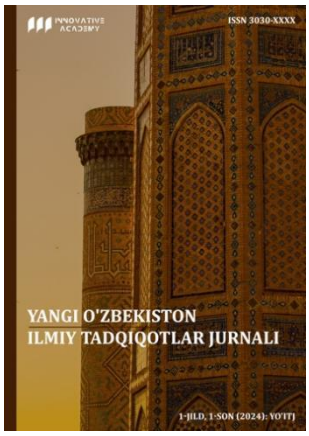

DEVELOPING STUDENTS' CREATIVE COMPETENCE THROUGH DESIGN TASKS IN TEACHING GEOMETRIC AND PROJECTION DRAWING

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ABSTRACT

This article examines the issues of developing students' creative competence in teaching geometric and projection drawing through design tasks. The role of geometric and projection drawing in the field of engineering graphics is analyzed, and the didactic significance of constructing complex models based on simple geometric solids is substantiated. It is demonstrated that teaching design tasks through real-life objects contributes to the development of students' spatial thinking, constructive analysis skills, and graphic literacy, and as a result, the growth of students' creative competencies is shown.

Introduction. The education system, grounded in the strategic directions of state policy, represents an integral and multi-tiered structure serving to train qualified specialists needed by society. The educational process in technical and engineering fields is particularly significant in that it aims not only to impart theoretical knowledge, but also to form practical design competencies. This is because all modern production, construction, and technological processes rely on design activity.

Geometric and projection drawing — one of the main components of engineering graphics — ensures students' readiness for future design work. Any object or structure is first formed as a graphic model. Therefore, applying design tasks in the teaching of drawing develops students' spatial imagination, thinking, and creative competence, teaches them to make independent decisions, and forms real engineering skills.

Educational activity is a purposeful teaching and upbringing process carried out to prepare an individual for effective work. The content of this process consists of systematically mastering the knowledge, skills, and abilities accumulated by humanity and transmitting them to subsequent generations.

In this study, educational activity was examined specifically as a means of developing students' spatial imagination, thinking, and creative competence in the process of teaching geometric and projection drawing. The main task of the drawing subject is not only to provide graphic knowledge, but also to develop the student's spatial imagination and thinking, to

direct independent thought, and to prepare for design activity. From this perspective, the research methodology relies on the principle of organizing the lesson process on the basis of design tasks in geometric and projection drawing — one of the main sections of the drawing subject. In particular, if the teacher does not creatively develop the educational process and does not generate new ideas and thoughts, students will only receive ready-made knowledge and remain limited to reproducing it — that is, they will rely solely on reproductive learning.
Geometric and projection drawing is one of the main sections of engineering graphics subjects. Tasks composed from these sections develop students' independent thinking ability, spatial imagination and thinking, and strengthen graphic literacy. Design tasks are an important tool for forming and consolidating the practical skills of this subject. Design tasks teach students to draw clearly and accurately, to read drawings correctly, and to graphically represent complex objects.

Constructing complex models (parts) from simple geometric solids. In engineering graphics and drawing subjects, every product or part is made from simple geometric shapes. Because any complex model is in fact a shape formed from the combination of several simple geometric solids. For example, new structural elements can be formed through combinations of basic solids such as cube, prism, cylinder, cone, and sphere. A new model is created by combining two or more geometric shapes. For instance, various parts are formed by combining cylinder with cylinder, cylinder with prism, cone with cube, or sphere with cylinder. Solids with hollow centers — such as a cone, prism, or cylinder — also fall within the two-element category (Figure 1).

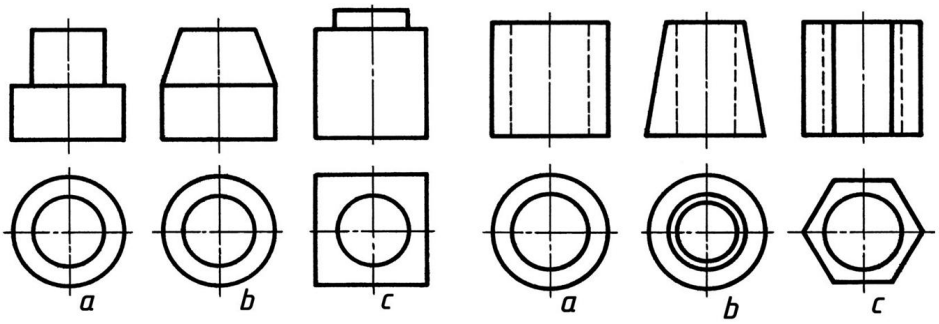

Figure 1

Topics such as constructing complex models from simple geometric solids, which are taught in the educational process, are in fact encountered very frequently in our daily lives. For example, every machine, building, and household item begins with simple shapes. Working with geometric shapes is not merely a school exercise — it is understanding how objects encountered in our daily life are created. For students, this process develops practical thinking, engineering skills, and a creative approach. For example, analyzing an object or producing such an object oneself. That is, skills such as imagining what geometric solids are hidden within an object by looking at it help solve many problems more easily in real life.

