

Intensive Methods of Developing Students' Spatial Imagination in the Teaching of Graphic Sciences

Abduraxim Abdubannaevich Kahharov,

Namangan Engineering Construction Institute

Republic of Uzbekistan, Namanagan city, 12 Islam Karimov street.

E-mail:a.a.qahharov@mail.ru Phone:+99897-230-50-90,

Annotation:The article presents the tools and methods of intensive development of students' spatial imagination in the teaching of the subject "Descriptive Geometry and Engineering Graphics" using computer technology and computer graphics.

Keywords: descriptive geometry and engineering graphics, spatial imagination, multimedia electronic textbook, multimedia e-book, intellectual computer games, virtual detail models, video tutorials, set of tasks, level tests, computer graphics.

Introduction

As part of the reform of the education system in Uzbekistan, the concept of development of higher education until 2030 includes "accelerating the process of studying and implementing best international practices to improve the quality of education and improving teaching methods" [1], training competitive personnel and their worthy contribution to economic development. As a result of reforms in the system, great attention is paid to the inclusion of higher education institutions in the list of the top 1000 higher education institutions in the ranking of internationally recognized organizations. The Action Strategy for the further development of the Republic of Uzbekistan for 2017-2021 identifies the priority "improving the quality and efficiency of higher education institutions on the basis of the introduction of international standards for assessing the quality of education and training." It follows that it is important to use modern methods of teaching based on multimedia computer technologies in research work in the higher education system.

Literature Review

Issues of improving the teaching methods of graphic education in the country, the development of spatial imagination of students R.Khorunov, I.Rakhmonov, A.Kholmiraev, Sh.Murodov, D.Kuchkarova, E.Ruziev, A.Khamrakulov, S.Saydaliev, D.Saidahmedova, Ch. Studied by Shokirova, N. Yadgorov and others. Modern issues of teaching the disciplines "Descriptive Geometry and Engineering Graphics", "Drawing", "Engineering Graphics", the formation and development of students' spatial imagination I.P. Istomina, L.V. Zanfirov, L.P. Rusinov, A.V. Piliper, Yu.A.Bolkova, A.I.Xubiev, L.N.Anisimov, P.A. Foreign scientists such as Ostrojkov, J.J.Djanabaev, Charles A, Rankovsky, Minaruth Galey, Neda Bokan, Marko Ljucovich, Srdjan Vukmirovich conducted research.

A.Khamrakulov, Ch.T.Shakirova, G.Tubaev, A.V.Smirnov, N.G. on the use of computer technology in teaching the subject "Drawing geometry and engineering graphics". Semenova, S.V. Scientists such as Panyukova, Z.Zongyi, F.Kaiping, Ch.Bing H.Stachel, D.P.Francesco conducted research.

Analysis and results

Although a lot of research has been done on the teaching of "Descriptive Geometry and Engineering Graphics", the teaching of "Descriptive Geometry and Engineering Graphics" in higher education institutions does not pay enough attention to the development of students' spatial imagination. Insufficient research on the development of graphic literacy and creative thinking has led to the need to conduct research on the development of students' spatial imagination on the basis of

multimedia computer technology in the teaching of "Descriptive Geometry and Engineering Graphics" in higher education.

As a result of teaching the subject "Descriptive Geometry and Engineering Graphics" in higher education institutions, the basis for the development of students' graphic competencies and the acquisition of graphic knowledge in the field is created. It is no coincidence that drawing is the language of technology. Therefore, the main problem in teaching the subject "Descriptive Geometry and Engineering Graphics" is the development of students' spatial imagination. As a result of educational reforms, young people who graduated from academic lyceums, vocational schools, colleges, technical colleges in the social sphere can be admitted to study in the fields of engineering, technology, construction, manufacturing, as a result of which they have the opportunity to choose the appropriate direction in applying to higher education. On the one hand, this is a practical result of the ongoing reforms to meet the demand for higher education, on the other hand, it requires a high level of graphic competence to study in this area.

