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Informatization of Engineering Graphics Education when Studying Engineering Graphics

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Annotation. This article examines the content of graphic education at different stages of education. Graphic education is a process as a result of which a person acquires the ability to perceive, create, save and transmit various graphic information about objects. By processes of phenomena, we will analyze the sequence of the formation of skills in working with graphic models of objects in the process of preparing for engineering activities at the stages of school and university.

Keywords: academic discipline, image of an object, formation, acquisition of skills, drawing, spatial object, graphic education, design document, modern graphic package, automatic design system, graphic information, pencil and paper technology, computer literacy, graphic package KOMPAS 3D, descriptive geometry , graphics engineering, graphic construction.

In a general education school, such academic disciplines as drawing, geometry and drawing can be considered responsible for the formation of skills in working with graphic models of objects. The study of each discipline has specific goals. Drawing is more aimed at acquiring the skills of realistic depiction of objects. Planimetry and stereometry as sections of geometry are intended, respectively, to form the ability to work with images of flat geometric and simple spatial objects in their arbitrary parallel and central projections. The purpose of studying drawing is to acquire the skills of reading and drawing design - a flat orthogonal projection model of a spatial object on mutually perpendicular planes.

Further graphic education is acquired at a vocational school.
In a technical university, engineering and graphic education, as well as at school, is responsible for many academic disciplines, but its foundations are formed in the study of descriptive geometry and engineering graphics.
Traditionally, the study of these disciplines is aimed at developing the skills of perception and creation of a design document - a drawing as one of the types of engineering graphic information.

Graphic engineering education is aimed at developing the skills of working with the most difficult, from the point of view of human perception, image of an object - a projection drawing containing numerous conventions and simplifications. The technical difficulties in creating such an image contributed to the development of automation tools for design and construction work, and the pinnacle of this process was the emergence of modern graphic packages. The evolution of the instrumental capabilities of computer-aided design systems took place in the opposite direction to the stages of graphic education: from using a computer as a tool for constructing a two-dimensional drawing of a product through a three-dimensional geometric model to an information virtual model.

The development of hardware and software for working with graphic information has led to the fact that the computer has become the main tool for creating, storing and processing images. If we analyze the types of graphic information that are used in engineering to implement information support for the life cycle of a product from conception to disposal, then at each stage

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various types of electronic documents will be relevant. Among them are such as traditional project documentation, information virtual model of the product and presentation information. In this regard, graphic education at a technical university should be aimed at the formation of a specialist who owns modern means of presenting information.

The main arguments in favor of the use of pencil-paper technology in engineering graphic education, such as low computer literacy of students and technical equipment, have lost their relevance. Computer literacy of applicants is getting higher every year.It should be noted that already today applicants with the skills of working with graphic packages are entering universities. This, in particular, was facilitated by the decision of ASKON to provide schools with the KOMPAS 3D graphic package. The result was not long in coming, which is confirmed by the dynamics of participation in the regional competition for the computer design of the drawing, held among students of educational institutions. So, if in 2007, 2008, before the implementation of the project, schoolchildren from only four educational institutions in AutoCAD took part in the competition, then in 2009 - from two educational institutions in AutoCAD and from seven schools, lyceums and gymnasiums, then in now there are also secondary schools. Thus, it can be assumed that in the coming years, the possession of the KOMPAS 3D graphics package by applicants of technical universities will become a fairly widespread phenomenon.

Descriptive Geometry is the general professional discipline that begins graphic engineering education in higher education. For its successful study, the student must have the skills of performing the simplest geometric constructions and a certain level of development of spatial imagination. At the same time, it can be noted that a significant part of the problems that arise when solving problems of descriptive geometry is precisely the lack of skills in working with traditional drawing tools and graphics packages. Skills in working with drawing tools must be acquired before entering a higher educational institution, and the basics of computer graphics and computer-aided design as university disciplines designed to teach computer tools for creating and processing images are studied in senior courses.

Despite the fact that the work program of the academic discipline "Descriptive Geometry" does not provide time for teaching a student to use a drawing tool, objective reality requires developing the skills of performing the simplest graphic constructions in the process of studying descriptive geometry, which is not the purpose of studying the subject. Today, it is easier and faster to teach a student to perform graphic constructions using computer programs than to perform a high-quality drawing with traditional drawing tools. At the same time, the motivation for studying a subject that is difficult for students to perceive is growing, since in the process of studying the skills of using modern information technologies in engineering are acquired.

Descriptive geometry is a section of geometry in which spatial figures, as well as methods for solving and studying spatial problems, are studied using their images on the projection plane.To perform graphic constructions on the projection plane, you can use KOMPAS-graphic, which is a system for automating drawing works in their traditional sense. Paper is replaced by a two-dimensional workspace, and instead of drawing tools, a set of commands is used to perform graphic constructions. The use of pencil and paper technology for geometric constructions in conditions when such a drawing device, like a drawing board, in universities can only be found as a museum exhibit, and for drawing parallel and perpendicular lines, a flight bus is used at best, and most often a set of triangles leads to a sharp drop in the accuracy of graphic constructions. As a result, students' understanding and adherence to algorithms for solving positional and metric

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problems of descriptive geometry ceases to be a determining factor in the correctness of the task, but on the contrary, it can cause uncertainty in understanding the subject. Correction of mistakes made in the process of performing work leads to blots and repeated redrawing, which significantly increases the complexity of the educational process and reduces the number of educational tasks to be solved. The use of the graphic package for the design of descriptive geometry tasks of the drawing tools removes the problems described above and allows, combining the accuracy of algebraic calculations and the clarity of geometric constructions, to make the understanding of the subject content responsible for the correctness of the solution. The skills of working with the graphic package are acquired by students quite quickly, and the time spent on familiarization with the program is fully compensated by the fact that the completion and correction of graphic works performed in electronic form does not require a complete re-drawing of the drawing.

