DEVELOPMENT OF STUDENTS' GRAPHIC COMPETENCE IN ENGINEERING GRAPHICS CLASSES

Mamanov Sirozh Kakhramonovich

teacher of the Department of applied mathematics of the Jizzakh branch of the National University of Uzbekistan named after Mirzo Ulugbek,

(+99893) 309-70-04, sirojmamanov92@gmail.com, 130100, Jizzakh region, Jizzakh city, Sh.Rashidov street, 259

Abstract: This article is devoted to the consideration of the role of graphic disciplines in the training of specialists from technical educational institutions. Graphic objects are an integral part of our life. Therefore, all participants in the production process must easily imagine the spatial forms of an object from its drawing, determine its dimensions and the way its parts interact. A future technical specialist must have knowledge and skills sufficient to carry out his professional activities.

Keywords: graphic competence, descriptive geometry, engineering graphics, graphic disciplines, three-dimensional modeling.

INTRODUCTION

Modern trends in the development of society, characterized by the growth of knowledge-intensive production, determine the need to strengthen the requirements for the training of highly qualified technical specialists. In the labor market, an employer is currently interested in a technical specialist with professional competencies that correspond to the level of development of modern design and engineering technologies. Employers make a number of demands on the level of training of young specialists, declare their intention to participate in the formation of the content of training of future engineers; propose to reflect the changing requirements of the industry in the programs that are currently implemented by universities; express dissatisfaction with the level of professional and psychological

readiness of young specialists to participate in production activities. Employers require graduates of a technical university to be able to change the types and methods of activity taking into account the current state and prospects for the development of production, to position themselves in the profession as a competent specialist. The problem of developing professional competence is associated with the transition of the domestic industry to a market economy, as well as with the need to solve professional problems using computer technologies. A special place in modern production is given to technologies for designing objects of professional activity based on three-dimensional modeling. Thus, graphic competence becomes a significant component of professional competence, the level of formation of which determines the success of mastering knowledge during training in special disciplines and the effectiveness of future professional activities of graduates of a technical university.

A future bachelor of technical profile should know the achievements of science and technology, advanced and foreign experience in the field of organization of production and management. The introduction of a competency-based approach to the organization of student training at a university should contribute to the modernization of the traditional approach, the priority of which is the formation of knowledge, skills and abilities.

MAIN PART

In documents devoted to the modernization of domestic and foreign education, the idea of the need to change the guidelines for education from obtaining knowledge, implementing abstract educational tasks to the formation of individual abilities, to increasing his competence level is traced [16]. By competence, A.V. Khutorskoy understands the general ability and readiness of the individual for activities based on knowledge and experience acquired through training, focused on independent participation of the individual in the educational and cognitive process, and also aimed at its successful inclusion in professional activities. In accordance with the division of educational content into general meta-subject (for all subjects), interdisciplinary (for a cycle of subjects or educational areas) and subject (for each

subject), he identifies a hierarchy of the corresponding competencies: key competencies - relate to the general (meta-subject); general subject competencies - relate to a certain range of academic subjects and educational areas; subject competencies - specific in relation to the two previous levels of competence, which have a specific description and the possibility of formation within the framework of academic subjects [14]. In his research, G.K. Selevko identifies "mathematical, communicative, informational, social, productive, moral" competencies [9]. In this case, informational competence intersects with all the others, etc. The named competencies (competencies) cannot be identified as separate. According to the author, each group contains elements of independent educational activity. He classifies competencies by types of activity, by branches of science, by components of the psychological sphere, as well as by spheres of public life, production, in the field of abilities and by levels of social maturity [9]. In our study, we consider the problems of developing the professional competence of future bachelors, we will dwell in more detail on the characteristics of the concept of "graphic competence". In the system of higher professional education, issues related to the formation of graphic competence were studied by (E.P. Vokh [2], N.V. Fedotova [11], T.P. Petlina [6], A.V. Petukhova [7] and others).

