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A TOOL FOR SOLVING PROBLEMS OF DESCRIPTIVE GEOMETRY FROM THE SECTION "POINT, LINE, PLANE" AND THEIR VERIFICATION

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Abstract
The article analyzes the problems of organizing activity-based geometrical graphic teaching and control. The experience of creating geometrical editor for solving some tasks of descriptive geometry and automatic checking the correctness of their solutions are presented.

Keywords: descriptive geometry, problem solving, computer checking.

Introduction

During the course of geometrical and graphical disciplines a first-year student should acquire theoretical knowledge new for him/herself and acquire a variety of practical skills, for example, only in descriptive geometry it is required to study projective modeling, geometrical transformations, formation of surfaces, etc.

In the conditions of reduction in the number of hours, first of all, class hours, a considerable part of work is forced to be done by the student independently, but low level of school geometry-graphic training (GGP) leads to actual inability of the student to assess and improve the quality of independent activity, which leads to reduction in the quality of GGP as a whole [1, 2]. At present, the possibility of improving the quality

of GCP is associated with the use of information technologies [2-5], which provide "visualization" of educational materials (animations, presentations, and three-dimensional models) and perform express-control of the obtained knowledge (computer-based testing). The experience of teaching at IHEU shows that these measures are not enough: students perceive "visual" materials well and successfully cope with tests, but experience difficulties when applying knowledge in practice, because visual demonstrations and controlling questions do not perform the function of control of the acquired skills.

Acquisition of skills is associated with the solution of practical tasks and assignments of the course. Verification of the correctness of solutions to problems is currently performed by the teacher. To compensate for the shortcomings of school education and the reduction of class hours can only increase the number and quality of independently solved problems. For comparison, the problem books on descriptive geometry (DG) by V.O. Gordon, S.A. Frolov, etc. (published under conditions of sufficient school education) can be used. (published in conditions of sufficient school education) contain hundreds of problems - the present students solve less than a hundred. But the number of tasks and assignments that a teacher can check and point out errors without reducing the quality of checking is limited. It becomes urgent to create technical means of computer verification of solutions of graphic tasks and assignments, to ensure their accessibility during independent work, to develop methods of their application. The need to create a geometric editor is explained by the fact that in the first classes students are not ready to solve problems using CAD editors.

Let's consider the creation of means of computer verification of graphical problems on the example of positional problems of NG course from the section "Point, line, plane".

The objects for solving such problems (modeling objects) are points, lines and planes of three-dimensional Euclidean space. The representation of solutions in computer memory is constructive geometric models (CGM) of solutions - sets of named elements described by sets of parameters and attributes [6]. And modeling can be performed directly (elements are three-dimensional figures) or according to projection modeling rules (elements are projections - two-dimensional figures). In the first case conditions of solution correctness are set in terms of space objects ("point on a straight line", "straight line perpendicular to the plane" etc.), in the second case - in terms of drawing objects. Since the section "Point, line, plane" is the first in the NG course, preference is given to the first option, - the geometric editor takes over the actions of marking and arrangement of elements in the drawing in accordance with

the spatial properties of the modeled objects, checks the compatibility of pairs of projections. Since the solution model is three-dimensional, it also becomes possible to display it at all stages of the solution both as a drawing and as a visual interactive image (NI).

The problem is solved by consecutive geometrical constructions. The constructions are represented by a set of commands on the toolbar. As a result of the construction (command execution) a new element is placed in KGM, the geometrical parameters of which correspond to the relations (belonging, parallelism, etc.), in which this element is with the original ones. Constructions can meet: 1) spatial relations (e.g., perpendicularity of straight lines and planes in space); 2) planar relations (e.g., perpendicularity of straight lines in a drawing); 3) imitation of drawing tools (ruler, compass, angle). The first option is not suitable for NG problems because not all spatial relations are clearly represented in the drawing.

The third variant is convenient because it requires a small number of commands (by the number of tools), but requires special techniques to use when solving problems. An intermediate variant was chosen - a set of constructions/commands is made on the basis of the second approach and supplemented with elements of the other two: a drawing point (projection) on the intersection of lines of the drawing; projection of a point on a line of the drawing along the line of communication; a line/ segment of space or drawing through a pair of points; a line of space or drawing parallel to the given one; a line of the drawing perpendicular to the given one; a vertical/horizontal ruler, etc.

Conditions of solution correctness are coded with the help of the reference CGM which allows taking into account: exact correspondence of the parameters of the spatial figure (correctly constructed object), presence of groups (correctly constructed two or more objects), possibility of alternative solutions (correctly constructed one of the required sets), presence of geometrical conditions (the required object is not defined, but a set of conditions is given).

The above principles have been implemented in the creation of the geometrical editor with functions of checking solutions of problems from the section "Point, line, plane". The editor provides an opportunity to choose a task from the list (more than 50 tasks), displays the current state of the model in the form of the drawing and the NI (Figure 1), provides an opportunity to perform constructions (parameters are set in the dialog window), at each step performs a check and reports if the solution is built, forms a hint - a list of objects that remain to be built.

For independent work the portable version of the editor is used, it does not have its own storage of tasks, but connects to the storage on the Internet. This approach allows

you to expand the database of assignments simultaneously for all copies of the editor. Local (or network) copies of the editor with a strictly defined set of tasks can be created for quizzes.

The full set of programs includes an editor with checking functions for students, an assignment editor for the teacher and a module for managing the task repository.

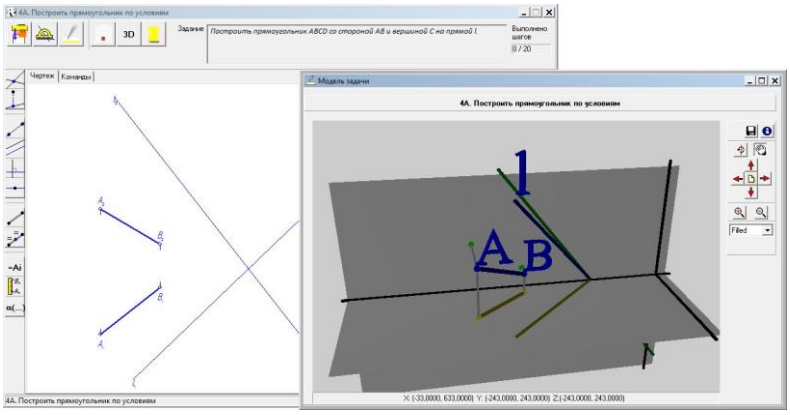

Fig 1. Geometric editor interface

Thus, the created technical tool allows you to perform the solution of problems and their checking, as well as provide the availability of checking for independent work. Currently, research is being conducted to create an effective method of using the editor in the learning process: you need to make suitable sets of problems, clarify the wording of problem conditions and hints, to ensure the ease of mastering the methods of working with the editor and the possibility of accumulating statistical data. For computer support of other sections of the course of graphic disciplines the development of appropriate means of computer check [6] is conducted.

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