AMERICAN JOURNAL OF EDUCATION AND LEARNING
ISSN: 2996-5128 (online) | ResearchBib (IF) = 10.91 IMPACT FACTOR
Volume-4| Issue-1| 2026 Published: |30-01-2026|

TEACHING METHODS FOR THE COMPUTER GRAPHICS COURSE

https://doi.org/10.5281/zenodo.18441890

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Abstract

The article is devoted to the development of an effective methodology for teaching the course “Computer Graphics” using the AutoCAD software package. Current trends in engineering graphics education are examined, and the needs of students in mastering modern computer-aided design tools are identified. The authors propose an innovative approach that combines traditional teaching methods with elements of project-based learning and the use of interactive technologies. The results of an experimental study are presented, confirming the improvement in students’ professional competencies through the implementation of the proposed methodology. Particular attention is paid to the development of students’ creative abilities and the formation of readiness to apply the acquired knowledge in practical activities.

Keywords

computer graphics, AutoCAD, engineering graphics, teaching methodology, project-based learning, interactive technologies, professional competencies, creative abilities

Introduction

Modern conditions require constant updating of educational standards and teaching methods for the discipline "Computer Graphics," as the ability to effectively use professional computer-aided design tools is becoming a requirement for many professions. One of the key programs in this area is AutoCAD, which offers a wide range of capabilities for automating drawing and modeling processes.

However, the traditional education system often faces several challenges: insufficient student engagement, low motivation, and a lack of practical skills necessary for successful project implementation. Therefore, there is a need to find innovative solutions aimed at improving the quality of the educational process.

The purpose of this study was to identify effective ways to improve the teaching effectiveness of the "Computer Graphics" course using AutoCAD by integrating interactive technologies and project-based learning methods. The study was based on an analysis of best practices at Russian and international universities, a series of experiments, and student surveys.

Therefore, the study's objectives include:

- studying the characteristics and benefits of using interactive technologies in the educational process;

- developing recommendations for organizing educational and methodological support for the course;

- assessing the impact of the implemented methods on the quality of education and the development of students' professional competencies.

The relevance of this topic stems from the need to adapt curricula to the new realities of the labor market, increasing employer demands for the qualifications of graduates in technical fields, and the development of the digital space.

Review of sources

An analysis of the experience of predecessors in training computer specialists reveals the rich legacy of scientific thought accumulated by domestic and international researchers. This aspect has received significant coverage in numerous scientific publications, monographs, and dissertations, demonstrating the scientific community's keen interest in improving teaching methods in IT disciplines. Numerous scientists and educators have been developing new approaches, methodologies, and technologies aimed at improving the quality of professional education and training qualified personnel for the information sector.

Let's consider the most significant authors and their contributions to the development of this field.

In his article "Modern Approaches to Teaching Computer Science in Universities," A.N. Vasiliev examines current trends in the development of educational technologies and proposes models for implementing active learning approaches into the educational process. Vasiliev emphasizes the importance of integrating information and communication technologies into the educational process. [1]

In their work "Using Interactive Methods in Teaching Computer Literacy to Students in Technical Specialties," authors N.A. Petrova and R.V. Petukhov examine the use of interactive methods in detail and highlight their effectiveness in developing students' practical skills. They offer specific recommendations for implementing interactive approaches in teaching practices [2].

In his works, Yu. F. Zorin explores the specifics of teaching computer science at technical universities and proposes a system of measures to improve the quality of education. His work, "Computer Science at a Technical University: Teaching Methods and Organizing Students' Independent Work," places particular emphasis on developing students' creative abilities [3].

O. B. Ivanov's work, "Pedagogical Design of Computer Science and ICT Curriculums," focuses on the design of effective curricula that address the needs of the modern labor market. Ivanov identifies key competencies required by university graduates in the digital economy [4].

In her work "Development and Implementation of Innovative Pedagogical Technologies in Information Technology Education," E.I. Romanova substantiates the need for continuous updating of educational content and the development of new teaching methods. She presents the concept of an innovative approach to developing the professional competencies of future specialists [5].