E.P. Vokh in his work understands graphic competencies as competencies that imply generalized methods of action based on the acquired knowledge, skills and abilities in applying standards and rules for making drawings, the ability to freely use design documentation, quickly navigate it and apply it in the professional activities of a future specialist [2].

The concept of graphic competence is defined by N.V. Fedotova: “a personal characteristic that is revealed in the focus on the professional development of a future technical specialist and provides for the possession of special knowledge, graphic skills and practical skills necessary for the further activity of a competitive specialist with high motivation for design and project activities, developed spatial thinking, readiness to master new technologies in professional activities, for continuous personal and professional growth in the context of informatization of society” [11].

In comparison with graphic competencies, the concept of graphic skills is presented by T.P. Petlina: “Engineering and graphic skills represent the ability to graphic technical activities based on spatial thinking (analysis of situations, spatial representation of results, forecasting the course of problem solving) and engineering and technical knowledge in performing technical calculations, graphic knowledge in drawing up design and technical documentation” [6]. In her study of graphic competence, A. V. Petukhova includes in the graphic component of the requirements for training specialists in the technical field “knowledge of the laws and methods of constructing images used in engineering practice, development of spatial and figurative thinking; the ability to perceive, analyze and adequately interpret information presented in graphic form (diagrams, graphs, charts, etc.); proficiency in a specific means of professional communication of engineers around the world - the language of technical graphics (knowledge of the features of drawing up drawings and conventions adopted in various industries); knowledge of world and state standards for drawing up design documentation, proficiency in a variety of graphic methods for solving engineering problems; experience in making drawings and models using modern technical means; an understanding of the functions and capabilities of information and graphic systems; experience working with various information resources (databases; libraries, reference and regulatory documentation, automated search systems); an understanding of the responsibilities imposed on the developer of design and graphic documentation” [7].

T.P. Petlina, studying this problem, identifies the following components of engineering and graphic skills: “a) graphic skills for drawing up design and technical documentation; b) engineering and technical skills for performing technical calculations; c) spatial thinking (situation analysis, spatial representation of the result, forecasting the course of decisions)” [6]. It should be noted that, in addition to the features of modern engineering activity, the definition of graphic competencies is influenced by the content of the concept of competence, which we, together with I.A. Zimnyaya, will understand as “some internal, potential, hidden psychological neoplasms: knowledge, ideas, programs (algorithms) of actions, systems of values

and relationships, which are then revealed in human competencies" [3]. The success of achieving the required level of competence of a graduate depends not only on what subject knowledge he or she acquired during his or her studies at a university, but also on how this knowledge was acquired: based on attention, memorization, or on the development of students' thinking, using reproductive or problem-based methods and forms of teaching. As our experience at the university shows, we attach particular importance to organizing independent graphic work of students, which is one of the most important components of the educational process and a condition for developing students' graphic competence.

Working independently, students not only firmly and deeply assimilate graphic educational material, but also develop research and graphic skills, the ability to work with educational and scientific literature, and the ability to make responsible and constructive decisions in various situations. Organization of students' independent work is carried out taking into account didactic principles that reflect the specifics of this area of pedagogical activity at the university. These include the following principles: the unity of educational (classroom) and independent (extracurricular) activities of students; individualization and differentiation; professional focus, facilitating the transfer of educational and cognitive activity of students into professional graphic; consciousness and creative activity of students; feasible difficulty of tasks for independent work. In the process of classroom and extracurricular independent graphic activity, the student defines and formulates the goals and objectives of independent work, develops an algorithm of actions necessary for implementation, analyzes the results obtained, generalizes and systematizes them, and draws conclusions. A distinctive feature of the competence-based approach is the organization of the educational process, largely focused on learning, active and independent acquisition of theoretical and applied knowledge by students. Strengthening students' independence entails greater responsibility on their part for the results of their own educational, cognitive and graphic activities.

