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USE OF INFORMATION TECHNOLOGIES IN ENGINEERING GRAPHICS CLASSES IN HIGHER EDUCATION INSTITUTIONS

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ABSTRACT

The article focuses on integrating innovative activities with information technologies in engineering graphics classes in higher education institutions. It highlights the role of information technologies as essential tools for enhancing the efficiency of education and their intensive implementation in the learning process, which can lead to significant positive changes in the education system.

KEYWORDS

Graphics, projection, innovation, intensive, didactics, portfolio, AutoCAD, Autodesk.

INTRODUCTION

Automated educational programs using technical tools and information technologies for teaching engineering graphics are gradually being developed in the higher education institutions of our country. Methods for using various types of information technologies in the educational process are also evolving.

In practice, instructors should have the option to choose between linear or branching types of information technologies or use them simultaneously. Linear information technologies allow students to

process and master all the educational material sequentially, while branching information technologies enable students to choose an individual learning path, depending on their level of preparedness. In both cases, the interaction between the student and instructor is facilitated through specialized tools, programmed learning materials, and computers. The advantage of this approach lies in the ability to constantly and comprehensively monitor the level and quality of students' mastery of the curriculum. Furthermore, this method eliminates the

issue of matching the speed of learning to the individual capabilities of students, as each student works at their own pace. Another advantage is the time saved by instructors on delivering information, which can instead be allocated to monitoring and assessing material comprehension.

The widespread implementation of information technologies requires appropriate material support. Currently, it is challenging to fully supply general education schools and vocational colleges with programmed textbooks, sets of graphic tasks, and test-based control assignments. A significant drawback of this teaching method is the additional strain it places on students' memory.

To use computers effectively in engineering graphics classes, the following requirements must be met:

- Students must possess basic computer skills.
- Before performing drawings on a computer, students should at least have basic knowledge of projection literacy.
- Drafting lessons should not be turned into computer graphics lessons (the distinction between these subjects must be maintained).

Let us consider the methodological aspects of students creating drawings using graphic software. Currently, many graphic systems like AutoCAD, TopCAD, JCAD, 3D-GRAF, KD-Master, КОМПАС, ВАРИКОН, and Тeфлекс are widely used in various fields of scientific and engineering activities. Among these, AutoCAD is the most popular in the education system. AutoCAD has also become the standardized system for automating project and drafting work in many

companies and organizations both domestically and internationally.

According to researcher A. Eshmurodov, improving the quality of graphic education during lessons significantly contributes to the learning process through a precise, targeted, and methodologically sound system of knowledge delivery. The effective use of modern teaching tools and materials, including didactic games and computer technologies, plays a crucial role in increasing the effectiveness of teaching drafting skills.

The process of informatization in modern society requires individuals to have the ability to use personal computers. The success of applying computer technologies in teaching engineering graphics primarily depends on how these technologies can improve traditional and well-established teaching methods and academic subjects. Visual aids, such as presentations, assist instructors in delivering educational material, developing students' skills in observing and analyzing object shapes, and ensuring comprehensive understanding while increasing students' interest in the topic.

Presentations serve specific purposes at all stages of the lesson, particularly in performing graphic and practical tasks. During the creation of presentations, instructors can use various software tools, demonstrating their own creativity. Spatial visualization and the ability to imagine and analyze shapes play a critical role in all areas of creative activity. The drafting process, along with spatial visualization, supports understanding the relationship between elements and further design development.

In modern computer usage, quick conceptualization and immediate visualization of ideas are essential. Therefore, individuals need to develop the skill of transferring their mental concepts onto paper alongside spatial visualization abilities. One of the key determinants of success in this area is the pedagogical literacy of both students and instructors.

The graphic assignments given to students are primarily designed for students in pedagogical higher education institutions who specialize in technical and drafting fields. These assignments are selected based on the type of graphic representations required in specific professional areas. For example, architectural and construction fields may focus on geometrical patterns or girih motifs frequently used in decorative arts, as well as designs for construction projects. This raises the question: “Why choose the AutoCAD software?” AutoCAD, developed by Autodesk, is considered the international standard for automated design.