Thus, the authors in question made a significant contribution to the development of modern methods of teaching computer disciplines, proposing new approaches and strategies aimed at increasing the effectiveness of the educational process.

Main Part. Methodology.

Analysis of existing teaching methods for computer science subjects.

Teaching computer science involves the use of a variety of methods, each with its own specific uses and areas of application. To analyze these methods, it's helpful to classify them based on the organization of the learning process, the methods of information transfer, and the level of student independence.

Forms of organization of the educational process

1. Traditional Methods

These methods include lectures, practical classes, and laboratory work. Their distinctive feature is the passive role of students, who absorb information primarily through listening and observation. For example, Professor A.P. Soloviev notes that traditional forms of education remain popular due to their simplicity and accessibility [6].

2. Active Methods

These methods involve students' active participation in the learning process. This includes project-based learning, case studies, game-based learning, and research projects. These methods promote the development of critical thinking and the ability to solve non-standard problems. According to Doctor of Pedagogical Sciences T.S. Borisova, active methods enable better learning and the development of professional skills [7].

3. Interactive Methods

Interactive methods are based on interaction between teachers and students, as well as between students themselves. Examples include discussions, debates, group work, and roundtable discussions. These methods encourage communication skills and the ability to argue one's position. Authoritative expert V.G. Zaitsev emphasizes that interactive methods are particularly effective in modern education because they help students adapt to the professional environment [8].

Methods of transmitting information

1. Information-receptive methods

These methods are characterized by the transfer of existing knowledge from teacher to student. Among them, the explanatory-illustrative method and the visual method stand out. Instructor I.M. Krasnov believes that receptive methods are important for developing the theoretical knowledge base necessary for further in-depth study of the subject [9].

2. Problem-searching methods

These methods focus on students posing problems and finding solutions, either independently or collaboratively with the teacher. These methods incorporate a heuristic approach and research. Didactics expert O.L. Alekseeva believes that problem-based learning methods promote a deep understanding of the material and develop students' creativity [10].

Level of student independence

1. Methods implemented by the teacher

Here, traditional lectures and seminars organized by the instructor predominate. Students gain knowledge and skills directly from their mentor. Learning takes place within a scheduled class schedule.

2. Independent work of students

This level involves completing assignments outside of class hours, including self-study, writing term papers and theses, and conducting research. According to Dr. N.K. Kuznetsov, a psychologist, independent work promotes personal growth and professional development in future specialists [11].

Thus, existing teaching methods for computer science courses are diverse and focused on solving various educational problems. The specific approach chosen is determined by the course objectives, the students' level of preparation, and the specifics of the curriculum.

However, engaging students in the creative process through visualization is particularly important when learning AutoCAD. Working with graphical models

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allows students not only to master technical operations but also to integrate knowledge from various fields—architecture, design, and engineering. This interdisciplinary approach develops a holistic understanding of design in students, where artistic ideas are combined with structural and technological solutions. Visualization becomes a key tool that unites theory and practice, develops spatial thinking, stimulates interest in design, and develops the skills to independently find solutions to complex creative problems.

In the first stage of learning AutoCAD, students are asked to complete an assignment to create a simple geometric composition using basic 2D drawing tools. The purpose of the exercise is to introduce students to the program interface, the logic of constructing objects, and the principles of visual representation of graphic elements.

