Original Article

Organization of effective use of the AutoCAD feature in teaching descriptive geometry

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Abstract

The paper considers the development of educational programs in the field of descriptive geometry and the organization of teaching in accordance with modern requirements. When developing new curriculums, the topics of design methods in traditional curriculums (the Monge method, projections of points, lines and planes) were placed after the topics about geometric objects. The topics of the curriculum are related to geometric objects (cube, prism, pyramid, cylinder, cone). The main purpose of this is to form ideas about geometric objects among students who are very poorly versed in descriptive geometry. Students form and develop spatial imagination, creating three-dimensional images of simple geometric objects (cube, prism, pyramid, cylinder, cone, inclined cylinder, inclined cone). At the same time, students develop skills of working with computer graphics programs. As a result of the development of curriculums and the introduction of three-dimensional virtual models in AutoCAD, students' interest in graphic geometry and the quality of assimilation indicators has increased.

1 INTRODUCTION

As a result of the development of computer technologies, teaching descriptive geometry in the traditional way has become ineffective. Therefore, the teaching of descriptive geometry requires reform and the use of innovative technologies. Many researchers note that the effective combination of the use of traditional methods and modern technologies of teaching descriptive geometry leads to a significant increase in students' academic performance.

In particular, the research work of A. Kakhkharov [7], D. K. Alimova, V. N. Karimova[1], A. Khamrakulov [4,5,6,8,9,10,11], I. V. Prokofieva, S. G. Demidov [3], Farid Nassery[12], I. Borivikov, G. Ivanov, I. Prokofieva, S. Demidov, K. L. Chernotalova [2] , Marianna V. Voronina, Zlata O. Tretyakova [13], A. Y. Goryachkina, I. A. Goryunova, O. M. Koryagina [14] is devoted to the use of computer technologies in teaching descriptive geometry, the use of innovative teaching methods and teaching reform.

In his research, A. Khamrakulov mainly used computer technology in teaching descriptive geometry as a teaching tool. C. Shokirova - on the determination of students' knowledge using computer tests, N. Yadgorov - on the formation of students' spatial imagination using computer technologies, A. Kakhkharov's research work [7] - on the development of students' spatial imagination using computer technologies (3D).

In the study of A. Kakhkharov, the spatial imagination of students was formed using 2D and 3D computer graphics programs. He also planned to develop the creative activity of students by changing the appearance of geometric objects using computer graphics programs in teaching descriptive geometry.

2 Materials and Methods

Reforming the teaching of graphic geometry and engineering graphics has become an urgent topic of the day. When reforming the teaching of natural sciences, first of all, its curriculum were restructured. That is, the traditional curriculums that have remained unchanged for 20 years have been reworked. When developing new curriculums, the topics of design methods in traditional curriculums (the Monge method, projections of points, lines and planes) were placed after the topics about geometric objects. The topics of the curriculum are related to geometric objects (cube, prism, pyramid, cylinder, cone). For example: prisms and pyramids can be shown straight lines in general and special cases, the mutual arrangement of straight lines, ways to define a plane, planes in general and special cases, the mutual arrangement of planes, the mutual arrangement of straight lines and planes.

In the teaching of descriptive geometry, first of all, the concepts of geometric objects and their formation were given, and not methods of projection. From the very first lesson, descriptive geometry was connected with practice. The lessons were conducted using models of cubes, prisms, pyramids and computer equipment. Students were given models, and they could rotate them from all sides. Then their formation was shown in the AutoCAD graphic program. In this program, viewing geometric objects from different angles in four windows on the "VID" toolbar positively influenced the development of students' spatial imagination (fig. 1).

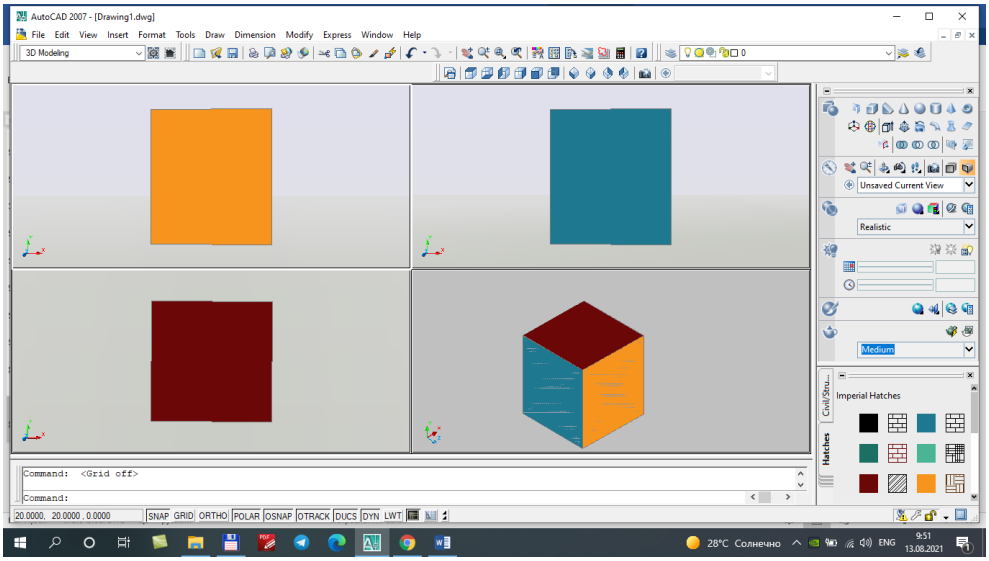

Fig. 1. A prism at different angles in four windows.