As a result of research, studies and observations, it was found that the graphic competencies and spatial perceptions of first-year students entering higher education vary (low, medium, high). The main reasons for this are that the subject of drawing is not taught in lyceums, vocational schools and colleges (social sciences, humanities, medicine and economics). It is obvious that the students entering higher education institutions have different potential, understanding, imagination in the field of drawing, that is, their spatial imagination is different.

Imagination — remembering things and events, situations, images of reality, as well as the process of creative imagination. Enriching the imagination with new images plays an important role in solving thinking tasks. Imagination is important in the acquisition of knowledge, in the acquisition of professional skills.

An important aspect of the imaginary imagination for man is that with the help of this imagination a person anticipates the future object, the thing. For example, an engineer imagines the machine he wants to create from his schematic. The architect imagines from the sketch he drew the building he wanted to build.

Spatial imagination –to have a complete understanding of the shape, size, appearance, condition, its characteristics of the object, drawing, piece, detail, etc. described. It is understood that a drawing, detail, etc., can be imagined by the human imagination, the imagination, and put it down on paper.

Lack of time (drawing, re-drawing and explaining on the board) is one of the major problems in the teaching of the subject "Descriptive Geometry and Engineering Graphics" in higher education institutions due to insufficient development of spatial imagination in conveying information to students on the topics specified in the model program. Gives a positive result to the educational process through the use of multimedia computer technology in solving the existing problem. In particular, it is necessary to use intensive methods in the development of spatial imagination in students, the formation of creative and independent work skills.

According to A. Khamrakulov, "...demonstration of spatial solutions before solving problems attracts students to independent thinking and creative approach to the problem, and allows students to show what they do not understand until they understand it again. Also, if there are interactive models of this type of problem, students will complete their assignments in interactive models. By entering the parameters of the tasks in the interactive model, the solution of the task will appear on the screen.

The lack of development of students' spatial imagination in the teaching of "Drawing Geometry and Engineering Graphics" creates various problems in the transfer of knowledge in the subject. Modern multimedia computer technologies and computer graphics should be used effectively to find an optimal solution to the existing problem. The development of spatial imagination in students to understand and consolidate the acquired knowledge of the subject "Drawing Geometry and Engineering Graphics" serves to ensure the quality and effectiveness of

education. Based on the above considerations, the issue of intensive development of students' spatial imagination is on the agenda. To do this, students develop science content and comprehension skills through multimedia e-textbooks, computer graphics, visualized virtual visual aids.

Experimental work on the development of students' spatial imagination on the basis of intensive methods in teaching the subject "Descriptive Geometry and Engineering Graphics" was carried out. For this purpose, a multimedia electronic textbook on the subject "Descriptive Geometry and Engineering Graphics" (multimedia e-book, a set of differentiated (level) tasks, intellectual computer games, video lessons, multivariate differentiated (level) test, virtual detail models, glossary) was created.

Possibilities of using multimedia computer technologies, engineering computer graphics and visualized virtual tools in the discipline "Descriptive Geometry and Engineering Graphics" (Figure 1).