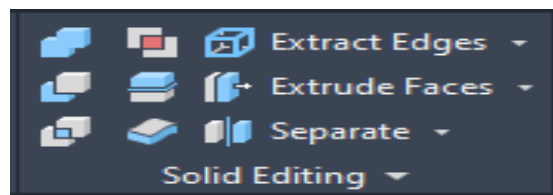
According to researcher G. X. Hamidova, AutoCAD is a sophisticated and widely used software for automated design that delivers high precision in creating various types of drawings and schematics. It enables users to fully realize their creative potential. Modern graphic software, such as AutoCAD, provides numerous advantages, including the ability to perform both 2D

and 3D drawings with exceptional precision. For 3D modeling, the software offers features such as:

1. Adequate tools for creating surfaces and axes for rotations.
2. The ability to view objects in three dimensions.
3. Shadowing and highlighting for rendered objects.
4. Precise placement of objects for production purposes.
5. The ability to view objects from multiple angles in 3D space.

Through these features, AutoCAD facilitates the creation of complex drawings and enhances the efficiency of the drafting process. For instance, to create a 3D model, surfaces and axes can be defined and then used with the “Revolve” command to draw objects. Similarly, “Solid Edition” commands enable precise trimming. These tools exemplify how modern software has transformed the drafting process, offering a versatile platform for teaching and learning in engineering graphics.

“Commands of the “Solid Editing” Panel and Their Usage



1. “Union” (Объединение). The Union command combines separate 3D objects into a single entity. This creates a unified model from individual parts. To use

this command: Select the Union command. Choose the objects to be combined. Confirm the selection by pressing Enter. See Figure 1. 2. “Subtract”

(Вычитание). The Subtract command removes unnecessary portions from one object that intersect with another. This is done by subtracting one object from a primary object. To use this command: Select the Subtract command. Choose the main object to retain and press Enter. Then, select the object to be subtracted and press Enter again to confirm. See

Figure 2.3. “Intersect” (Пересечение) The Intersect command retains only the overlapping portions of two objects that intersect. To use this command: Select the Intersect command. Choose both objects. Confirm the selection by pressing Enter. See Figure 3.