The main purpose of this is to form ideas about geometric objects among students who are very poorly versed in descriptive geometry. Students form and develop spatial imagination, creating three-dimensional images of simple geometric objects (cube, prism, pyramid, cylinder, cone, inclined cylinder, inclined cone). At the same time, students develop skills of working with computer graphics programs.

In traditional orthogonal projection training programs (the Monge method), only the point projection is displayed on the point projection, while in the new teaching program, the projection of the intersection point of the sides of the cube is set together with the projection of the point (fig. 2).

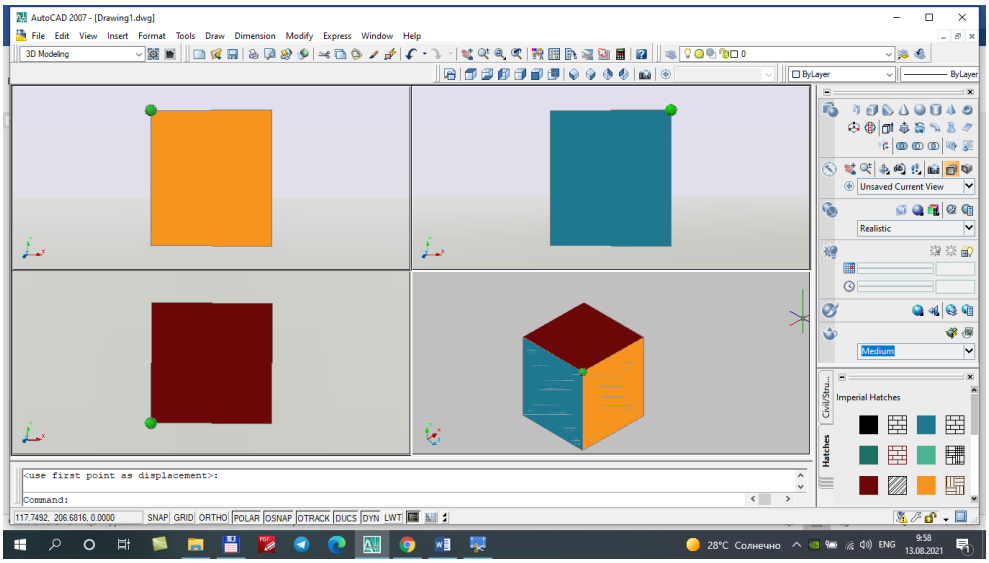

Fig.2. Projection of the point.

The edges of a cube can be considered as a special case of a straight line and a projecting straight line. It is also possible to explain the sides as planes and the opposite sides as mutually parallel planes.

In addition, the particular position of the plane will be the base of the pyramid, and the general position will be the side of the pyramid. The base and sides of the pyramid can be studied as the mutual positions of the plane.

The edges of the pyramid are shown in a straight line with red colors (fig. 3). The edges of the pyramid can be represented as a straight line in the general case, and the perimeter of the base as a straight line in the special case. If the base of the pyramid is a rectangle, the opposite sides of the base are two straight lines parallel to each other. However, the adjacent sides of the base will be perpendicular to each other.

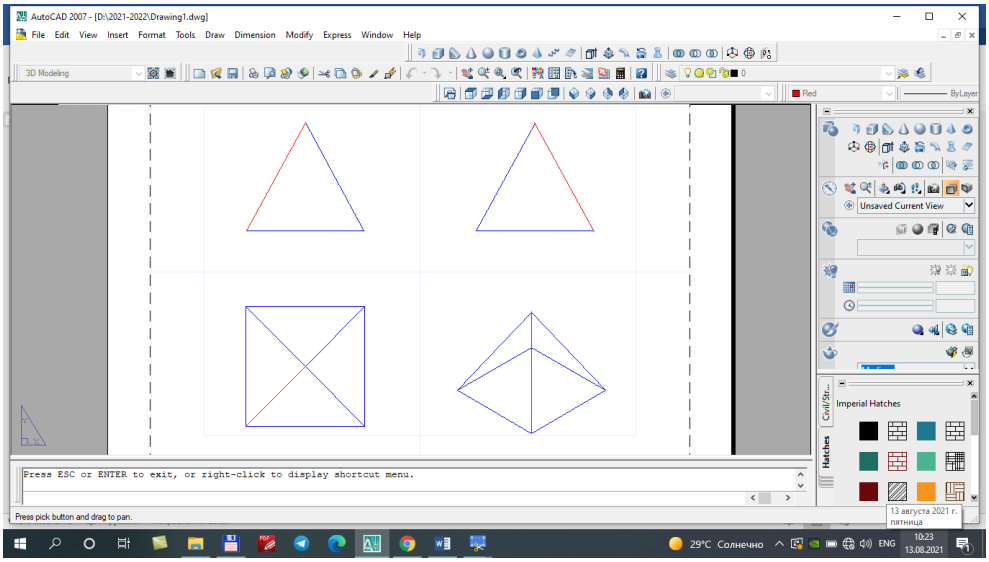

Fig. 3. The projection of the straight line is shown by the example of the length of the edges of the pyramid.

