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APPLICATION OF CAD TECHNOLOGIES IN ENGINEERING GRAPHICS TRAINING OF STUDENTS IN TECHNICAL SPECIALTIES

Dilfuza Satvoldievna Umarova
Senior Lecturer, Department of General Technical Disciplines
Andijan State Technical Institute, Andijan, Uzbekistan

Abstract
The digital transformation of industry and CAD technologies has increased the requirements for engineering education. Modern engineers need skills in digital design, modeling, and technical documentation. This study examines the use of CAD tools in engineering graphics training for students of technical specialties, focusing on Engineering Mechanics and Metal Technology. The roles of AutoCAD and SolidWorks are analyzed in developing graphic competencies, spatial thinking, and digital design skills. The comparison shows that AutoCAD is effective for technical drawing and documentation, while SolidWorks supports advanced 3D modeling and product development. The results confirm that CAD integration improves engineering education quality and strengthens professional competencies in line with industry needs.

Keywords: Engineering graphics, CAD technologies, AutoCAD, SolidWorks, digital design, 3D modeling, engineering education, professional competencies, spatial thinking.

Introduction

The rapid development of digital technologies in modern industry has fundamentally transformed the nature of engineering activity and engineering education for engineering education, to possess not only theoretical knowledge but also advanced practical skills in computer-aided design, three-dimensional modeling, and digital documentation. In this context, engineering graphics plays a central role in the formation of professional competencies, as it develops students' spatial imagination, technical thinking, and ability to interpret and create engineering drawings in accordance with international standards.

The transition from traditional manual drafting to digital CAD-based design represents one of the most important changes in academic training. Computer-aided design systems such as AutoCAD and SolidWorks have become standard tools in both academic and industrial environments. These systems provide students with the opportunity to visualize engineering objects, create accurate technical drawings, and develop complex mechanical structures in a virtual environment. As a result, the learning process becomes more interactive, practical, and aligned with real engineering tasks.

AutoCAD is widely used in engineering graphics education due to its strong capabilities in two-dimensional drafting and technical documentation. It allows students to produce precise drawings, apply standard dimensions, and follow established engineering conventions. SolidWorks, in contrast, is a powerful tool for three-dimensional parametric modeling, assembly design, and engineering analysis. It enables students to construct complex models,

simulate mechanical interactions, and visualize products in realistic conditions. The combination of these two systems creates a comprehensive learning environment that supports the gradual development of both basic and advanced engineering skills.

The integration of CAD technologies into the educational process significantly improves students' learning outcomes. It enhances their motivation, increases engagement, and provides immediate feedback through visual representation of design results. Moreover, CAD-based learning develops independent thinking and problem-solving skills, as students are encouraged to explore different design solutions and evaluate their effectiveness.

A detailed comparison of AutoCAD and SolidWorks in the context of engineering graphics education is presented in the following table:

Table 1. Comparison of AutoCAD and SolidWorks

Aspect	*AutoCAD*	*SolidWorks*
Type of design	2D drafting	3D parametric modeling
Learning level	Beginner to intermediate	Intermediate to advanced
Main function	Technical drawings and documentation	Product design and simulation
Visualization	Basic 3D representation	Advanced realistic visualization
Engineering focus	Standards and precision	Innovation and spatial design
Industry use	Drafting and documentation	Mechanical design and development
Educational benefit	Accuracy, discipline, technical literacy	Creativity, spatial thinking, system design

In addition to software comparison, the educational impact of CAD technologies can also be analyzed through the development of specific competencies among students. These competencies include technical drawing accuracy, spatial visualization ability, digital modeling skills, and understanding of engineering standards. The table below summarizes the key competencies developed through CAD-based instruction.

Table 2. Competencies Developed Through CAD Training

Competency	Description	CAD Contribution
Technical drawing	Ability to create accurate engineering drawings	AutoCAD strengthens precision and standardization
Spatial thinking	Understanding of 3D structures	SolidWorks enhances visualization and imagination
Design skills	Development of engineering solutions	Both systems support design creativity
Digital literacy	Use of modern engineering software	CAD systems provide essential industry skills
Problem-solving	Analysis of engineering tasks	Simulation and modeling improve decision-making

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The use of CAD technologies also contributes to improving the efficiency of the educational process. Students can quickly modify designs, correct errors, and test multiple variants without repeating manual work. This flexibility allows for a more dynamic and practice-oriented learning environment. At the same time, it encourages students to take an active role in their own learning process, which is essential for developing professional independence.

Despite the advantages of CAD technologies, traditional engineering graphics methods still hold significant educational value. Manual drawing techniques help students develop discipline, attention to detail, and a deeper understanding of geometric principles. Therefore, the most effective approach in technical education is a blended system that combines traditional methods with modern digital technologies. This ensures a balanced development of both fundamental and advanced competencies.

From a pedagogical perspective, the integration of CAD technologies also supports competency-based education. Students are not only evaluated based on theoretical knowledge but also on their ability to apply practical skills in real design tasks. This shift aligns higher engineering education with industry requirements and enhances graduate employability.

In conclusion, the application of AutoCAD and SolidWorks in engineering graphics training significantly improves the quality of education in technical specialties. It contributes to the formation of a new generation of engineers who are capable of working effectively in a digital engineering environment. The combined use of both software systems ensures the development of comprehensive professional competencies, including technical accuracy, spatial thinking, creativity, and digital literacy. Therefore, CAD technologies should be considered an essential component of modern academic training and further integrated into academic curricula to meet the demands of contemporary industry.

REFERENCES

1. Umarova D. Development of students' creative competencies in studying computer graphics // Scientific and Technical Journal of Namangan Institute of Engineering and Technology. – 2024. – Vol. 9, Special Issue 2. – P. 369–376.
2. Umarova D.S. Muhandislik va kompyuter grafikasini o‘qitishning nazariy, metodik va raqamli asoslari: Monograph. – Andijan, 2026. – 156 p.
3. Боголюбов С.К. Инженерная графика. – Moscow: Mashinostroenie, 2020. – 392 p.
4. Чекмарёв А.А. Инженерная графика. – Moscow: Yurait, 2021. – 389 p.
5. Васильева Л.С. Компьютерная графика и основы AutoCAD. – Moscow: KNORUS, 2021. – 256 p.
6. Миронов Б.Г. Сборник упражнений для чтения чертежей по инженерной графике. – Moscow: Akademiya, 2019. – 224 p.
7. Branoff T.J. The Effects of 3D Modeling in Engineering Graphics Education // Journal of Engineering Education. – 2020. – Vol. 109, No. 2. – P. 215–228.
8. García R.R., Pareja-Lora A. Teaching CAD at the University: Specifically Written or Commercial Software? // Computers & Education. – 2007. – Vol. 49, No. 3. – P. 696–709.

9. Sola-Guirado R., Moya M., Hernández M. Teaching CAD/CAM/CAE Tools with Project-Based Learning in Distance Learning // Education Sciences. – 2021. – Vol. 11, No. 11. – Article 722.
10. The Impact of CAD Software on the Teaching of Engineering Graphics // Problems of Education in the 21st Century. – 2023. – Vol. 81, No. 2. – P. 245–258.

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