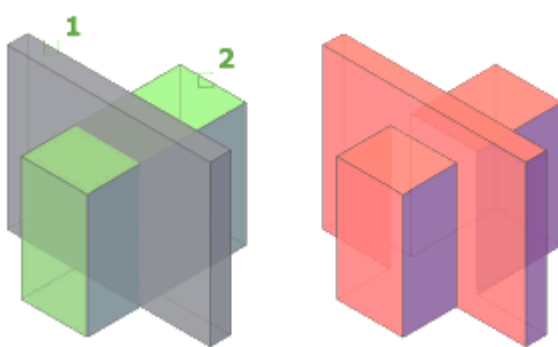


Figure 1

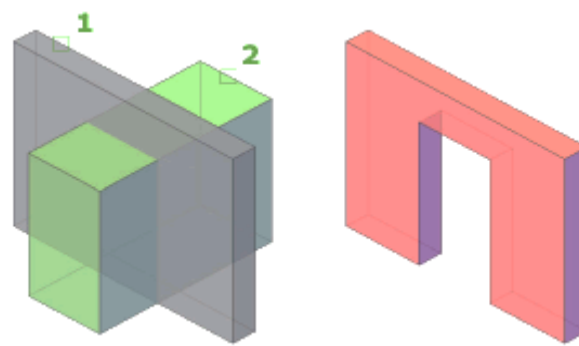


Figure 2

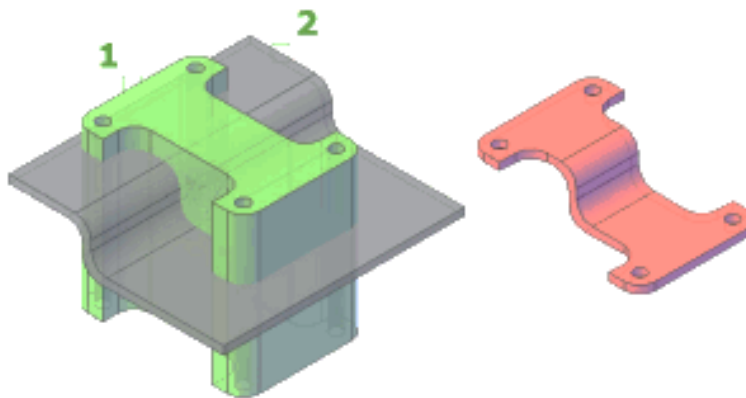


Figure 3

The above-mentioned capabilities of 3D modeling on a computer show that computer-generated 3D drawings have numerous advantages compared to paper-based 3D drawings. These include the convenience of drawing, high quality and precision, editing capabilities, and, of course, the ability to control parameters through modeling. On paper, technical objects with particularly complex surfaces often have approximate geometric parameters, a problem resolved in computer-based 3D modeling. Today, most automated design systems used in modern manufacturing are in English, making it essential to develop skills for working with such systems in the future. Therefore, the English terminology and functions of 3D modeling tools are studied through foreign literature based on AutoCAD software [1].

In global educational development, the significance of developing independent, logical thinking and imagination skills is unparalleled in determining a nation's progress, socio-economic prospects, and future. The success of higher education systems in developed countries (USA, UK, Germany, Japan, South Korea, India, China, Russia, Ukraine, etc.) is largely defined by preparing graduates with competencies in independent work, graphical literacy, reading and creating drawings, and designing (components, buildings, landscape design, etc.). Distance and independent learning in graphic disciplines, including “Descriptive Geometry and Engineering Graphics,” and acquiring graphical knowledge through multimedia tools contribute to the spatial imagination of students and enhance the effectiveness of graphical education. The application of multimedia computer technologies in teaching “Descriptive Geometry and Engineering Graphics” to develop students’ spatial imagination is of great importance.

In Europe and the USA, researchers such as M. Sroka, B. Radovan, T. Jelena, H. Stachel, and others, in CIS countries V. V. Kondratova, J. J. Djanabayev, S. V. Panyukova, and in Uzbekistan A. K. Khamrakulov, Ch. T. Shokirova, N. D. Yadgarov, D. S. Saidakhmedova, have provided scientific recommendations on using multimedia computer technologies in “Descriptive Geometry and Engineering Graphics” courses at various levels of higher and vocational education. Special attention has been given to the principle of visualization in these recommendations. Today, in the computer graphics discipline, studied as part of descriptive geometry and engineering graphics, there are possibilities to create high-quality assignments in a short period. The AutoCAD graphic software is considered the most optimal tool for this purpose. Creating assignments on topics in this software is more convenient than with other programs. For instance, using AutoCAD, one can develop projects on topics like finding the third view from two views, tangency, line types, axonometric projections, surfaces, sections, and cuts. Although various programs can be used to develop tiered graphical assignments, AutoCAD offers significant advantages due to its wide-ranging capabilities. Models created in 2D can easily be transformed into 3D with a few necessary steps, allowing dimensions, coloring, and similar tasks to be completed effortlessly. Utilizing this software for creating tiered assignments in “Descriptive Geometry and Engineering Graphics” is highly efficient [2].

An analysis of scientific literature reveals that using information technologies in engineering graphics classes in higher education institutions makes the educational process more effective and interactive. Information technologies can be applied in the following areas:

1. Digitization of study materials: Presenting textbooks, manuals, and other materials in electronic format provides students with easy access to necessary resources.

2. 3D modeling software: Using programs like AutoCAD, SolidWorks, or SketchUp, students learn to create three-dimensional models, an essential skill for engineering graphics courses.

3. Interactive learning platforms: Organizing lessons and managing assignments through platforms like Moodle or Google Classroom simplifies the teaching process.