Girih patterns, which are frequently encountered in our lives, are decorative shapes constructed on the basis of precise geometric laws and drawing methods. In the process of drawing girih, geometric elements and shapes related to geometric drawing — arcs, circles, straight lines, polygons — are used.

It would not be an exaggeration to say that girih is a complex decorative pattern system formed by continuously connected lines based on geometry. Girih patterns are most often used in Islamic architecture. Although a pattern may appear simple at first glance, it is drawn in accordance with a certain regularity from the combination of very complex geometric shapes (Figure 2).

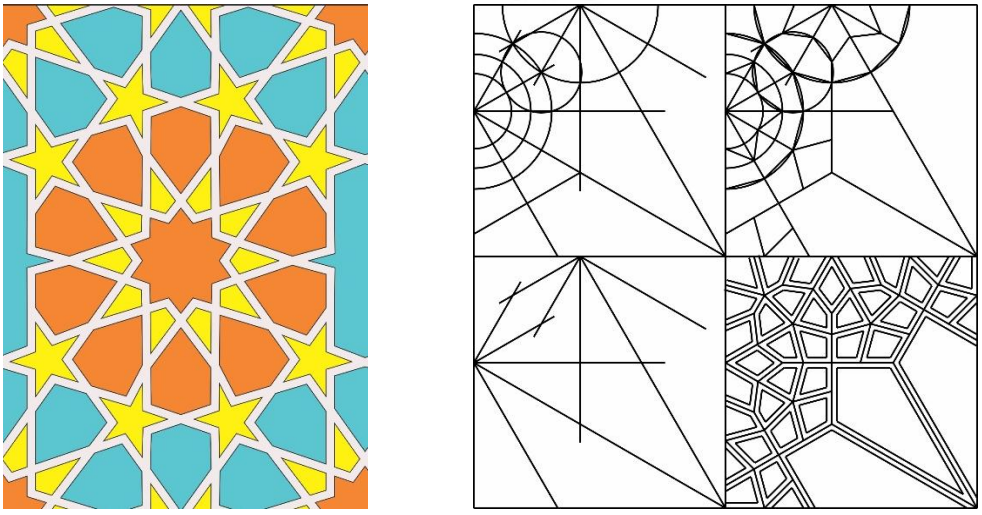

Figure 2

Developing students' cognitive activity in the drawing subject is one of the most important tasks of the educational process. In this regard, it is first necessary to involve students in solving various problems, to increase their interest in completing tasks, and to develop educational activity to a certain extent. Because any process of acquiring knowledge is not limited to simple reception and memorization, but also requires mental processes such as independent thinking, analysis, comparison, and drawing conclusions. For this reason, if students are involved in solving problems from the very first stage, they gradually learn to independently seek knowledge, find new ways, and approach creatively. At subsequent stages, it becomes necessary to deepen the activity and initiative of their independent thinking and to strengthen the creative approach. This process proceeds more effectively when organized by the teacher on the basis of a carefully considered methodological approach, rather than spontaneously.

In the process of learning design, as the teacher solves a number of creative tasks together with students, their spatial competence begins to form. For this, it is required to engage in making various devices and to rework some roughly made objects in a neat and economically efficient manner. For this, it is necessary to make changes to their shape. This is called partial geometric redesign of an object (Figure 3).

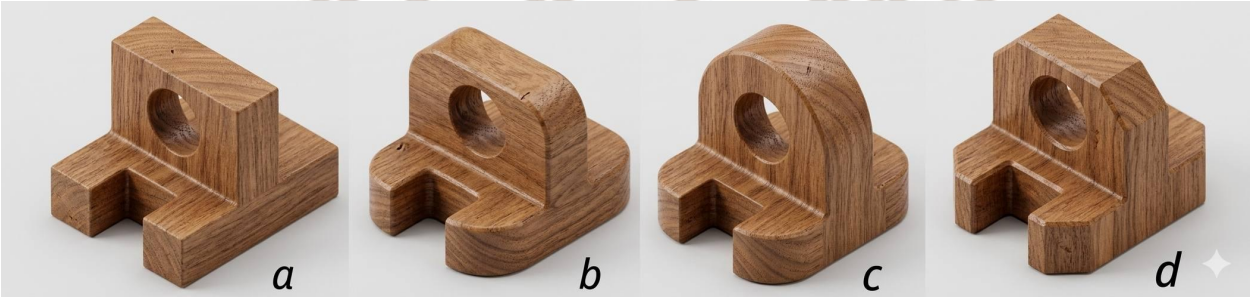

Figure 3

If the change made to a part is realized through a drawing, it is called ***creative redesign of the drawing***. Mentally changing the shape of a part and imagining its creatively redesigned state develops flexibility of thinking. By introducing creative design elements into a drawing, various problems can be solved.