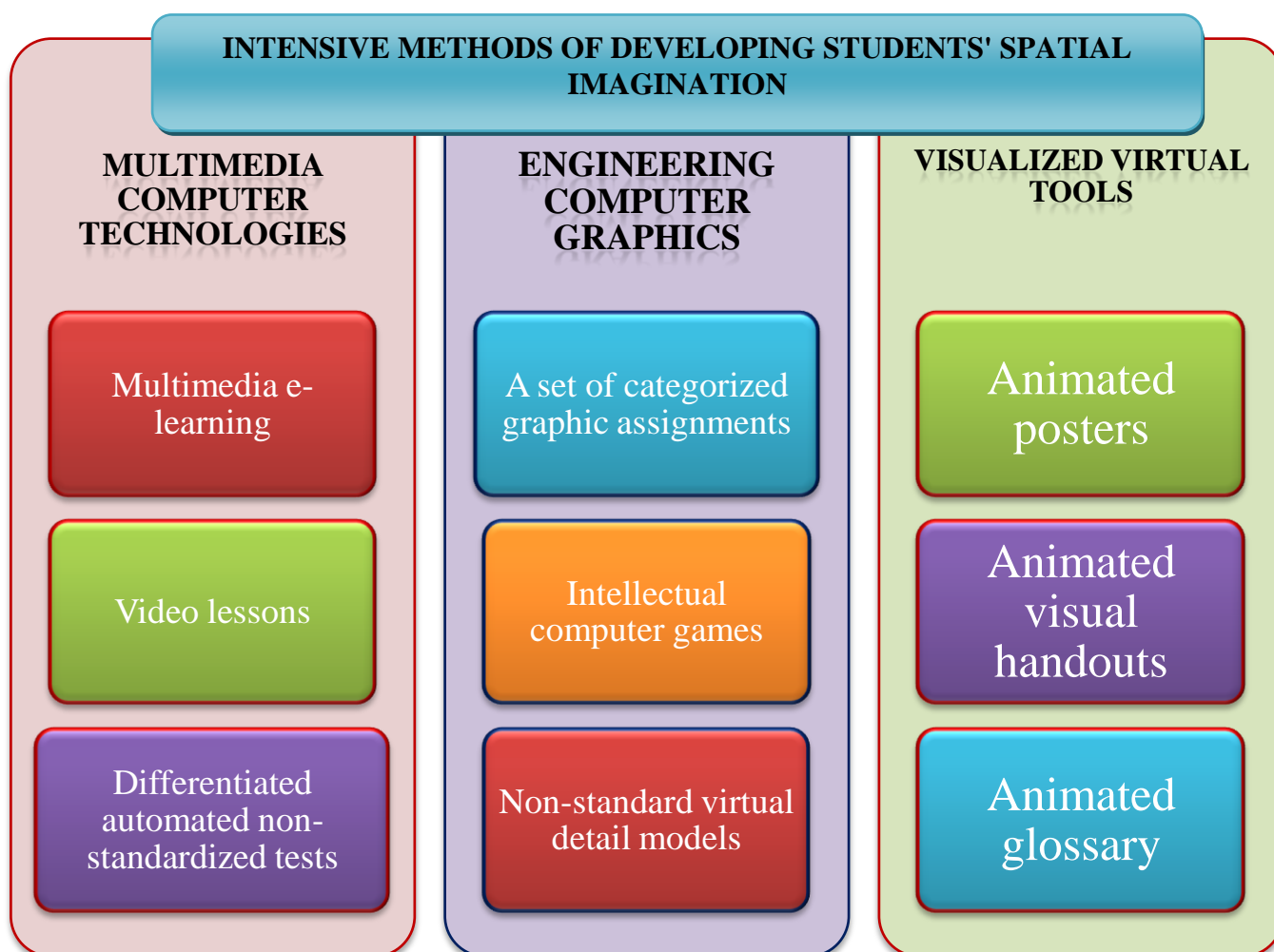


Figure 1. Intensive methods of developing students' spatial imagination in teaching the subject "Descriptive Geometry and Engineering Graphics".

When using intensive methods of developing students' spatial imagination in teaching the subject "Descriptive Geometry and Engineering Graphics":

teaching the basics of descriptive geometry and engineering graphics, the integration of elements of the conceptual model of the conceptual model of ensuring continuity, the development of graphic thinking, definition, theorem, reading diagrams, the laws of imagination and reading, control, knowledge enhancement;

development of students' spatial imagination based on the systematization of the influence of positive and negative factors in the reflexive, intensive methods of learning a set of teaching-intellectual computer games, control-level tasks and diagnostic-virtual detail models;

Improving the algorithm of sequential execution in animation to the requirements of axiological, visual, illustrative, visual indicators in the development of a multimedia electronic textbook that develops the spatial imagination of students in a virtual learning environment based on the introduction of automatic, mechanical procedures;

Professors can perform the tasks assigned to them by continuously monitoring the development of students' spatial imagination, processing mastery indicators, improving on the basis of automated non-standard tests and stratification of graphic tasks, which determine the methodological criteria for analyzing the results.