4. Video lessons and online resources: Students can use platforms like YouTube or Khan Academy to gain additional knowledge and study independently.

5. Simulation software: Simulation tools (e.g., ANSYS or MATLAB) help students understand real-world scenarios while solving problems.

6. Collaborative tools: Programs like Google Docs or Microsoft Teams allow students to work on projects collaboratively.

7. Digital portfolios: Students can compile their work digitally, creating portfolios for future employers.

The effective application of these technologies can significantly improve students' knowledge and skills in engineering graphics. Educators, by using modern methods, can make lessons more engaging and productive.

Our research indicates that using information technologies in engineering graphics classes helps

students create, analyze, and present graphical representations with modern methods. Interactive learning: Developing interactive educational materials through information technologies encourages students to participate actively. Teacher preparation: Educators must learn to integrate information technologies into their lessons effectively, leading to high-quality education. The role of information technologies in engineering graphics classes is crucial for preparing students for the modern labor market. These methods also foster creativity and help translate theoretical knowledge into practical skills.

Today, modern information technologies are present in nearly every aspect of our lives. They play a significant role in the advancement of education, enabling activities like online research, education, scientific investigations, business automation, multimedia application development, and more. However, challenges remain in teaching engineering graphics, such as:

1. Lack of methodological support for organizing a modern information-based educational environment, as well as insufficient skills and qualifications of educators in using modern information technologies to solve subject-related issues and enhance graphical literacy.

2. Insufficient knowledge among engineering graphics educators about modern information technologies and their effective application in teaching. Existing teaching materials and manuals do not fully meet current requirements.

In general, establishing an electronic library for our discipline or enriching the existing ones would be beneficial for future generations and young

professionals. A modern information-based educational environment provides new opportunities for educators, requiring them to utilize advanced information technology tools proficiently. Consequently, the continuous professional development of “Engineering Graphics” educators, preparing them to work in information-based educational environments, is essential.

Examining the challenges of the subject allows us to propose innovative solutions. The introduction of new teaching technologies in our educational system places significant responsibility on educators, requiring them to master modern information and pedagogical technologies thoroughly. Currently, the active implementation of computers and information-communication technologies in the learning process, especially during practical and laboratory sessions involving computer-based activities, the use of multimedia tools, virtual labs, interactive exercises, pedagogical software solutions, and the development of their usage methodologies form the foundation for practical implementation [3].

In today’s competitive world, the growing demand for teaching “Computer Graphics” as a subject has led to its application in various fields. Therefore, it is important to explore the methodological foundations of using computer technologies effectively and instill purposeful approaches to achieving results through their application in newly emerging fields. Pedagogical and psychological tools should also be applied and scientifically justified. The “Computer Graphics” discipline primarily focuses on working with drawings and images, which are vital in information technology.

Scientific and theoretical analysis has identified the main factors and sources for developing information-

methodical support for students’ academic activities based on corporate network technologies. Numerous pedagogical researchers have contributed to the integration of computer graphics software into the educational process. E.I. Mashbits, one of the pioneers in this field, emphasized that integrating computers into education is an irreversible process, requiring contributions from scientists, educators, and software developers. Researchers in Uzbekistan, such as U.Sh. Begimkulov, have also conducted significant studies on creating electronic resources for higher education, managing educational processes using these resources, and developing a unified information-educational environment.

The application of information and communication technologies in the educational process increases the quality of information exchange, enhances automation opportunities, and improves educational processes.

In engineering graphics classes, using modern graphic software, 3D modeling tools, and augmented and virtual reality technologies has become increasingly essential. These tools reinforce technical knowledge, enhance design and planning skills, and prepare students for successful careers.

To align higher education institutions with global standards, the following measures are crucial:

- Developing and integrating modern e-learning tools alongside traditional teaching methods,
- Supporting and advancing educational processes through ICT-based tools,
- Standardizing and certifying electronic educational resources, and

- Preparing highly competitive professionals capable of using ICT effectively.

By fostering a modern academic environment, higher education institutions can improve learning outcomes and prepare students for future challenges.

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