Thus, the competence-based approach includes a set of principles for determining the goals of education, expressed in learning ability, self-determination,

and development of students' individuality, as well as the content of education and organizational forms of training focused on the acquisition of graphic competencies by students. Graphic disciplines, traditionally studied in a technical university in the first and second semesters, contribute to the formation of students' graphic and professional competence, the basics of knowledge and skills necessary for the successful mastery of successive disciplines of a technical profile, studied in subsequent semesters. This knowledge is important when working on the graphic part of a course project, studying the theory of machines and mechanisms, machine parts, and special disciplines. By the concept of "graphic competence" of a future technical specialist we mean a set of qualification and professional-personal guidelines of consciousness and behavior that ensure readiness to apply knowledge, skills and personal qualities for successful geometric and integrative modeling, as well as graphic presentation of engineering objects. We consider the development of students' graphic competence at any level of their training in graphic disciplines as a process of step-by-step theoretical mastering and practical consolidation of norms, rules and methods of creation, analysis of the graphic nature of engineering objects, mental recreation of graphic objects and manipulation of graphic images in the course of solving practical graphic problems.

RESULTS AND DISCUSSION

The study of graphic disciplines forms the intellectual sphere of an engineer and his readiness for professional design and engineering activities. To identify the difficulties that first-year students encounter when studying descriptive geometry and engineering graphics, we used such methods as questionnaires, testing, tests to determine residual knowledge, and oral surveys of students. The students attributed the following factors to the difficulties in studying graphic disciplines: a very high level of abstraction in the content of the subject descriptive geometry, underdeveloped spatial thinking, low level of school preparation, complexity of textbooks on the subject, irregularity of classes. Teachers are forced to look for new forms and methods of teaching in order to quickly bring the level of first-year students up to the standards established at the university. The development of graphic

competence in students of a technical university entails solving the following problems: - awareness and comprehension of the importance of graphic training for solving specific educational and professional problems; - development of readiness to carry out professional activities, realizing in it the acquired graphic potential; - development of a technical type of thinking, which presupposes well-developed spatial thinking, predetermining the creative potential of a future technical specialist; - development of a motivational and value attitude to the need to develop professional and personal qualities and abilities by means of graphic training; - possession of the required volume of design and graphic knowledge, skills and abilities, taken in unity and interaction with a professional engineering and design focus; – development of general educational (generalized) skills – management (goal setting, planning, control and analysis), information (finding, processing and using information), logical (structuring the content of the educational process, setting and solving educational problems), communicative (implementing various types of contacts between participants in joint activities). Graphic objects have become an integral part of our lives and the space around us. Various graphic images are presented in photographs, store signs, architectural compositions and other objects that we consider from an aesthetic point of view.

At the same time, the creation of any object is unthinkable without its graphic image on a plane, which is made by one person and reproduced by another. Therefore, all participants in the production process must have developed spatial thinking in order to imagine the three-dimensional shape of an object from a flat image of an object, as well as have sufficient knowledge to determine the size of an object or its individual parts, their position during interaction. Many technical problems can be solved using an analytical or graphical method, while choosing a more rational method. Often, the graphical method allows you to cope with the task faster and easier. All this knowledge and skills can be obtained by mastering the techniques and methods of descriptive geometry and engineering graphics. In the course of gradual mastering of theoretical knowledge and its practical application for the analysis and solution of graphical problems, mental representation of the

graphical image of an engineering object, as well as the study of norms and rules, the development of graphical competence of future specialists occurs. Graphic competence means the professional and personal qualities of students, their motivation and readiness to apply the acquired informational, graphical, research, technological, creative, analytical and reflexive knowledge and skills for the successful solution of the graphical problems facing them [5; 13].