As noted above, not only tasks such as partial geometric redesign of an object, but also design tasks in projection drawing differ from other tasks in their variety and in the fact that their solutions are also diverse. In fact, the very difference of design tasks lies in their multiple-solution nature. Teachers should make effective use of such tasks during lesson processes.

Let us now present a few examples of such tasks.

Problem 1. Three holes and the isometric view of a cube are given. Design the cube such that a part that passes tightly through all three holes is formed (Figure 4).

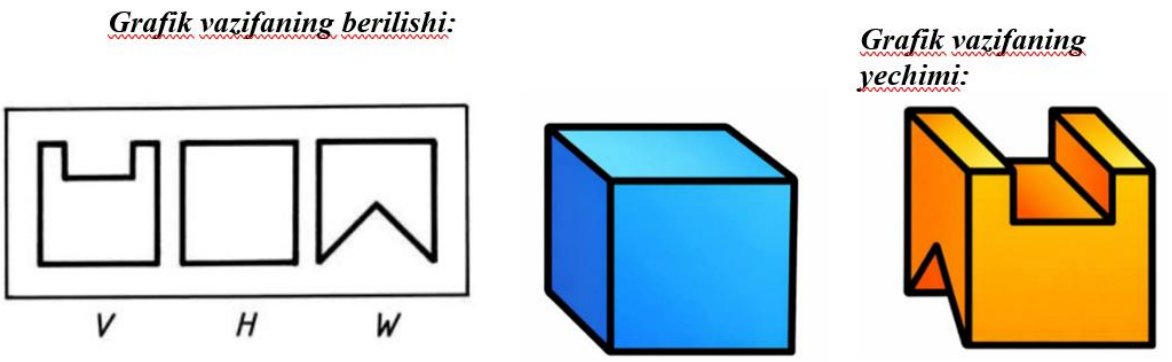

Figure 4

Problem 2. Mentally (imaginatively) place the hatched side of the part parallel to the horizontal projection plane. In Figure 5,b the answer to this drawing is shown — drawn parallel to the horizontal projection plane. In simple terms, the part is shown rotated through spatial visualization (Figure 5).

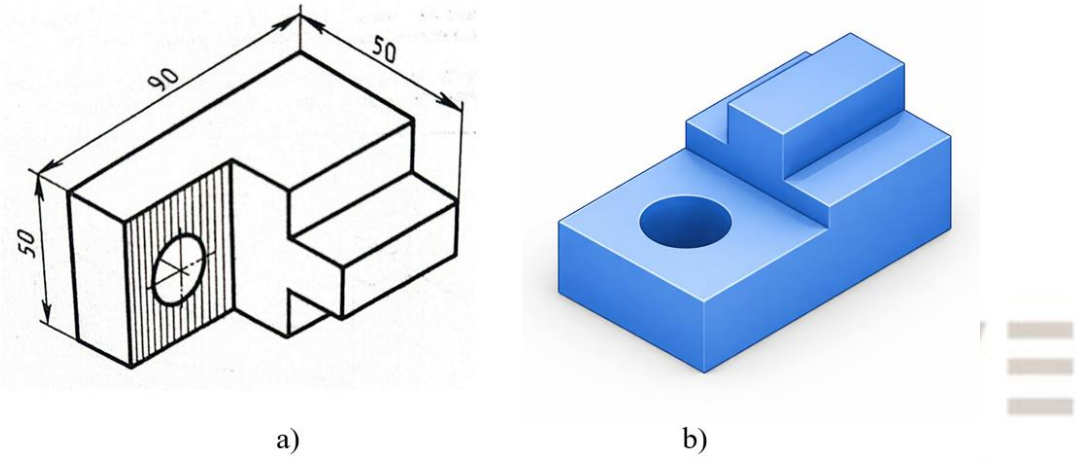

Figure 5

When new objects are being invented or existing ones are being improved, if the answer is two or more — that is, multi-variant — then the problem is considered creative. When a designer encounters such a multi-variant solution in the design process, they engage their highest level — creative activity — and select the most optimal variant taking into account the conditions of technical, technological, and economic problems. In this way, they achieve their goal through various graphic representations.

Conclusion. The results of this research show that geometric and projection drawing forms the theoretical and practical foundation of engineering graphics, and through design tasks, develops students' spatial imagination, logical thinking, and graphic literacy. The process of constructing complex models from simple geometric solids forms students' skills of constructive analysis, decomposing an object's structure into elements, and recombining them.

The analyses show that teaching design tasks in connection with real-life objects and constructive solutions increases educational effectiveness. Additionally, practical examples based on precise geometric laws, such as girih patterns, reveal not only the technical, but also the aesthetic and cultural significance of the drawing subject.

In general, it was determined that teaching design tasks systematically, step by step, and based on real-life examples is an effective methodological approach in forming students' spatial competencies.

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