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GRAPHIC PREPARATION AS A TOOL FOR IMPROVING THE QUALITY OF ENGINEERING EDUCATION IN HIGHER EDUCATION INSTITUTIONS

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Abstract: The success of high-quality training of future specialists depends on the formation of their graphic culture in the process of education as an important part of general and professional culture. The quality of education is understood as a comprehensive characteristic of the process, the result of training, education, related to both the educational institution and students. Graphic education is understood as the totality of knowledge, skills and abilities that students must obtain as a result of their training at a technical university in the process of studying descriptive geometry, engineering graphics and other disciplines. A high level of spatial perception and thinking is a prerequisite for the successful acquisition of various general and specialized technical disciplines at all stages of training. This paper examines graphic training and graphic activity that ensure the formation of students' techniques for creating various graphic images using cognitive processes, as well as the development of spatial perception and thinking in the study of descriptive geometry, engineering graphics.

Keywords: quality of education, graphic education, spatial perception, graphic culture, graphic training.

Introduction

Modernization of higher education in the world defines ensuring the quality of education as the main task of educational policy based on maintaining its fundamentality and compliance with the long-term needs of the individual, society and the state. The quality of education is an ambiguous term for understanding by different audiences in the education system as a whole. The quality of education is understood as a comprehensive characteristic of the process, the result of training, education, related to both the educational institution and students [1]. It is obvious that the quality of education is a multifaceted problem. It depends on the level of teaching all disciplines in universities [2, 3].

The current level of development of engineering education dictates a justified need to form the graphic literacy and culture of students as future specialists who have the ability to develop drawings both manually and using computer programs. A person who does not know how to read and draw drawings on paper correctly will not be able to meaningfully do this on a computer. The prerequisites for the successful study of engineering graphics at a university on the part of students are their basic graphic training, motivation, personal qualities and abilities. Any graphics, be it drawing, painting or any other type, is a very favorable environment for the development of creativity. Engineering graphics is no exception. Specific to this discipline is that often the same problem can be solved in several ways. Here it is very important to give the student the opportunity to think, analyze and choose the best option. Therefore, as well as for a number of other reasons,

the issue of graphic training was and remains very relevant. It is graphic training that underlies engineering education.

Main part

The educational standards of higher professional education define a range of tasks that a graduate of a technical university must be ready to solve; he must be graphically educated. Graphic education is understood as the set of knowledge, skills and abilities that students must obtain as a result of their studies at a university in the process of studying descriptive geometry, engineering graphics and other disciplines.It is believed that descriptive geometry and engineering graphics are among the most "difficult" subjects for first-year students of technical specialties.Descriptive Geometry is adiscipline that underlies engineering education. The main purpose of the course in descriptive geometry is to develop spatial perception and thinking in students and to create a theoretical basis for the subsequent course in projection, mechanical engineering or construction drawing. Spatial perception and thinking are a type of mental activity that ensures the creation of spatial images and their manipulation in the process of solving practical and theoretical problems.

Spatial perception exhibits the main characteristic features of figurative thinking, such as dynamism, recoding of images, and their manipulation in order to create new ones. This is a complex process that includes not only logical (verbally understandable) operations, but also many perspective actions, without which perception and thinking cannot proceed, namely, descriptive geometry and engineering graphics in atechnical university is the academic discipline in the study of which students master the processes of handling various types of graphic images and graphic activity. The success of high-quality training of future specialists depends on the formation of their graphic culture in the educational process as an important part of general and professional culture. Graphic culture is determined by the socio-economic development of society, as well as the need to preserve and transmit various information about three-dimensional objects. The formation of graphic culture underlies the training of specialists in various fields, since the importance of graphic disciplines is determined by the fact that graphics is a generally accepted and recognized language for transmitting information; a means of understanding three-dimensional space, the harmony of objects existing in it, and reflecting them in an accessible form. At the university, graphic literacy is formed by a combination of many factors of educational activity taking place in the classes "Descriptive Geometry, Engineering and Machine Graphics". This discipline provides atheoretical basis for the rules for constructing, reading and designing various graphic documents, and also makes it possible to form generalized techniques of graphic activity in students used both in the study of other disciplines and in practical work.