In teaching the subject "Descriptive Geometry and Engineering Graphics" using multimedia computer technology to develop students' spatial imagination, multimedia e-learning to develop spatial imagination, video lessons for lectures and practical classes, the creation of differentiated multivariate tests to analyze the development of students' spatial imagination. development and creation of differentiated graphic tasks, intellectual computer games, virtual detail models aimed at developing students' spatial imagination using the capabilities of graphics.

Using computer graphics is an effective way to develop students' spatial imagination. In the section of engineering graphics, which is the second part of the subject "Descriptive Geometry and Engineering Graphics", various details, items, assemblies, technical drawings, buildings (plan, facade, shear, perspective), projections marked with numbers (platform, apparel area, slope planes, depth, height, dam, canal, tunnel), etc., is the most convenient tool to use the capabilities of computer graphics in displaying and explaining (Figure 2).

The use of multimedia computer technology and computer graphics in the classroom is directly related to the type of lesson (Lecture and Practice), and the teacher can take advantage of modern pedagogical technologies in combination with traditional methods.

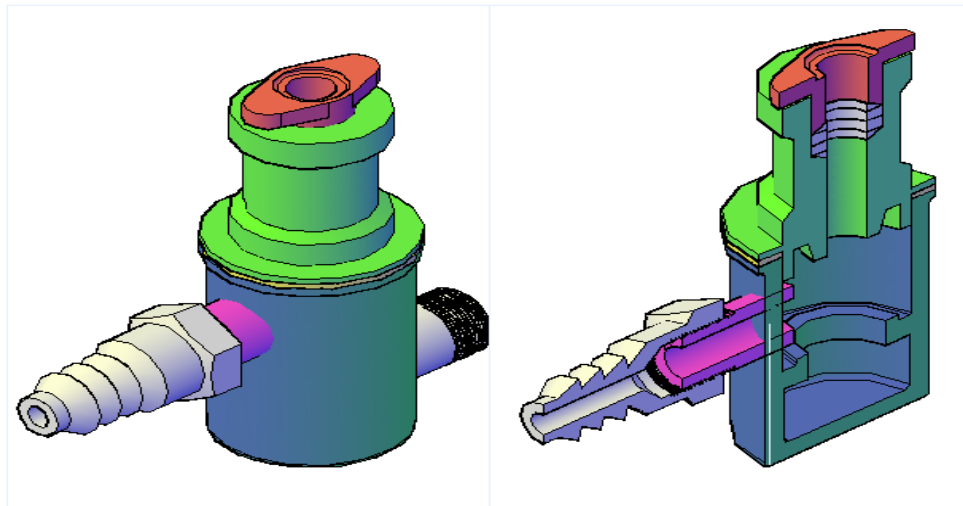


Figure 2. Views of virtual detail and visualized cuts and sections of the assembly unit drawing in science.

In explaining the topics of "Descriptive Geometry and Engineering Graphics" using the capabilities of AutoCAD graphics software virtual modeling (2D, 3D) and the creation of interactive details, students have the opportunity to present their knowledge in a convenient, simple and effective way.

There are a number of programs that can be used in the learning process of engineering computer graphics, such as AutoCAD, ArchiCAD, Compas, 3dsMax, CorelDraw, Lumion. However, among these programs, the use of AutoCAD graphics program in teaching the subject "Drawing Geometry and Engineering Graphics" is effective. AutoCAD graphics program directly

complies with the laws and standards of the discipline "Descriptive Geometry and Engineering Graphics" and is user-friendly.

