Educator Insights: A Journal of Teaching Theory and Practice
Volume 2, Issue 6, June 2026
brightmindpublishing.com
ISSN (E): 3061-6964

THE USE OF DIGITAL TECHNOLOGIES IN TEACHING ENGINEERING AND COMPUTER GRAPHICS IN THE PRODUCTION SECTOR

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Abstract
This article analyzes the application of digital technologies in teaching engineering and computer graphics for the production sector. A comparative study was conducted between traditional methods of graphics instruction and educational approaches based on digital graphic technologies. The study substantiates the potential of CAD systems and three-dimensional (3D) modeling tools to enhance students' practical skills and spatial thinking required in modern industrial production. The findings indicate that teaching engineering graphics through digital technologies significantly improves the effectiveness of preparing engineering specialists whose competencies meet the current demands of industrial production.

Keywords: Engineering graphics, computer graphics, digital technologies, CAD systems, industrial production, spatial thinking.

Introduction

The rapid development of modern industrial production has fundamentally changed the requirements for engineering education. Increasing technological complexity in manufacturing processes, the diversification of industrial products, and growing demands for quality require technical documentation, engineering drawings, and design documentation to be prepared with a high degree of accuracy and in accordance with established standards. Consequently, technical drawings, three-dimensional models, and digital design documentation have become indispensable components of contemporary production processes.

The efficiency of manufacturing processes largely depends on engineers' graphical literacy, spatial thinking abilities, and proficiency in computer graphics

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technologies. In this context, the discipline of Engineering and Computer Graphics plays a fundamental role in developing these competencies, enabling future engineers to analyze production processes, visualize engineering solutions, and effectively perform design-related tasks.

Traditional methods of teaching engineering graphics are primarily based on manual drafting and static graphical representations. However, compared with the digital technologies, Computer-Aided Design (CAD) systems, and three-dimensional modeling tools widely employed in modern manufacturing, such approaches are no longer sufficient to satisfy industrial requirements. Therefore, integrating digital technologies into engineering graphics education and aligning the educational process with industrial demands has become an important scientific and practical challenge.

Engineering graphics education based on digital technologies enables students to visualize complex engineering objects in three dimensions, simulate manufacturing processes, and identify potential technological errors before production. This approach contributes to the development of practical engineering skills, enhances engineering thinking, and significantly improves the overall effectiveness of the educational process.

Figure 1 illustrates the conceptual relationship between digital technologies, engineering and computer graphics, CAD systems, and industrial production requirements.

The purpose of this study is to analyze the scientific foundations of applying digital technologies in teaching engineering and computer graphics within the production sector, determine the possibilities for their integration into the educational process, and develop recommendations aimed at improving the quality of engineering education in accordance with modern industrial requirements.

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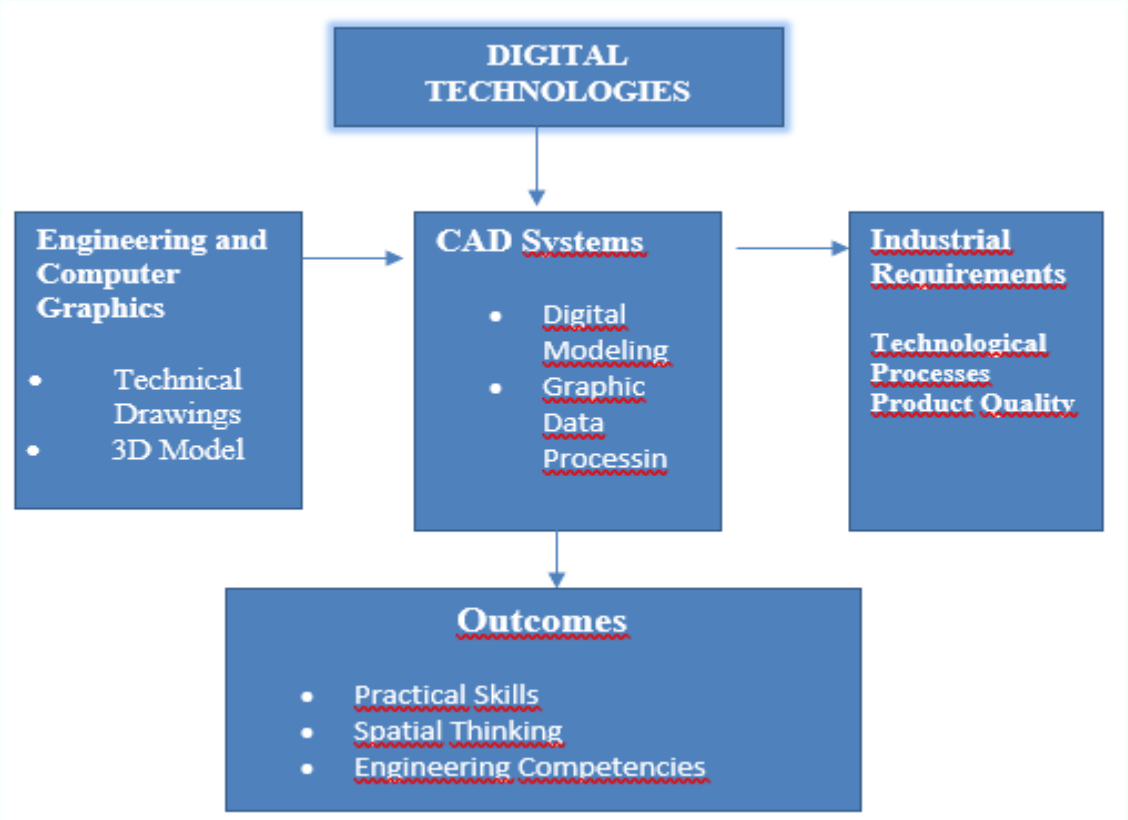

