

METHODS OF INTENSIVE DEVELOPMENT OF STUDENTS' SPATIAL IMAGINATION

Fayzullayev Khayriddin Alimurodovich,
Karshi State Technical University,
Associate Professor, Doctor of Technical Sciences

Abstract. The article is devoted to the importance of studying the discipline of "Engineering Graphics" in the preparation of qualified specialists in the areas of the national economy related to engineering and technology, and methods of intensive development of students' spatial imagination are explored.

Keywords: Spatial imagination, information technology, drawing, engineering graphics, computer graphics, multimedia, graphics, stands, models, posters, computer tools, designer, digital stylistic support.

Scientific research is being conducted in engineering departments of higher educational institutions of our republic on the formation of students' motivation for independent distance learning, the development of spatial imagination and graphic thinking, creative thinking skills, the introduction of multimedia educational technologies, virtual modeling methods. In this regard, it is important to expand the opportunities for multimedia education to develop students' spatial imagination, competence in working with graphic tasks, design drawings. As an important factor in ensuring the graphic knowledge, skills and literacy of future engineers, designers, architects, and competitive personnel, multimedia education is an important factor in improving digital methodological support, increasing the role and effectiveness of multimedia electronic textbooks in developing students' spatial imagination, and substantiating the requirements for an imitation model in the process of developing students' spatial imagination based on graphic knowledge.

Currently, in higher educational institutions, the work on the formation of students' spatial imagination, independent and creative thinking skills using stands, models, posters, and computer tools in teaching the subject "Engineering Graphics" is rapidly developing. However, the lack of sufficient educational and methodological resources, electronic books, textbooks, multimedia lectures, and sets of assignments prepared on the basis of computer technologies in this subject is not considered sufficient for today, when modern educational technologies should be used. The low level of use of graphic programs, electronic textbooks, video projectors, and electronic boards in teaching the subject indicates the existence of serious problems in the field and their scientific and methodological solution. As noted, the formation and development of students' spatial imagination and independent thinking skills in teaching the subject "Engineering Graphics" is one of the main tasks of teaching this subject. That is why teachers use various teaching aids (models, display posters, handouts, computer tools) to form spatial imagination in students. Currently, teachers face many problems in teaching the subject of "Engineering Graphics". Spatial imagination is a complete understanding of the shape, size, appearance, situation, and characteristics of the depicted object, drawing, item, detail, etc. Spatial imagination is understood as the ability to visualize the drawing, detail, etc. in the human imagination and to record it on paper. There are certain experiences in teaching the subject of engineering graphics using computer technologies in higher educational institutions. However, due to the lack of sufficient scientific research on the methodology for developing students' spatial imagination based on multimedia computer technologies in teaching the subject

of "Engineering Graphics", there remains a need to develop electronic resources that can be used in graphic education practice and implement them in the educational process.

Using existing traditional methods, it is impossible to fully master the planned topic in the prescribed time during the teaching process. Problems still remain in developing students' spatial imagination, independent and creative thinking skills, and increasing the efficiency of mastering educational material using various methods. Researchers have achieved educational effectiveness by organizing classes using multimedia presentations of information and details related to drawing geometry using computer visual capabilities. Also, research work has been conducted by foreign and domestic scientists on the use of multimedia technologies in teaching the subject of "Engineering Graphics" [1-6].

Currently, using modern technologies, it performs the following functions:

- a necessary technical and software tool for implementing a database on a subject;
- an assistant to the teacher in the educational process;
- a tool for perceiving and understanding educational materials through animation tools;
- a tool for forming the imagination of a person mastering knowledge; a tool for forming and strengthening computer skills;
- a tool for updating and supplementing educational materials;
- a tool for controlling knowledge and skills (testing) and forming creative activity;
- a tool for creating and distributing the most modern knowledge base in the educational process;
- an object for reading and learning information in distance education;
- an electronic library in a multimedia format;
- ensuring the syncretism of all information on a subject.

Among higher education institutions, in the distance learning and educational system, access to high-quality textbooks and scientific materials, audio and documentary information on the Internet can be facilitated, computer technologies can be used in tests, experiments, and business games to accelerate the exchange of information, simplify the educational system, and verify the knowledge acquired.

The use of computer technologies in teaching the subject "Engineering Graphics" creates the following opportunities:

- A tool for teaching the subject "Engineering Graphics";
- An object for teaching computer graphics based on the laws of the subject "Engineering Graphics";
- A tool for forming spatial imagination, creative and logical thinking skills based on these subjects;
- A tool for checking the acquired knowledge in computer tests;
- A tool for studying and analyzing various geometric figures in the subject "Engineering Graphics" using a simulator; A tool for solving graphic tasks in the subject using a virtual experimental stand;
- A tool for using multimedia capabilities in lecture classes;
- A tool for using a set of tasks in the subject;
- A tool for using computer games; A tool for finding answers to control questions; A tool for using a glossary to understand the meaning of terms in the subject;
- A tool for using a database of a sufficient level for the independent learning process, etc.

The problems of student activity and independent thinking are one of the didactic roots of practice. If students cannot spatially imagine the state of graphic materials, the teacher's work will not be effective in terms of positive educational results. Modern computer technologies and software tools created on their basis effectively help students to think independently and form

spatial imagination in mastering the subject. In addition to using a multimedia e-book in teaching the subject "Engineering Graphics", the use of automated design system programs is highly effective. These can include AutoCAD, 3d Max and Compass programs.

The multimedia e-book is used for the following lesson objectives: Educational goal: to organize students' study of theoretical information on the subject being studied through spatial visualization and the implementation of graphic tasks based on this knowledge during practical lessons. Educational goal: to clearly understand the sequence of theoretical and practical knowledge on the subject being studied through spatial visualization and to use them as a necessary tool in real life, to form the skills of independent work and creative abilities. Developmental goal: to transform knowledge into skills, and skills into qualifications, and to develop the ability to work independently based on the developed spatial visualization of the subject being studied. The use of a computer as a didactic tool in the development of students' design and technological creativity skills gives effective results. Because modern computer tools serve as a convenient tool for applying theoretical knowledge in practice and quickly and objectively determining the level of mastery of the acquired knowledge and skills. Video lesson - a lesson development that presents certain knowledge and skills in video form, both visually and with sound, and helps the user (student, specialist, etc.) to learn the necessary knowledge by seeing and hearing. Leveled graphic task - the development of graphic tasks for students according to the principle of progression from simple to complex. Many foreign and domestic scientists have conducted research and made scientific recommendations on the use of computer technologies in graphic education [8-9].

Showing spatial solutions to problems before solving them encourages students to think independently and approach the problem creatively, and creates an opportunity for them to go back and show the part they do not understand until they understand it. Also, if there are interactive models of such problems, students can try to complete their tasks on interactive models. By entering the parameters of the tasks into the interactive model, the solution to the task appears on the screen. In AutoCAD, students can also form spatial imagination through standard details. When creating these details, they can try to create them in various ways using the necessary dimensions. This opportunity can be compared to a virtual experimental stand. In addition, its parameters and details can be edited as much as desired.

Conclusion: Based on the analysis, the following issues are relevant: in the current education system, it is advisable to ensure the continuity of education in general secondary schools, vocational schools, and higher education institutions, to focus on didactic methods in the superficial parts, to form spatial imagination and constructive thinking in students, and to increase students' cognitive activity.

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