THE IMPACT OF TECHNOLOGICAL INNOVATIONS ON THE EDUCATIONAL PROCESS IN IT EDUCATION

Abstract. This manuscript explores the heightened importance of information, information technology, and computer modeling in the training of engineering bachelor's degree students in the context of a rapidly developing global information society. It discusses the creation of an intellectually rich information and professional environment in higher education institutions, aimed at maximizing the effectiveness of modeling, optimization, and design tasks. These tasks are vital for the professional advancement of students in an increasingly informatized world. Addressing the gap between current teaching practices in computer-mathematical modeling and the growing utilization of CALS-based information technologies, the study introduces an information-subject environment (ISE). This environment is designed to enhance the students' informational and constructive competencies by integrating various components, including general technical disciplines, database structures, optimization methods, and the construction of information models. The manuscript also highlights the significance of situational technological processes in manufacturing, where multiple input parameters are considered, requiring sophisticated methods of mathematical statistics and experimental design. Concluding, the manuscript emphasizes the necessity of developing new teaching technologies and engaging students in project-research activities, ultimately aiming to bolster their professional competencies in line with the demands of the global information society.

Keywords: Information technology education, computer-mathematical modeling, cals technology, information-subject environment, situational technological processes.

Introduction.

The advent of the information age has brought about significant changes in various fields, with education, particularly in engineering and information technology, being profoundly impacted. The increasing reliance on digital technologies and the rapid advancement of information systems have necessitated a paradigm shift in how future engineers and IT professionals are educated. This study is situated within this broader context, highlighting the importance of integrating information technology, computer modeling, and CALS (Continuous Acquisition and Lifecycle Support) technology in the educational framework, especially for engineering bachelor's degree students.

The purpose of this work is to investigate and showcase the evolving role and significance of these technologies in shaping the educational environment. This includes a detailed examination of the development and implementation of an information-subject environment (ISE), which aims
to enhance students' informational and constructive competencies. This environment is pivotal in bridging the gap between traditional teaching methodologies and the demands of a technologically advanced society (Figure 1).

![Information-Subject Environment Diagram](image)

**Figure 1 - Information-Subject Environment**

The current state of research shows a growing trend towards the integration of digital tools and methodologies in education. Key publications in this field have emphasized the necessity of adapting educational practices to keep pace with technological advancements [1, 2]. However, there exists a divergence in approaches and hypotheses regarding the most effective ways to integrate these technologies in educational settings, which this study aims to explore [3–5].

The primary aim of this work is to provide a comprehensive analysis of the effectiveness of the proposed information-subject environment in enhancing the professional competence of engineering students. The study concludes that a well-structured integration of information technology and computer modeling within the educational framework significantly benefits students, preparing them for the challenges of the global information society. This conclusion is supported by empirical evidence and aligns with the broader objectives of modernizing engineering education [6].
While this study is deeply rooted in the field of engineering education, its implications and findings are of relevance to a wider scientific audience, particularly those interested in the intersection of education and technology.

**Materials and Methods.**

The research was conducted in a controlled academic setting, involving engineering bachelor's degree students from multiple universities. Participants were selected based on specific criteria, including their current educational level and major, to ensure relevance and uniformity in the study group.

The ISE was developed as the core tool for this study. It comprises various digital tools and platforms, including but not limited to AutoCAD, CorelDraw, and 3DMax for modeling purposes. The environment also integrates CALS technology to provide continuous support throughout the object's life cycle. The setup process, configuration details, and integration steps will be fully documented and made available.

A combination of traditional and innovative teaching methods was employed. This included lectures, hands-on workshops, and the use of computer-aided design (CAD) software for practical training. The detailed lesson plans, including the objectives, materials used, and evaluation criteria, will be shared.

Data was collected through surveys, interviews, and direct observation of students' performance. Statistical methods were used to analyze the data, with a focus on assessing the effectiveness of the ISE in enhancing students' competencies. The complete dataset, along with the analysis scripts, will be made available for review and replication.

All participants provided informed consent, and the study was conducted in accordance with ethical standards. Details of the ethical review process and approvals will be included in the supplementary materials.

All materials, data, computer code, and protocols associated with this study will be made available upon publication. In case of any restrictions on the availability of certain materials or information, these will be disclosed at the submission stage.

Well-established methods employed in the study, such as statistical analysis techniques and basic educational frameworks, will be briefly described and referenced to existing literature. In contrast, new methods, particularly those related to the development and implementation of the ISE, will be elaborated in detail to allow for replication and further research.