It is also possible to shape students' spatial imagination through standard details in AutoCAD. These details can be made in different ways by using the necessary dimensions in the creation. This opportunity can be compared to a virtual experience stand. In addition, it allows students to effectively master the knowledge of the subject by performing the necessary editing operations on its parameters and details.

Depending on the type of lesson, the science teacher determines the time of use of multimedia computer technologies and computer graphics. As a result, it is advisable to use a multimedia electronic textbook or computer graphics for the necessary part of the lesson time to understand the information provided to students on the topic, to be able to spatially visualize drawing details, assignments. In this case, the information provided through animation, video, video, visual, illustrative, etc. plays an important role in the spatial representation of the information acquired by students. The student acquires the knowledge he receives only when he imagines the appearance, condition, condition, shape, size of the drawings.

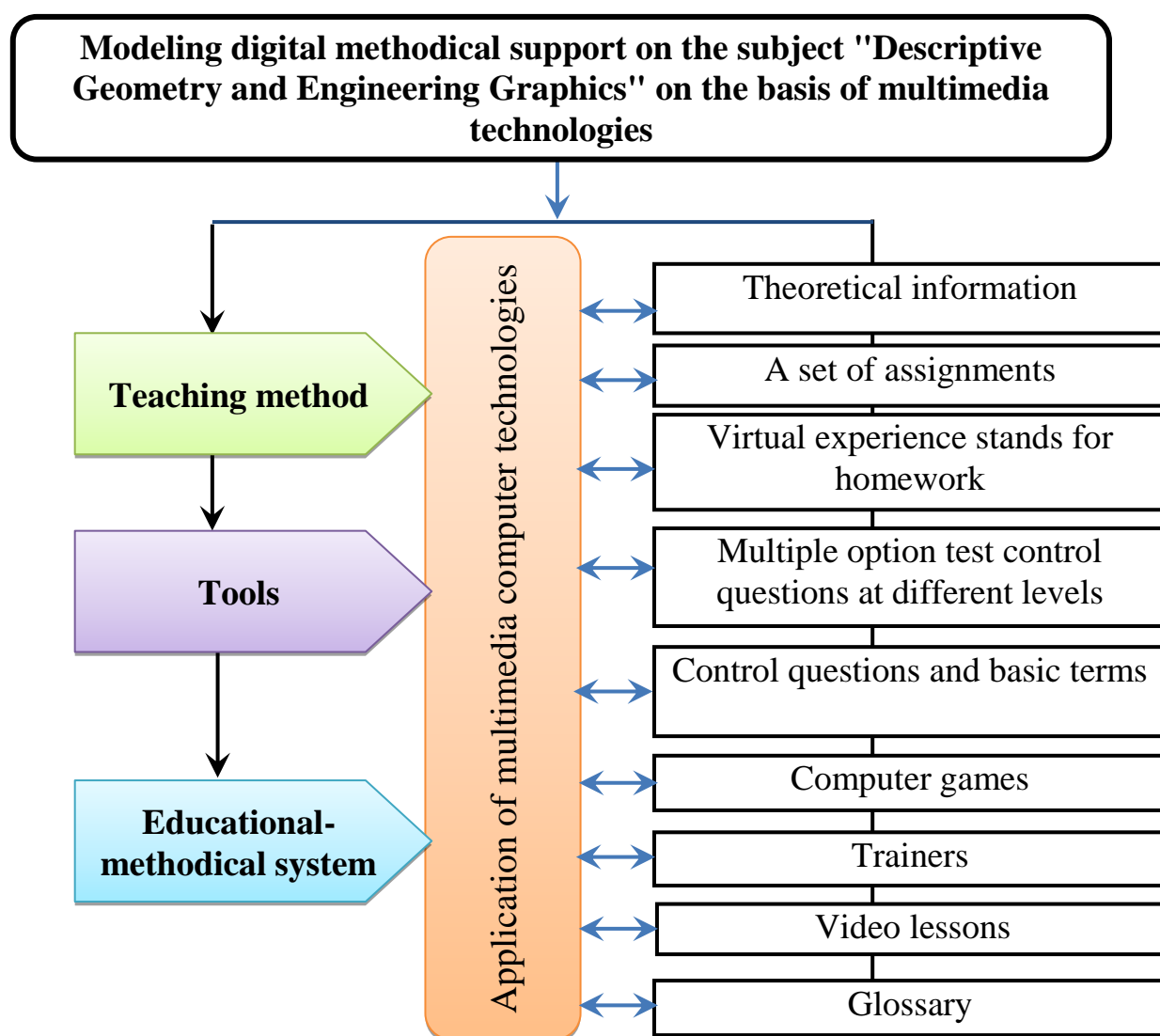


Figure 3. A multimedia pedagogical model that intensively develops students' spatial imagination in the discipline "Descriptive Geometry and Engineering Graphics".

It is known from the world experience that the creation of opportunities for independent learning, the availability of the necessary information on the subject in a modern way helps students to acquire independent knowledge. The multimedia electronic textbook on the subject "Descriptive Geometry and Engineering Graphics" is designed for learning in all types of education. In addition, there are opportunities for independent and distance learning to receive information on the subject, study and control the acquired knowledge. A multimedia e-textbook can view and learn thematic drawings in animated and video form. It is also possible to automatically and automatically control the drawing sequence of the drawings. Practical assignments can be viewed through the option and a sample of their execution. The student can review the sequence of completion of the task and the part he / she did not understand in order to consolidate and master it. It acts as a tutor to the students.

The multimedia e-textbook is a key factor in the development of students' spatial imagination in the teaching of "Descriptive Geometry and Engineering Graphics", providing a full display of the subject. That is, students' spatial imagination is developed on the basis of visual, visual, illustrative, conceptual materials. It will also be the basis for improving the quality of education, enriching, testing, shaping and developing knowledge based on it.

