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TEACHING ENGINEERING AND COMPUTER GRAPHICS THROUGH DIGITAL TECHNOLOGIES

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Abstract
This article examines the theoretical and methodological foundations of teaching Engineering and Computer Graphics through the integration of digital technologies. Particular attention is given to the educational potential of computer-aided design (CAD) systems, three-dimensional (3D) modeling tools, and visual simulation technologies in improving the quality of engineering education. The study demonstrates that integrating digital technologies into the teaching process contributes significantly to the development of students' spatial thinking, graphical literacy, technical creativity, and professional competencies. Furthermore, the paper discusses contemporary pedagogical approaches aimed at enhancing students' practical skills through interactive learning environments and digital engineering tools. The findings indicate that combining traditional engineering graphics instruction with modern digital technologies improves learning efficiency and better prepares future engineers for professional practice in the context of digital transformation.

Keywords: Engineering graphics, computer graphics, digital technologies, CAD systems, 3D modeling, visual simulation, spatial thinking, professional competence, engineering education.

Introduction

In the modern higher education system, teaching Engineering and Computer Graphics is becoming increasingly important not only for developing students' graphical literacy but also for forming the professional competencies required for their future careers. In the context of the digital economy, industrial modernization, production automation, and computer-aided design, engineering education should develop students' spatial thinking, graphical analysis, digital modeling, design, and visualization skills in addition to traditional drafting abilities.

Engineering and Computer Graphics is one of the fundamental disciplines that develops engineering thinking. It enables students to represent geometric objects, understand projection principles, prepare sections and sectional views, construct axonometric drawings, analyze machine parts and assemblies, read engineering documentation, and use modern graphic software.

Today, digital graphic systems such as **AutoCAD, Kompas-3D, SolidWorks, Fusion 360,** and **SketchUp** are widely used together with traditional teaching methods. However, in many cases these programs are taught as separate software applications rather than as an integrated part of the course. As a result, students may know software commands but often experience difficulties applying them to real engineering tasks.

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Digital technologies make it possible to present complex geometric and engineering objects in a dynamic and interactive way. They simplify the transition from two-dimensional drawings to three-dimensional models, improve understanding of projection relationships and object geometry, and facilitate engineering visualization. In addition, digital learning increases students' motivation, promotes independent learning, and provides opportunities for individualized instruction.

From a pedagogical perspective, teaching Engineering and Computer Graphics through digital technologies involves more than introducing computers into the classroom. It requires updating the content, teaching methods, learning activities, and assessment according to competency-based education. Therefore, learning outcomes should be evaluated not only by theoretical knowledge but also by students' ability to apply their knowledge and skills in professional situations.

The purpose of this study is to analyze the methodological foundations of teaching Engineering and Computer Graphics through digital technologies and to determine their role in developing students' professional competencies.

Methodological Foundations of Teaching Engineering and Computer Graphics through Digital Technologies

Teaching Engineering and Computer Graphics through digital technologies should combine theoretical knowledge with practical skills. Students need not only to understand the principles of engineering graphics but also to apply them using modern CAD software.

The teaching process can be organized in several stages. At the first stage, students study engineering drawing standards, projection methods, and the basic principles of graphical representation. At the second stage, they become familiar with CAD software and learn to create engineering drawings and three-dimensional models. The third stage focuses on practical assignments, where students independently complete graphic tasks using digital tools. Finally, the completed work is analyzed and evaluated, allowing students to identify and correct mistakes while improving their professional skills.

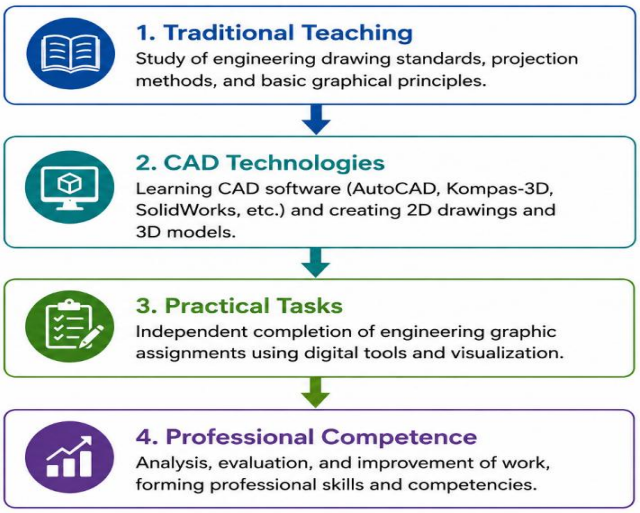

Figure 1. Digital technology-based teaching process in Engineering and Computer Graphics.

Modern software such as **AutoCAD, Kompas-3D, SolidWorks, Fusion 360,** and **SketchUp** provides broad opportunities for engineering education. These programs help students create accurate drawings, develop 3D models, visualize engineering objects, and improve their spatial thinking.

Table 1. Digital technologies and their educational applications in Engineering and Computer Graphics

Digital Technology	Main Educational Application	Learning Outcome
AutoCAD	Preparation of 2D engineering drawings	Development of technical drawing skills
Kompas-3D	Mechanical design and engineering documentation	Improvement of engineering design competence
SolidWorks	3D modeling of engineering components	Development of spatial thinking and modeling skills
Fusion 360	Product design and collaborative engineering	Enhancement of digital design competence
SketchUp	Visualization of engineering objects	Better understanding of object geometry and visualization

However, digital technologies should complement rather than replace traditional engineering graphics. Students must first understand the theoretical foundations of engineering drawing and then apply this knowledge in a digital environment. Combining traditional teaching methods with modern digital technologies makes the educational process more effective and practice-oriented.

The use of digital technologies also encourages independent learning. Students can complete practical assignments, revise their work, and improve their skills using electronic learning resources and engineering software. As a result, they gain the competencies required for modern engineering practice.

Conclusion

The integration of digital technologies into Engineering and Computer Graphics education improves both the quality and effectiveness of the teaching process. The use of CAD software, 3D modeling, and digital visualization helps students better understand engineering concepts, develop spatial thinking, and strengthen their practical skills.

The combination of traditional teaching methods with modern digital technologies creates more effective learning conditions and supports competency-based education. Students acquire not only theoretical knowledge but also practical experience in solving engineering problems using digital tools.

Therefore, the application of digital technologies in teaching Engineering and Computer Graphics contributes to the development of professional competencies and prepares future engineers to meet the requirements of modern industry and the digital economy.

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