Descriptive geometry and engineering graphics are considered to be among the most "difficult" subjects for first-year students of technical specialties. The main purpose of the course descriptive geometry is to develop spatial perception and thinking in students and to create a theoretical basis for the subsequent course, engineering graphics (technical drawing). The development of spatial perception and thinking occurs in the process of mastering the accumulated knowledge of mankind by the student and is one of the essential characteristics of the ontogenesis of the psyche. A high level of development of spatial perception and thinking is a necessary condition for the successful acquisition of various general and specialized technical disciplines at all stages of training. Spatial perception is an essential component in preparation for practical activities in many

specialties. According to many researchers, teaching practice constantly reveals weak development of spatial perception and thinking in students, starting from primary school. In addition, the experience of teachers of secondary and higher educational institutions, as well as psychologists and educational researchers shows that students often fail to cope with tasks of both theoretical and practical nature, requiring the formation of a specific type of mental activity for their solution, providing for the analysis of spatial properties.

Shortcomings in this area of education affect the academic performance of students in various school subjects, such as drawing. This indicates that the secondary comprehensive school does not create sufficient conditions for the development of spatial perception, thinking, since school education is structured in such a way that verbal and logical thinking receives preferential development. Until now, no sufficiently complete comparative study has been conducted on the level of development of spatial perception, thinking depending on the nature of educational activity at different age stages. Spatial perception, thinking is a type of mental activity that ensures the creation of spatial images and their operation in the process of solving practical and theoretical problems. This is a complex process that includes not only logical (verbally understandable) operations, but also many perspective actions, without which perception and thinking cannot proceed, namely, the recognition of objects presented in reality or depicted by various graphic means, the creation of adequate images on this basis and their manipulation according to the idea.The content of spatial perception and thinking is the manipulation of spatial images based on their creation using visual support (object or graphic, of varying degrees of generality and conventionality).The manipulation of spatial images is determined by their initial content (reflection in the image of the geometric shape, size, spatial arrangement of objects); the type of manipulation (change in the course of manipulation of the position of the object, its structure); completeness, dynamism of the image (the presence of various characteristics in it, their systematicity, mobility, etc.). Spatial perception and thinking in their most developed forms are formed on a graphic basis, therefore the leading images for it are visual images.

The transition from some visual images reflecting spatial properties and relationships to others is constantly observed in solving problems where different types of graphic images are used. On their basis, not only individual images adequate to each image arise, but also their integral system. The ability to think in the system of these images characterizes spatial perception and thinking. In spatial perception, the main characteristic features of figurative thinking are manifested, such as dynamism, recoding of images, operating with them in order to create new ones. In particular, for the creation of spatial images and operating with them in the process of solving problems (practical, professional, graphic), the choice of a spatial reference system is important. The latter, for example, is not an essential point in the creation of images in their objective, material content. Based on the theoretical provisions of S.L. Rubinstein [5], I.S. Yakimanskaya implemented an approach to the study of spatial perception, thinking as a dynamic unity of the subjective and objective, their close and inseparable mutual enrichment in the process of activity. Based on the fact that the manipulation of images is a special type of representational activity that does not coincide either in its content, or in the conditions of implementation, or in the results with the process of creating an image, I.S. Yakimanskaya thus received the opportunity to determine the main function of spatial thinking and perception [4].Spatial thinking implies free manipulation of spatial images

created on various visual bases, their transformation taking into account the requirements of the task.

The basis of spatial perception, thinking as a type of figurative thinking is the activity of representation, which occurs in various forms, at different levels. "We distinguish two levels of this activity: creating an image and manipulating it," writes I.S.Yakimanskaya [4]. Within each of these levels, one can distinguish different types of both creating images and manipulating them, which, according to Yakimanskaya, is determined by certain specific conditions. When creating any image, including a spatial one, the visual base on which the image arises is subject to mental transformation.When manipulating an image, the image already created on this basis is mentally modified, often in conditions of complete distraction from it. The author considers the ability to create images and manipulating them as acertain level of development of figurative (spatial) perception and thinking. Methods Descriptive geometry and engineering graphics are the theoretical basis for solving technical drawing problems. In engineering, drawings are the main means of expressing human ideas. They should not only determine the shape and size of objects, but also be simple and accurate enough in graphic execution, help comprehensively explore objects and their individual parts. In order to correctly express your thoughts with the help of a drawing, sketch, drawing, you need to know the theoretical foundations of constructing images of geometric objects, their diversity and relationships between them, which is the subject of descriptive geometry.

