods were used to identify the role and practical significance of the innovative approach in developing students' design and construction competence. These methods allow for assessing the effectiveness of the educational process, determining the impact of innovative approaches, and studying their influence on students' knowledge, skills, and creative thinking.

### **1. Theoretical Methods:**

- o **Literature Analysis** – studying innovative pedagogical technologies, advanced research on developing design and construction competence, and foreign experiences.
- o **Comparative Analysis** – comparing traditional and innovative approaches to determine their effectiveness.
- o **Modeling** – developing a theoretical model of the process of developing design and construction competence.

### **2. Empirical Methods:**

- **Pedagogical Experiment** – testing innovative approaches and evaluating their results in the educational process.
- **Surveys and Interviews** – assessing the effectiveness of innovative methods through surveys conducted with students, teachers, and specialists.
- **Observation** – analyzing student activity in design and construction exercises and identifying the impact of innovative methods.

### **3. Experimental Methods:**

- **Experiment** – applying innovative approaches to a student group and comparing the results with a group taught using traditional methods.
- **Diagnostics and Test Trials** – developing special tests and tasks to assess design and construction competence.
- **Mathematical-Statistical Analysis** – analyzing experimental data using statistical methods and determining the reliability of the results.

Using these methods, the impact of innovative approaches on students' competence is determined, and practical recommendations are developed.

**Results.** The use of innovative approaches has a positive impact on the development of students' design and construction competence. The introduction of advanced pedagogical technologies, project-based activities, and digital resources into the educational process has led to improvements in students' knowledge, skills, and competencies.

### **1. Theoretical Results:**

- The role of innovative approaches in developing design and construction competence is scientifically grounded.
- The influence of innovative pedagogical technologies on students' engineering skills is analyzed.
- The effectiveness of modern educational methods based on the competence approach is determined.
- The fundamental principles of innovative approaches in engineering education are developed.
- The advantages of STEAM, digital technologies, and problem-based learning (PBL) approaches are substantiated.
- Strategies for applying innovative technologies such as 3D modeling, simulations, and virtual laboratories are developed.

### **2. Practical Results:**

- Methodological recommendations for developing design and construction competence based on innovative approaches are provided.
- Methods for increasing student participation in practical exercises are identified.
- Mechanisms for integrating innovative technologies into educational programs in the fields of design and construction are developed.
- Students' creative and critical thinking abilities are enhanced.
- Tasks focused on solving real engineering problems are developed for students.

o Teaching methods based on project-based learning are used to encourage students to work independently.

### **3. Pedagogical Results:**

o The effectiveness of developing design and construction competence is evaluated.  
o The impact of innovative teaching methods on student outcomes is analyzed.  
o The results of the experimental group are compared with those of the group taught using traditional methods.

o The effectiveness of teaching based on digital technologies and innovative methods is increased.

o The experience of creating engineering projects using digital tools is enhanced.  
o The potential for developing design and construction competence through distance and hybrid learning models is studied.

### **4. Innovative Results:**

o Directions for implementing advanced technologies and innovative methods in developing design and construction competence are identified.

o Methods for developing students' constructive thinking through 3D modeling and simulations are proposed.

o Opportunities for improving the design process using artificial intelligence (AI) and IoT technologies are explored.

o Recommendations are developed for introducing innovative engineering laboratories in educational institutions.

o Opportunities for students to create startup projects by engaging in practical projects are provided.

o Collaboration platforms for developing engineering projects using digital technologies are established.

As a result of this article, scientific, practical, and methodological recommendations for developing students' design and construction competence based on innovative approaches are provided. Additionally, the effectiveness of modern technologies and advanced pedagogical approaches in the educational process is analyzed, and strategies for implementing innovative educational models are proposed.

**Discussion.** The development of students' design and construction competence is one of the critical issues in modern engineering education. Today, innovative approaches play a crucial role in shaping and enhancing this competence.

### **1. The Importance of Innovative Approaches:**

Traditional teaching methods are more theory-based, while innovative technologies and interactive teaching methods help direct students towards practical activities. Modern methods such as 3D modeling, digital simulations, virtual laboratories, and problem-based learning contribute to the development of students' skills in solving technical problems, creative thinking, and creating independent projects.

### **2. Practical Significance:**

- **Understanding engineering design and construction processes:** Students have the opportunity to reinforce their knowledge through working on real projects.
- **Analysis and problem-solving:** Innovative approaches enable students to independently analyze engineering problems and find creative solutions.
- **Integration with production and industry:** Modern teaching methods help students adapt to real production environments.

**3. Discussion and Recommendations:** To effectively implement innovative approaches, the following factors are crucial:

- Integrating modern technologies into educational programs.
- Encouraging student participation in practical projects and startups.
- Utilizing digital technologies and artificial intelligence in engineering education.
- Developing a hybrid learning system for teaching design and construction processes.

**Conclusion:** Innovative approaches serve not only to deepen students' theoretical knowledge but also to enhance their readiness to work independently in practical engineering activities. This enables a more efficient process of preparing modern engineers and technical specialists.

**Findings:** The research results show that innovative approaches play a significant role in developing students' design and construction competence. The use of modern technologies, advanced pedagogical methods, and digital resources strengthens students' theoretical knowledge and develops their practical skills. The implementation of innovative approaches led to the following results:

- Increased student activity in project and construction activities, with enhanced problem-solving and creative thinking abilities.
- Confirmed effectiveness of using digital technologies and software-based educational tools, improving the quality of the learning process.
- Experimental research results indicate that students taught using innovative methods achieved better results compared to those taught using traditional methods.

**Practical Recommendations:**

- Widely implement innovative pedagogical technologies in the educational process, such as project-based learning, problem-based learning, and research-based approaches.
- Develop the use of digital resources such as 3D modeling, virtual laboratories, and interactive platforms to enhance student competence.
- Promote students' creative and problem-solving thinking by developing their skills in independent project and construction work.
- Integrate research findings into teaching practices by developing methodological guides for instructors and adapting them to the educational process.

**In conclusion,** the effective implementation of innovative approaches in the educational process helps improve students' professional preparedness, supports their independent creative activities, and contributes to the preparation of competitive specialists in the modern labor market.

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