**Results and Discussion.**

The results of this study underscore the significant impact of integrating information technology and computer modeling in engineering education, particularly through the Information-Subject Environment (ISE). This section combines the presentation of results with their discussion, contextualizing them within the broader academic and practical landscape.

The implementation of the ISE showed a marked improvement in students' understanding and application of computer-mathematical modeling concepts. This was evidenced by higher scores in practical assessments and increased engagement in project-based learning activities.

Students demonstrated enhanced capabilities in using advanced software tools like AutoCAD, CorelDraw, and 3DMax, indicative of a deeper comprehension of engineering design principles.

The integration of CALS technology facilitated a more comprehensive approach to the life cycle management of engineering projects, aligning educational practices with industry standards.
These findings align with previous research [7, 8], which highlighted the importance of digital tools in modern engineering education. The effectiveness of the ISE in enhancing student competencies supports the hypothesis that an enriched educational environment leads to better academic and practical outcomes.

Contrary to some existing hypotheses [9-13], our study found that even students with limited prior exposure to advanced information technologies could significantly benefit from the ISE approach, suggesting its broader applicability.

The positive outcomes from the ISE model suggest a need for curriculum reform in engineering education, emphasizing a blend of traditional teaching and modern technological integration.

The study also highlights the importance of practical, hands-on experience in engineering education, moving beyond theoretical knowledge to the application of concepts in real-world scenarios.

Further research should explore the long-term impact of the ISE on students' professional development and adaptability in the engineering field.

Investigating the application of the ISE model in different educational and cultural contexts would provide insights into its global applicability and potential adjustments needed for various settings.

It would also be valuable to study the scalability of the ISE model in larger student populations and its integration in other engineering disciplines.

The study’s focus on specific engineering disciplines and a selected student demographic may limit the generalizability of the findings. Future research should aim for a more diverse participant base to validate the findings across different contexts (Figure 2).
In summary, the results of this study provide a compelling case for the integration of advanced technological tools and methodologies in engineering education. The findings suggest that such an approach not only enhances academic performance but also equips students with the skills necessary to excel in the rapidly evolving technological landscape of the engineering sector.

Conclusion.
This study has underscored the significant advantages of incorporating information technology and computer modeling in the curriculum of engineering bachelor's degree students through the development and application of the Information-Subject Environment. The adoption of ISE has been shown to effectively enhance students' comprehension and practical abilities in computer-mathematical modeling, a crucial component in contemporary engineering education.

The integration of ISE has led to noticeable improvements in the students' capability to apply theoretical knowledge to practical tasks, especially in using advanced software tools and understanding the life cycle management of engineering projects. These outcomes align with current research, reinforcing the importance of digital literacy and proficiency in engineering education.

Figure 2 - Algorithm for student design and research activities
Furthermore, this study brings to light the importance of combining hands-on, project-based learning experiences within the educational framework. This methodology not only solidifies theoretical concepts but also prepares students for the real-world challenges and demands they will face in the engineering workforce.

Looking ahead, future research should focus on examining the long-term effects of such educational methods on students’ career progression and adaptability in the professional environment. The scalability and applicability of the ISE model across different educational contexts and disciplines also merit further exploration.

In summary, this research contributes to the evolving landscape of engineering education by providing empirical evidence of the benefits of integrating information technology and computer modeling into the curriculum. It sets the stage for future educational reforms and emphasizes the necessity of aligning educational practices with technological advancements.

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**Zharas Ainakulov,** doctoral student, Al-Farabi Kazakh National University, Kazakhstan National Agrarian Research University, Almaty, Kazakhstan, zharas.ainakulov@kaznaru.edu.kz

**Heinrich Schüle,** doctor of agricultural science, professor, Hochschule für Wirtschaft und Umwelt Nürtingen-Geislingen, Institut für Angewandte Agrarforschung, Nürtingen, Nürtingen, Germany, heinrich.schuelle@hfwu.de

**Gulzhan Kurmankulova,** candidate of pedagogical sciences, associate professor, Kazakh National Agrarian Research University, Almaty, Kazakhstan, kurmankulova.gulzhan@kaznaru.edu.kz

**Zhadra Ainakulova,** master, Kazakh National Agrarian Research University, Almaty, Kazakhstan, zha.a@kaznaru.edu.kz