Results and discussion

The most important applied value of descriptive geometry and engineering graphics as an academic discipline is that it teaches you to master the graphic language, perform and read drawings and other images of geometric objects, without which the formation of a future specialist is unthinkable. It ensures continuity between school courses in geometry and drawing and graphic disciplines of the university. In the psychology of perception, it has long been known that only a few percent of the population initially has the rudiments of spatial perception and thinking. The process of studying at a university involves developing the thinking characteristics of future specialists, called technical thinking, which will determine the success of their work with technical objects. The development of imagination and perception is the most important condition for mastering the ability to construct and read a drawing and graphic activity in general. At the same time, the process of teaching drawing serves as one of the most important means of developing imagination and perception. Descriptive geometry and engineering graphics at a university is the academic discipline in the study of which students master the processes of operating various types of graphic images and graphic activity.

At the same time, the graphic activity of students at a university should act as a general educational and upbringing tool, as a source of knowledge and a means of developing graphic literacy. Through graphic activity, such cognitive processes as sensation, perception, representation, thinking, etc. are simultaneously realized, due to which the student creates a community of many mental functions. When constructing a drawing, these processes are also combined and coordinated with the kinesthetic and motor functions of the hands, which, according to psychology, is the most important condition for differentiating spatial relationships of objects.The success of high-quality training of future specialists depends on the formation of their graphic culture in the educational process as an important part of general and professional culture. Graphic culture is conditioned by the socio-economic development of society, as well as the need to

transmit and store various information about three-dimensional objects. The formation of graphic culture underlies the training of specialists in various fields, since the importance of graphic disciplines is determined by the fact that graphics is agenerally accepted and recognized language for transmitting information; a means of understanding three-dimensional space, the harmony of objects existing in it, and reflecting them in an accessible form.

"Descriptive Geometry and Engineering Graphics" is afundamental discipline in the graphic training of students of a technical university, without knowledge of which it is impossible to create or understand drawings of machine parts and tools. The study of graphic disciplines makes it possible to develop spatial and logical thinking. Without these factors, it is difficult to imagine competent engineers and designers capable of designing modern machines and structures [6].

Work in the junior courses has its own specifics. First-year students face new difficulties - an unfamiliar educational system, a period of adaptation to a new social environment, the need to independently plan their time. Due to the insufficient development of spatial imagination, many students have difficulties in studying graphic discipline.A decrease in the quality of students' graphic education will entail a deterioration in their abilities for logical spatial thinking and, as a consequence, a decrease in the quality of assimilation of special engineering disciplines. The formation of professional qualities must begin simultaneously with the beginning of education at the university; starting from the first year, the student must clearly understand the goals of studying a particular subject, the relationship of the subject with his further professional activity. The methodology of teaching descriptive geometry and engineering graphics, worked out over decades, turns out to be ineffective in the changed conditions of life. Courses, previously designed for afairly large number of hours, for studying graphic disciplines, acquire the appearance of cut and logically incomplete. It is difficult to provide serious practical training with such anumber of hours allocated to studying graphic discipline.Therefore, the taskis to modernize both the course of descriptive geometry and engineering graphics and the methodology of its teaching within the existing time constraints. To determine ways to improve the efficiency of learning the educational material, to qualitatively change both the process of professional training and its results. To achieve professional success in a constantly changing world, a university graduate must be able to quickly learn and retrain, be professionally mobile and successful. Modern trends in the development of professional education bring to the forefront the independent work of students as the main form of training. The credit-rating system of training contributes to the development of the ability to independently plan their activities and determine the amount of upcoming work during the semester. The student's rating is affected by points that are awarded for the performance of individual graphic works, passing test control, writing essays, participating in Olympiads. In fact, the rating system is acomprehensive assessment of the quality of students' academic work. It increases students' motivation to master the curriculum, creates an incentive to increase the intensity of work, since there is a differentiated assessment of the student's work. The teacher needs to plan more time to control the independent work of students, coordinate and direct this work.

The need to improve teaching technologies, including through the introduction of new teaching technologies into the educational process, is caused by the current socio-economic conditions and is aimed at improving the quality of training specialists. Active forms and methods of teaching or active learning technologies play a special role in

training, which are based not only on the processes of perception, memory, attention, but above all on the creative, productive thinking, behavior, communication of the student himself. The focus is on the student, acquiring knowledge through activity, in the context of the future profession and based on experience.