In order to determine the accuracy of the scientific hypothesis, experimental work on teaching the subject "Descriptive Geometry and Engineering Graphics" using multimedia computer technology and computer graphics was conducted regularly during the academic semester. Experimental and control groups were selected for the study at the Namangan Institute of Civil Engineering: 1st control group (44-45-TIE-19), 2nd experimental group (30-31-AYA-19) are the spring semester of the 2019-2020 academic year that is, it was done remotely online in a pandemic setting. At the next stage, in the autumn semester of the 2020-2021 academic year, groups 43-44-YM-20, 45-46-47-YM-20 were held both online and in the traditional way. The experiments were performed in weeks. Experimental test work yielded the expected result. Compared to the control group, the mastering rate of the experimental group was 13.5% higher on average. In addition, in the 2018-2019 academic year, experimental tests were conducted and the results of the experimental group were observed to be on average 13.2% higher than in the control group. In the 2020-2021 academic year, the average was found to be 13.8% higher.

Conclusion/Recommendations

1. Monitoring students' lessons during the problem-solving phase, checking students' practical assignments and analyzing the results of interviews with teachers, questionnaires proved that the use of multimedia computer technology in teaching is more useful than other modern teaching methods.

2. During the problem-solving phase, the lessons were based on multimedia computer technology. Interviews with students, questionnaires showed that the use of multimedia e-books, intellectual computer games, virtual detail models, a set of level practical assignments, multivariate level tests in the lessons of drawing geometry and engineering graphics increased students' interest in science and developed creative thinking skills.

3. According to statistical analyzes, the method of using multimedia computer technologies (85.2%) in teaching graphic geometry and engineering graphics has been proven to be more effective than the traditional (72.0%) method used on the basis of mathematical statistical methods. The drawing has proved in practice and in theory that it will increase its efficiency by 13.2% due to the positive results in teaching geometry and engineering graphics and strengthen students' knowledge, intensive development of their creative thinking, spatial imagination.

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