The main condition for the use of a graphic package in the process of teaching graphic disciplines is its availability for individual use by a student in extracurricular independent work. It is supported by a training version that can be installed on any computer without copyright infringement.

Currently, all companies that develop graphics packages have various educational programs that allow educational institutions to acquire relatively inexpensive university licenses, and students to use their products for independent work. In addition, the compliance of the instrumental capabilities of the graphic package with the requirements of subject training is important. In this sense, any graphics package on the market is suitable for studying descriptive geometry. In systems such as SolidWorks and KOMPAS 3D, a flat drawing and a solid part are various graphic documents that can be associated associatively. Therefore, the information environment of these systems is very convenient for teaching descriptive geometry.

Over the past years, we have offered students to use the KOMPAS graph as a drawing tool for the design of diagrams of descriptive geometry.In conditions when the classroom time for teaching a subject decreases, it is not possible to allocate it to the study of the graphic package, therefore an indispensable requirement was the independent study of the COMPASS schedule. Acquaintance with the program interface during the first classroom lesson and the implementation of all geometric constructions by the teacher using KOMPAS in the classroom to explain theoretical material and solve problems, as practice has shown, is a sufficient condition for the majority of students to successfully master the package. Author's textbooks and the "ABC KOMPAS" built into the package were used for independent acquaintance with the instrumental capabilities of the package, and the resolution of emerging issues was carried out during consultations, both classroom and using e-mail.

It should be noted that when using any graphics package for solving problems of descriptive geometry, there are some inconveniences associated with the inconsistency of coordinate systems. The workspace of a graphics package is a plane, the position of any point in which is specified by the x and y coordinates. By default, the coordinate axes are in math direction. The formation of a complex drawing in descriptive geometry occurs by combining two mutually perpendicular projection planes, rotating the horizontal projection plane around the x axis until it is aligned with the frontal plane. On the plane obtained in this way, we use three coordinates (x, y, z) to construct projections of the object.

In addition, the directions of the coordinate axes of the descriptive geometry and the default world system in any graphics package are different. If the direction of the x and y axes can be brought into line with the introduction of a custom coordinate system, then the use of the z

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coordinate requires additional conventions. The introduction of the z coordinate on the property panel into the y-coordinate value dialog box with a minus sign, as practice has shown, significantly complicates students' understanding of the process of forming projection images of objects. This can be avoided if constructions in a graphics package are performed in the same way as on paper: to build projections of a point with coordinates (x, y, z) from the ordinate axis, perpendicular segments are restored from a point with coordinates (x, 0) - the lines of the projection links, on which, not using a ruler, but by entering the length in the dialog box of the property bar, plot the distances up, equal to the z coordinate, and down - y.

The organization of teaching descriptive geometry in the KOMPAS environment, the graph allows, simultaneously with the study of subject content, to acquaint students with the instrumental capabilities of the system. So, when studying the methods of graphically specifying a point, line, plane, skills are acquired in creating a custom coordinate system and methods for constructing the simplest geometric objects in a computer environment, and in the process of solving positional and metric problems, skills in working with bindings and image editing tools, conducting parallel and perpendicular lines.

Skills of two-dimensional geometric constructions in KOMPAS-graph, formed in the process of drawing up diagrams (drawings), allow you to switch to three-dimensional modeling in the KOMPAS-3D system.

The use of modeling tools KOMPAS 3D to demonstrate algorithms for shaping surfaces studied in descriptive geometry contributes to a better perception of educational information and the acquisition of skills in creating electronic models of objects. These models contribute to the conscious construction of the projection drawing, and the comparison of the diagram obtained in the KOMPAS graph with the associative drawing allows the student to independently check the correctness of the work.

By the end of the academic year, students studying descriptive geometry using KOMPAS acquire the skills of geometric modeling - both flat and three-dimensional, which, in turn, creates a platform for organizing the study of engineering graphics in the KOMPAS 3D environment, which makes it possible to start preparing design documentation from building a product model with the subsequent registration of associative graphic design documents in accordance with the requirements of ESKD.

The practice of using KOMPAS-3D in the process of teaching descriptive geometry has shown that the use of graphic packages within the framework of initial graphic training at the university is expedient and does not damage the content of the subject. It should be noted that the use of drawing graphic packages for solving educational problems at the initial stage of higher professional education contributes to the formation of sustainable skills in the use of modern information technologies to solve production problems and thus creates conditions for the preparation of a modern engineering and technical specialist for various industries.

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