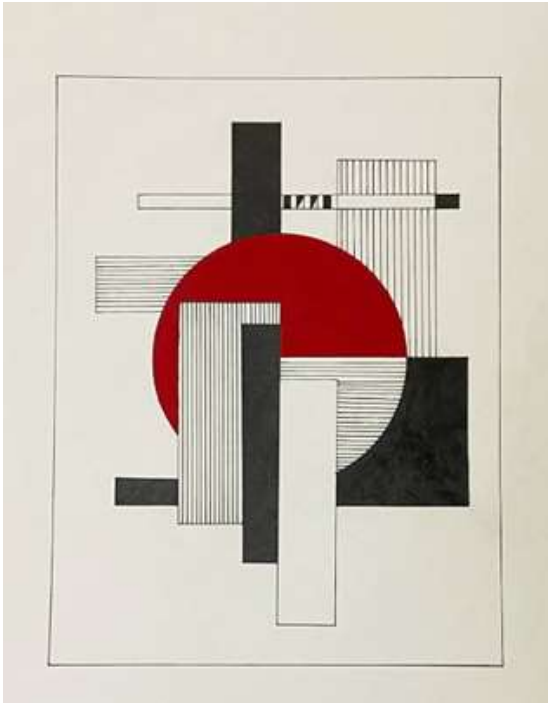

Fig. 1 Assignment for creating a composition

Exercise:

Create a simple composition of:

3-4 rectangles (of varying sizes),

1 circle (in the center or at the intersection), parallel paths,

fill and hatching, with varying line thicknesses.

The goal of the lesson is to learn how to use basic AutoCAD commands: **LINE, PLINE, CIRCLE, OFFSET, HATCH**, changing line thickness and filling.

As part of the assignment, students master the following commands: constructing line segments; creating polylines; constructing circles; creating parallel lines and contours; filling and hatching shapes; changing line thickness and object color.

The composition is built on simple shapes—rectangles, lines, and circles—using filling, hatching, and varying contour thickness. This allows students not

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only to master technical techniques but also to begin developing skills in visual thinking, spatial organization, and compositional balance.

The **Line** command in AutoCAD is used to create straight lines between two points. Here's a detailed description of the command and its use:

1. Start the command: Type LINE at the command prompt or use the Line button on the toolbar. Press Enter or left-click in the workspace.

2. Specify the first point: Type the coordinates of the first point at the command prompt or left-click in the workspace to specify the first point of the line.

3. Specify the second point: Type the coordinates of the second point at the command prompt or left-click in the workspace to specify the second point of the line.

4. Continue the line: After specifying the second point, AutoCAD prompts you to continue the line. You can specify the next point to continue the line or press Enter to end the command.

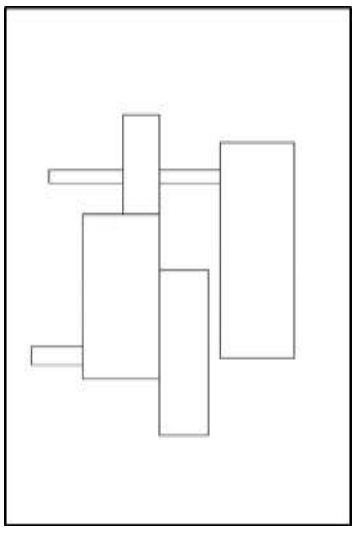
5. End the command: Press Enter or type C (for quit) at the command prompt to end the Line command.

Examples of use:

Example 1: Drawing a line using coordinates: Type LINE in the command line and press Enter; Enter the coordinates of the first point, for example, 0,0, and press Enter; Enter the coordinates of the second point, for example, 100,100, and press Enter; Press Enter to complete the command.

Example 2: Drawing a line using the mouse: Type LINE in the command line and press Enter; Left-click on the workspace to specify the first point; Move the cursor and left-click to specify the second point; Press Enter to complete the command.

Additional options:



- Undo last point: Enter U at the command prompt to undo the last point entered.

- Cancel entire command: Enter ESC or press the Esc key on your keyboard to cancel the entire command.

The Line command is one of the most basic and frequently used commands in AutoCAD, and mastering it is an important step for beginners.

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Fig. 2. Construction of simple rectangles using the (Line) command.

A similar composition can be created using the rectangle tool in **AutoCAD** (Fig. 2).

First, let's look at how to create a composition using rectangles in AutoCAD. Let's say we need to create a simple geometric composition consisting of rectangles of different sizes and orientations.

