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FACTORS FOR DEVELOPING STUDENTS' CREATIVITY IN TECHNICAL DRAWING CLASSES

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Abstract: This article analyzes the factors contributing to the development of students' creative thinking in technical drawing and engineering graphics classes, with particular attention to guiding students from standard design solutions toward independent and innovative approaches. The article presents methods for enhancing students' creative abilities while adhering to modern pedagogical technologies and the standards of the Unified System for Design Documentation (ESKD).

Keywords: interactive learning, teaching methods, problem-based learning, logical and spatial thinking, engineering design, design skills, visualization, visual aids, independent learning, creative tasks, spatial imagination, graphic representation.

In the rapidly developing era of technology and engineering, students specializing in engineering are required not only to read and reproduce ready-made technical drawings but also to generate new technical ideas and express them graphically. Technical drawing is one of the fundamental disciplines requiring spatial imagination and logical thinking, and it provides extensive opportunities for students to demonstrate their creative potential.

The main objective of modern engineering education is not only to provide students with ready-made technical knowledge but also to train specialists who are capable of finding independent and innovative solutions in non-standard situations. At higher educational institutions, the subjects of "Technical Drawing" and "Engineering and Computer Graphics" serve as a fundamental foundation for developing students' engineering thinking and spatial imagination.

Unfortunately, for many years, technical drawing classes have largely been based on reproducing ready-made drawings or mechanically following strictly defined algorithms. Such an approach limits students' independent creative potential. Today, when rapid technical design, modeling, and proper documentation in accordance with ESKD standards are increasingly required, investigating and implementing factors that foster students' creativity in technical drawing classes has become an important scientific and pedagogical problem.

The issues of developing students' spatial imagination and creative abilities in teaching graphic disciplines have been studied by many scholars, including A.D. Botvinnikov, I.S. Yakimanskaya, A.A. Rakhimov, and others. Research findings indicate that spatial imagination is not merely the ability to visualize the shape of an object, but also the ability to mentally perform dynamic operations on an object, such as rotating, cutting, and modifying its shape.

During the research, pedagogical observation, variant modeling of graphic problems, comparative analysis, and problem-based inquiry learning methods were employed. In assessing students' creativity, the degree to which they were able to develop non-standard design and graphic solutions to given tasks was used as a criterion.

The pedagogical experiment and analysis demonstrated that the development of students' creativity in technical drawing classes directly depends on several important factors. Replacing traditional assignments with creative tasks produces significant results. These include:

• **Optimization of an existing shape:** redesigning a given component to reduce its mass while maintaining its strength and manufacturability.

• **Restoring missing elements and constructing the third view:** determining the most compact and logically appropriate third view of an object based on two given views and applying complex sectional views where necessary.

• **Designing using tangencies and second-order curves:** independently designing smooth transitions and tangencies commonly encountered in technical fields such as aviation and automotive engineering.

Students' creative activity in technical drawing classes depends on several important factors:

1. Problem-based and challenging learning tasks

Instead of traditional "copying from a model," students should be given design problems with uncertain parameters or multiple possible solutions. For example, students may be asked to determine the third view of an object based on two given views and optimize its internal structure.

2. Developing spatial imagination and graphic thinking

Exercises aimed at quickly identifying relationships between two-dimensional views and three-dimensional spatial forms expand students' imaginative abilities. When working with complex surface intersections, second-order curves, and tangencies, the ability to visualize an object from different perspectives serves as a foundation for creative thinking.

3. Integration of modern CAD systems with traditional technical drawing

The use of computer graphics systems such as AutoCAD, KOMPAS-3D, and SolidWorks allows students to test several design alternatives within a short period of time. This helps redirect their time from routine drafting toward improving the form and construction of an object.

4. Finding independent solutions within ESKD standards

Creativity does not mean violating standards; rather, it means finding the most concise and comprehensible graphic solution within existing ESKD requirements, including rules governing line types, scales, sections, and cross-sections.

Examples of Creative Assignments

• **Redesigning an existing construction:** modifying the shape of a finished component to reduce its weight or improve its assembly characteristics and preparing the corresponding technical drawing.

• **Making graphic assignments variable:** providing each student with an individual graphic problem that does not have a single predetermined solution.

In this process, creativity means finding the optimal solution within established rules and constraints rather than violating those rules. Students should be given the freedom to select different graphic representations while complying with ESKD standards, including line types, scales, dimensioning rules, sections, and cross-sections. For example, when representing a particular component, students should independently determine which view should be selected as the main view and where a local section should be applied.

Increasing students' creativity in technical drawing and engineering graphics classes means transforming the educational process from merely providing theoretical knowledge into practical design and engineering activities. Problem-based tasks, flexible application of ESKD standards, and integration with CAD systems contribute to the development of students' independent engineering thinking. Systematic implementation of these factors in the educational process can significantly improve the quality of training competitive specialists who are capable of creating and implementing technical innovations.

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