When introducing new information technologies in the process of graphic training, it is advisable to use multimedia information systems, educational computer programs, videos and control tests. The most important condition for the effectiveness of training is the availability of prompt feedback, which allows you to judge how well and how well the students perceive the material. For this purpose, the following are carried out: entrance testing, current, midterm and final control. Based on this, the teacher has the opportunity to track the dynamics of the learning process and adjust their own actions and the actions of students.

Currently, the main task of the teacher is to develop and implement such teaching methods to stimulate the intellectual abilities of the student, make him work with information and reference materials, awaken his interest in the subject in order to maximize the acquisition of theoretical and practical knowledge. A trained and sought-after specialist must have not only professional competence in the relevant subject-industry area, but also the ability to work in a team, the desire and ability to learn, and improve their skills. The first year provides fundamental training for an engineer, which will allow the specialist to quickly and flexibly navigate the unstable engineering labor market.

Graphic training is a process that ensures the formation of rational reading techniques and the execution of various graphic images encountered in the multifaceted labor activity of a person. Graphic training provides the basis for graphic literacy, allowing students to some extent to navigate an extremely large volume of graphic information tools. In higher education institutions, graphic literacy is formed by a combination of many factors of educational activities that take place in the classes of "descriptive geometry and engineering graphics".This discipline provides theoretical foundations for the rules of construction, reading and design of various graphic documents, and also makes it possible to develop generalized techniques of graphic activity in students that are used both in the study of other disciplines and in practical work.In this regard, it becomes obvious that the issues of the effectiveness of graphic training of university students are directly related to the quality of engineering, and not only, education in general. Graphic training is integrated into the professional training of future specialists, but the established educational practice weakly takes this relationship into account.

In particular, design, technological, research areas of engineering activity assume that students have knowledge and skills related to the analysis of the shape of objects and the determination of methods for their manufacture, but the practice of their graphic training existing in universities is limited, as a rule, to the formation of skills to construct, read drawings, diagrams and solve a number of metric and positional problems on this basis and does not take into account the features of engineering problems, in the process of solving which it is used. In these conditions, the problem of increasing the efficiency of graphic training of students at the university, which would be closely connected with the nature of the future professional activity of the student, i.e. its content would be integrated with the content of this activity, creating a basis for its successful implementation, becomes especially urgent.

We consider the concept of "graphic culture" as a set of human achievements in the field of development and mastering of methods of transmitting information by means of graphics as a way of creative self-realization of a person. The creative potential of an individual develops through the inclusion of students in various types of creative activity related to the application of graphic knowledge and skills in the process of solving problem situations and creative tasks. The process of assimilation of knowledge includes four stages: understanding, memorization, application of knowledge according to the rule and solving creative problems. The stages are associated with the activity of recognition, reproduction, solving typical and non-typical problems requiring the application of knowledge in new situations. Without the last stage, the learning process remains incomplete.

Therefore, the process of assimilation of the educational material of each section should contain the solution of propaedeutic creative problems, locally aimed at assimilation of the relevant knowledge. Graphic culture as an element of the general culture of the individual is characterized by a high level of knowledge, skills and abilities in the field of visualization, understanding of the mechanisms of effective use of graphic displays to solve educational and professional problems at an acceptable aesthetic level. The basis of educational activity in the study of descriptive geometry is the graphic activity of students. By graphic activity we mean the educational activity of students to master the course of descriptive geometry and engineering graphics, during which geometric images are operated with subsequent display on a plane, aimed at mastering knowledge, skills and abilities, the result of which is a change in the student as a subject of the educational process.

Conclusion

To improve the quality of graphic training, it is necessary to use new methods of conducting classes and monitoring students' knowledge. Apply innovative technologies, such as three-dimensional modeling, multimedia support for lectures and practical classes. All this will improve the quality of teaching the discipline and intensify the process of graphic training of students. The introduction of distance learning methods will improve the efficiency of students' self-training, which in turn will increase the level of knowledge in the taught discipline. Considering the importance of graphic training in the general process of training an engineer, we consider it appropriate to introduce an entrance exam in drawing in higher technical education institutions. After all, drawing is the international language of an engineer.

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