The sides of a cube, a prism, a pyramid, the bases of a cylinder and a cone can be shown as planes. The bases of the pyramid are shown as planes (fig. 4.)

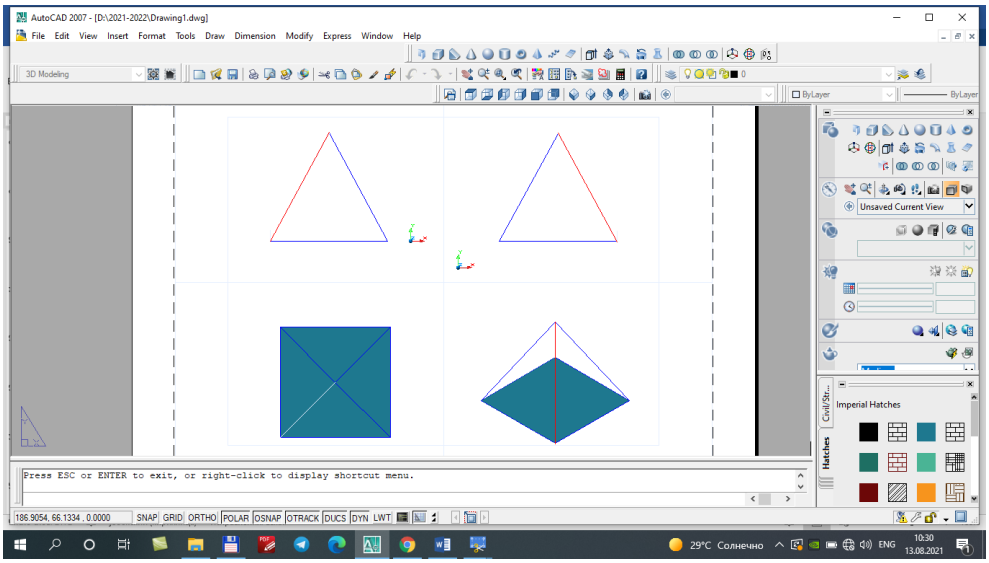

Fig. 4. The projection of the plane is shown by the example of the base of the pyramid.

The base of the pyramid can be recognized as a particular position of the plane, the side-as the general position of the plane, the sides of which are intersect planes. In the same way, it can be shown that the sides of the prism, the base of which is a rectangle, are two parallel planes.

As for the methods of converting drawings, prisms, pyramids, cones, cylinders were also presented as tasks and examples.

This structure of curriculums demonstrates the interdependence of disciplines and practices.

Computer graphics can create two types of images: static (in Microsoft Power Point, Microsoft Word, etc.) and dynamic (AutoCAD, 3D MAX, Corel Draw). Demonstrating the problems of drawing in Microsoft Power Point, Microsoft Word, the teacher develops the skills of reproductive (spatial imagination) thinking in students. That is, students can solve their problems based on ready-made problem samples. Demonstration of spatial problem solving in AutoCAD, 3D MAX, Corel Draw programs allows students to quickly develop skills in partially creative (spatial thinking) and creative thinking.

The use of computer graphics in teaching engineering graphics is recommended in the following cases:

• in showing spatial solutions to problems;

• when unfolding surfaces;

• when creating spatial curves;

• when defining lines of intersection of surfaces;

• in the construction of axonometric projections;

• for section and cuts;

• when constructing a third projection and a technical drawing based on the given two projections of the part;

• when creating a sketch of a part and its technical drawing;

• when working with assembly drawings, their reading and detailing.

The use of computer graphics by the teacher during the transition to these topics ensures the effectiveness of the lesson. During the lecture, the teacher can use pre-prepared electronic lecture texts, methodological recommendations. During a brief explanation of the topic and after students are given frontal or individual assignments, some of them are performed by the teacher in graphics programs (AutoCAD, 3D MAX, Corel Draw), which develop students' spatial thinking skills and interest in science.

3 CONCLUSIONS

We all know that there is an opinion among students that descriptive geometry is difficult. A student who is well versed in mathematics also has difficulties solving problems in descriptive geometry. They can only work with standard tasks, depending on the model. This is due to the fact that the student has not formed a spatial imagination. Suddenly, when passing the methods of projection, points, lines, plane projections, the student asks himself why they are needed. The projection of a point, a straight line, a plane on a geometric object , is the answer to the question. By this time, the student has formed a spatial imagination. Then he can visualize and solve complex tasks of descriptive geometry. As a result, students' interest in the study of natural sciences increased and the development of spatial imagination accelerated. In general, the connection of disciplines with practice had a positive effect on the mastery of disciplines.

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