1. Creating the first rectangle

Use the **RECTANG** command to draw a rectangle. For example, enter the coordinates of the rectangle's lower-left corner and the dimensions of its sides:

Command: **RECTANG**

Specify first corner point or [Chamfer/Elevation/Fillet/Thickness/Width]: 0,0

Specify other corner point or [Dimensions]: @100,50

This will create a rectangle measuring 100 x 50 units.

2. Adding a Second Rectangle

Create a second rectangle using similar commands, but with different dimensions and position:

Command: **RECTANG**

Specify first corner point or [Chamfer/Elevation/Fillet/Thickness/Width]: 50,50

Specify other corner point or [Dimensions]: @80,-30

This rectangle will be positioned to the upper right of the first one.

3. Repeat the process for the remaining elements

Continue adding rectangles of different shapes and sizes, placing them in the desired locations in your drawing. Use the MOVE, ROTATE, and COPY commands to move, rotate, and copy objects, respectively. Using these commands, you can adjust the position and size of each rectangle to achieve the desired result.

Method 2: Using the PLINE command — manually using four points

1. Enter PLINE → Enter
2. Specify the first point (e.g., 100,100)
3. Enter the second point (e.g., 200,100)
4. Third point: 200,150
5. Fourth point: 100,150

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6. Close: Enter C → Enter (Close)

This method is useful if you need to control each side separately or create slanted rectangles.

To create a composition, you may need to draw parallel lines. Parallel lines and contours help organize the composition: create frames, double rectangle contours, stripes, and repeating elements with equal offsets. In AutoCAD, this is done quickly and accurately using the OFFSET command.

Basic method: OFFSET command

1. Run the command: OFFSET → Enter;

2. Specify the parallel distance:

• Action: Enter a numeric value (e.g., 10) → Enter.

3. Select the source object:

• Action: Click on the line, polyline, or rectangle from which you want to create the parallel.

4. Specify the offset side:

• Action: Click the cursor on the side where the parallel line/contour should appear (inward or outward).

• Result: An exact copy is created, parallel to the source object, at the specified distance.

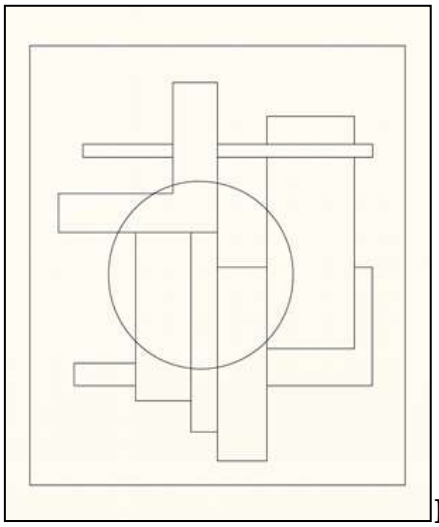

Fig.3 Adding a circle.

Drawing a Circle in AutoCAD (Fig. 3)

1. Launching the Command

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•In the command line, enter CIRCLE → Enter

or select the circle icon on the Draw toolbar.

2. Specifying the Circle's Center

•Mouse Click: Position the cursor and click the desired point.

•Precise Coordinate Input: You can enter the coordinates of the center, for example, 100,100 → Enter.

•Using Snaps (OSNAP): Enable Snaps (F3) and select Endpoint, Midpoint, or Intersection. Position the cursor over the intersection of lines or the midpoint of a segment → a marker will appear; click.

3. Specifying the Radius

•After selecting the center, the program will prompt you to specify the radius.

•Mouse Click: Move the cursor and click the desired point—the circle will be drawn.

•Precise Input: Enter a number, for example, 20 → Enter (radius 20 mm).

4. Alternative Construction Methods

•By two points of the diameter: Launch CIRCLE → select the 2P (Two Points) option; specify the first and second points, and the circle will be constructed using the diameter.