Figure 1. Conceptual Framework for the Application of Digital Technologies in Teaching Engineering and Computer Graphics for Industrial Production

Comparative Analysis of Teaching Engineering and Computer Graphics Based on Digital Technologies

A comparative analysis of the approaches employed in teaching engineering and computer graphics provides an opportunity to evaluate the effectiveness of preparing engineering specialists who meet the demands of modern industrial production. Traditionally, this discipline has been taught through manual technical drawing and two-dimensional graphical representations. Although this approach contributes to the development of fundamental engineering thinking, it is not fully compatible with the digital technologies currently applied in modern manufacturing environments.

Within the traditional approach to engineering graphics education, students acquire the skills required to construct technical drawings step by step, master projection principles, and prepare graphical documentation in accordance with engineering standards. However, this method offers limited opportunities for visualizing the spatial structure of complex engineering objects, simulating manufacturing processes, and rapidly analyzing engineering design solutions.

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By contrast, engineering and computer graphics courses organized on the basis of digital technologies extensively employ Computer-Aided Design (CAD) systems, three-dimensional (3D) modeling, and digital graphic data processing tools. This approach enables students to visualize engineering objects in three dimensions, effectively represent engineering solutions, and simulate situations associated with industrial production processes. As a result, graphical training
The comparative analysis demonstrates that digital technology-based instruction enables students not only to prepare technical drawings but also to analyze them from an engineering and manufacturing perspective, establish relationships with technological processes, and justify engineering decisions. As presented in Table 1, this approach facilitates the development of technical thinking, spatial visualization, and integrated engineering competencies that are essential in modern industrial production.

Table 1. Comparative Analysis of Traditional and Digital Approaches to Teaching Engineering and Computer Graphics

Comparison Criteria	Traditional Graphics Instruction	Digital Technology-Based Instruction
Method of completing graphic assignments	Manual drafting and static illustrations	CAD systems and digital modeling
Development of spatial thinking	Limited	High
Visualization of engineering objects	Based on two-dimensional drawings	Based on three-dimensional models
Relevance to manufacturing processes	Indirect	Direct
Editing engineering documentation	Difficult and time-consuming	Fast and flexible
Development of practical skills	Moderate	High
Flexibility of the educational process	Low	High

Furthermore, the use of digital graphic tools significantly increases the flexibility of the educational process. While completing graphic assignments, students are able to compare different design alternatives, rapidly modify engineering solutions, and visually evaluate the obtained results. Consequently, this approach

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develops essential competencies related to rapid decision-making and technological adaptability, which are highly valued in industrial practice.

Overall, the comparative analysis of traditional and digital approaches to teaching engineering and computer graphics demonstrates that educational processes organized on the basis of digital technologies are considerably better aligned with the needs of modern industrial production. This approach enhances the practical significance of engineering graphics education and creates favorable conditions for preparing competitive engineering specialists equipped with contemporary knowledge and professional skills.

Conclusion

The digital transformation of industrial production requires a comprehensive revision of engineering education and its adaptation to practical industrial needs. This study analyzed the application of digital technologies in teaching engineering and computer graphics and demonstrated that this discipline plays a significant role in developing the engineering competencies required for modern manufacturing.

The results of the comparative analysis indicate that, although traditional methods of teaching engineering graphics contribute to the formation of fundamental engineering thinking, they are not fully compatible with the digital design and modeling technologies extensively employed in contemporary industrial production. In contrast, digital technology-based instruction expands students' opportunities to visualize engineering objects in three dimensions, rapidly analyze graphical solutions, and establish effective links between engineering design and manufacturing processes.

Teaching engineering and computer graphics through digital technologies promotes the development of students' practical skills, spatial thinking, and the ability to justify engineering decisions. Consequently, this approach improves the effectiveness of preparing specialists capable of working with modern industrial technologies while strengthening the practice-oriented nature of engineering education.

Overall, the integration of digital technologies into engineering and computer graphics education represents one of the essential prerequisites for establishing an educational model closely connected with industrial production. This approach contributes to improving the quality of engineering graphics education, aligning

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the educational process with the requirements of modern manufacturing, and preparing competitive engineering professionals equipped with advanced technological competencies.

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