Graphic competence includes the totality and readiness to apply knowledge, skills and personal qualities for successful geometric modeling, as well as graphical development of machines and mechanisms. Our task is to prepare students at any level of their training in graphic disciplines. As noted in the works [15], in addition to academic knowledge, it is necessary to draw the attention of students to those analogs that we can observe in the environment, and to those artifacts that are obtained by man by borrowing from nature. The study of graphic disciplines forms the intellectual sphere of an engineer and his readiness for professional activity. And based on the above, we can define the main tasks of forming the graphic competence of future specialists [4; 8]: flexibility of thinking; the ability to generate new ideas; rapid restructuring of consciousness; mastering new types of technologies and methods of professional activity. These qualities in future specialists can be ensured by the development of spatial imagination, which is determined not only by the ability to produce original images, but also by the quality and speed of intellectual processes, the ability to quickly and correctly find a solution to the problems.

A person sensitive to changes in nature is able to see the goal from afar, since he has more developed figurative and spatial thinking, as well as, which is very important, aesthetic taste. It should be noted that for the development of graphic competence in students with certain abilities and positive motivation to study graphics, controlled independent work of students plays an important role. The mind and desire of the student, his abilities are manifested in the relatively independent acquisition of knowledge, solving new problems for him, in the transfer of this knowledge to a new situation. The main tasks that need to be solved when solving this problem [8; 10]: organizing the student's independent work; increasing

motivation for acquiring new knowledge in the discipline; stimulating the conscious need for independent work; systematically assessing the student's achievements; adjusting further actions with the help of teachers. Such methods of working with students are used by teachers during lectures, practical and laboratory classes. The effectiveness of classes is determined largely by the skill of the teacher, his influence on students, the quality of his preparation for classes. He needs a deep knowledge of the scientific foundations of drawing, a wide acquaintance with the specialized literature on the subject, knowledge of standards.

The teacher should know the history of the development of graphics and be aware of the latest achievements. All this will give you the opportunity to feel confident in the classroom, deeply cover the theory of the subject, find interesting and convincing examples that are as close as possible to your future professional activity. Even the teacher's speech and the ability to briefly and logically express your thoughts not only contribute to a better perception of the educational material, the assimilation of special concepts and professional terms, but also serves as a model for students, which is extremely relevant in our days. The discipline of descriptive geometry and engineering graphics is mandatory in the first years of any technical university, because the drawing is the embodiment of engineering thought. At the same time, the training of graduates of a technical university is aimed at obtaining specialists who are able to work on modern equipment, an integral part of which are digital technologies. Therefore, when teaching graphic disciplines, it is also necessary to use them, and the discipline of computer graphics using various graphic editors has become an integral part of training. Working in a graphic editor allows you to consolidate the knowledge and skills obtained in the study of the discipline of descriptive geometry and engineering graphics, as well as easily correct errors made during the work. The use of 3D visualization elements of various engineering objects allows students to become more familiar with regulatory documentation, learn how to perform graphic constructions of individual parts, assemblies, units of engineering structures and promotes the development of spatial thinking [1].

Three-dimensional solid modeling helps to create a spatial image of an object, while it is possible to use color and animation. Together with the ability to analyze a projection drawing of a geometric object, decompose its complex shape into simple constituent geometric bodies, the acquired skills will allow you to easily move from 3D models to flat drawings, without distracting the attention of students from solving the assigned tasks [12].

CONCLUSION

Teaching students graphic disciplines using traditional and digital technologies in technical universities contributes to the formation of graphic competence, which is manifested in the possession of modern automated design tools, and also develops sustainable motivation for the use of graphic editors, the ability to work in which allows you to ensure effective professional activity and its creative focus in a highly competitive environment. It should be noted that a whole complex of professional, organizational and personal components is the key to effective activity in developing students' graphic competence.

REFERENCES

1. Aksenova O.Yu., Nikolaeva E.A., Ovsyannikova E.A. Modernization of the educational process of graphic disciplines through information and computer technologies // Integration of modern scientific research into the development of society: collection of materials of the III International scientific and practical conference. - Kemerovo: ZapSibNC, 2017. - Vol. II. - Pp. 266-268.

2. Vokh E.P. Formation of graphic competencies in future engineers in independent cognitive activity: dis. ... Cand. Ped. Sciences. - Ekaterinburg, 2008. - 189 p.