•By three points: Launch CIRCLE → select the 3P (Three Points) option; specify three points on the circle, and the program will construct it automatically.

•By center and diameter: Launch CIRCLE → select the D (Diameter) option; specify the center → then the length of the diameter (e.g., 40).

The next step of the task is to fill it with color using the command: HATCH.

Action: Select a fill type: Solid; click inside the closed shape; select a color (e.g., red or black)

Hint: Make sure the shape is closed, otherwise the fill won't work.

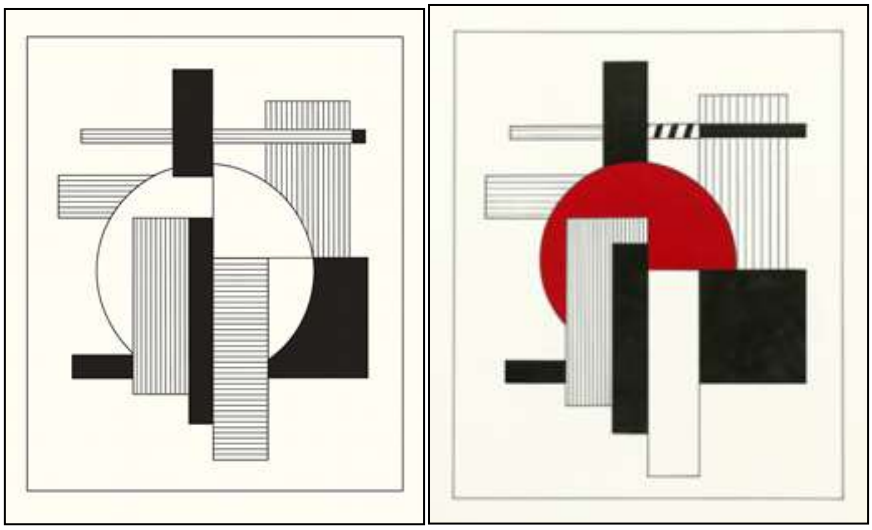

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Fig. 4.5. Executing shading. Filling with color.

In addition to the commands listed above, this composition uses the hatch command.

Command: HATCH: Select Type: ANSI31; set the angle (0° - horizontal, 90° - vertical); adjust the density (Scale: 1-5)

Hint: Use hatching for white shapes to show texture.

If necessary, you can use the line thickness command.

Command: PROPERTIES or CHPROP: Select the desired line; set the Lineweight (e.g., 0.30 mm for emphasis, 0.13 mm for thin lines)

Hint: Turn on the display of lineweights: LINEWEIGHT → Display Lineweight.

The next step is filling with color.

Command: HATCH

Action: Select Fill Type: Solid; Click inside a closed shape; Select a color (e.g., red or black)

Hint: Make sure the shape is closed, otherwise the fill will not work.

Conclusion

Simple lines created in AutoCAD are not only a basic graphic construction tool but also a foundation for developing the interdisciplinary thinking of future professionals. Each line in a composition carries a functional and aesthetic load: it sets direction, forms structure, and influences the perception of the overall image. It is important for students to understand that even elementary graphic objects become part of a complex system where technical precision is combined with artistic expressiveness.

Continuous practice with lines allows students to gradually move from the mechanical mastery of commands to the development of design thinking skills. Experiments with thickness, parallelism, and intersections develop the ability to see composition as an integration of various disciplines. In architecture, lines define structural axes and proportions; in design, rhythm and visual emphasis; in engineering, precision and technological reliability. Thus, the simplest graphic elements become a universal language uniting artistic and technical approaches.

Involving students in the process of constructing line-based compositions has important pedagogical significance. It fosters spatial imagination, develops skills in analyzing form and structure, and stimulates creative thinking. A line in AutoCAD is no longer just a drawing tool; it becomes a means of interdisciplinary interaction, allowing students to integrate knowledge from architecture, design, and

engineering into a unified design system. This approach fosters professional competence, where technical precision and artistic exploration complement each other.

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