3. Zimnyaya I.A. General culture and social and professional competence of a person // Internet magazine "Eidos". - 2006. - May 4. - http: //www.eidos.ru/journal/2006/0504.htm (date of access: 30.08.2011).

4. Zimnyaya I.A. Pedagogical psychology. - Moscow: Logos, 2000. - 183 p.

5. Klochkova G.M. Allocation of components and levels of graphic-design competence of students of technological education // Modern problems of science and education. - 2014. - P. 11.

6. Petlina T.P. Formation of engineering-graphic skills of students of agricultural engineering specialties in the process of general technical training: dis. ... candidate of ped. sciences. - Samara, 2007. - 188 p.

7. Petukhova A.V. Engineering-graphic training of students in a professionally-oriented educational environment of the university: dis. ... candidate of ped. sciences. - Novosibirsk, 2009. - 186 p.

8. Pidkasisty P.I. Organization of educational and cognitive activity of students. - Moscow: Pedagogical Society of Russia, 2004. - 108 p.

9. Selevko G.K. Competencies and their classification // Public education. - 2004. - No. 4. - P. 136-144.

10. Fedorova M. Model of organization of extracurricular independent work // Higher education in Russia. - 2007. - No. 10. - P. 88-90.

11. Fedotova N.V. Formation of graphic competence of students of a technical university based on three-dimensional modeling: dis. ... candidate of ped. sciences. - Tambov, 2011. - 180 p.

12. Fedotova N.V. Three-dimensional modeling in teaching graphic disciplines // Fundamental research. - 2011. - No. 12 (part 1). - P. 68-70. 338

13. Khanov G.V., Fedotova N.V. Problems of forming graphic competence in students with a low level of preparation in graphic disciplines // Fundamental research. - 2014. - 5 (2): T. - P. 374-378.

14. Khutorskoy A.V. Key competencies as a component of the personality-oriented paradigm of education // Public education. - 2003. - No. 2. -P. 58–64; No. 5 - P. 55–61.

15. Yasvin V.A. Educational environment: from modeling to design. - Moscow: Smysl, 2001. - 365 p.

16. Tanirbergenova A.S., Kagazbaeva A.K., Musalimov T.K. Problem and cognitive education as a form of innovative pedagogical technology. LifeSciJ 2014;11(8s):181-185] (ISSN:1097-8135)http://www.lifesciencesite.com.

17. Tangirov Kh.E. The use of electronic educational resources for individualization in the process of teaching algebra in schools //European Journal of Research and Reflection in Educational Sciences. United Kingdom: Progressive Academic Publishing. Vol7. – 2019. – №. 3. – С. 43-48.

18. Botirov D.B., Tangirov Kh.E., Mamatkulova U.E., Aliboyev S.Kh., Khaitova N.F., Alkorova U.M. (2020). The importance of teaching algorithms and programming languages in the creation of electronic education resources. *Journal of Critical Reviews*, *7*(11), 365-368. doi:10.31838/jcr.07.11.63

19. Tangirov K.E., Jomurodov D.M., Murodkasimova S.K. The importance of e-learning and e-learning resources in individualized learning // Asian Journal of Multidimensional Research (AJMR), 2021. Vol 10, Issue 3, March, 2021. – pp. 464-469. http://dx.doi.org/10.5958/2278-4853.2021.00176.2

20. Tangirov Kh.E. The use of electronic educational resources for individualization in the process of teaching algebra in schools // European Journal of Research and Reflection in Educational Sciences. Progressive Academic Publishing, UK. 2019, Vol. 7, No. 3, - pp. 43-48.

21. Tangirov Kh.E., Mamatkulova U.E., Khasanov Z.Sh. (2022). Possibilities of individualization of learning in interactive electronic information and educational // Mental Enlightenment Scientific-Methodological Journal:Vol. 2022: Iss. 1, Article 17. 166-175. https://uzjournals.edu.uz/tziuj/vol2022/iss1/17.