Three-dimensional modelling technology for computer science education

Jahongir Qosimov[1], Dilorom Kuchkarova[1], Umida Nasritdinova[1], Raxmatilla Nigmanov[1], Unarbek Edilboyev[1]

[1]Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, 100000, M.Ulugbek str. Tashkent, Uzbekistan

E-mail: jaxongirqosimov7@gmail.com

Abstract. The article describes the technology of imitation modelling of the educational process using a three-dimensional modelling tool in teaching computer graphics. Based on this technology, a method, a system of teaching methodologies, tools and methodologies have been developed. In addition, mathematical and statistical analysis of the implementation of this technology in the learning process and the results are obtained.

1. Introduction

In the developed world, the focus on the effectiveness of computer graphics training is growing due to the importance of making significant advances in the development and globalization of computer technology, and the advancement of advanced technology. Today, the leading universities of the world are directly concerned with the development of virtual educational resources aimed at developing the design culture of future professionals, such as the visualization of computer graphics, working with various effects, and the training of professionals in the field of sustainable development such as CAD master, visualizer and animator. remains.

Using innovative approaches in the field of computer graphics education such as "Animation and graphics", "Sonication of 3D modeling" and "Design of graphics" to improve the methodological support of science, the development of spatial graphic representation and the development of visual skills in design skills. effective research is being carried out. It is important to create a learning environment based on advanced international experience and to develop a methodological system for the formation of future professionals' creative abilities based on a quimimetric approach. Therefore, the further development of the students 'pedagogical capacities for the development of creative activity is based on the development and implementation of a three-dimensional modeling technique in teaching computer graphics, as well as enhancing the students' professional design culture. [1]

The role and importance of Computer Graphics, currently being taught in HEIs, can be seen as satisfying the material and spiritual needs needed in our social life, as well as the ability of experts in all areas to automate their activities. Therefore, at present time the Republic of Uzbekistan is studying different areas of computer graphics, creating methodological bases for its use in a number of fields, effective use of computer technologies and new areas of work (specialized artist, special effects, vector art, CAD master). The need to provide qualified specialists such as fashion designers, animators, texturers, visualizers, etc. brought him. Today, in teaching high school "Computer

Graphics" in the formation of students' motivation towards science and thus achieving results, they use the necessary pedagogical and psychological tools.

2. Methods and materials

Developing students' creative activity in Computer Graphics is a complex process that can be implemented using the capabilities of graphic software, ie the introduction of a three-dimensional modeling tool into the learning process, following the following requirements:

Pedagogical Criteria: To provide students with the knowledge and skills for designing three-dimensional models of simple and complex details in the design process using modern graphic software; to use industry-related projects not only to draw a plane, but to create a 3D model; the use of this tool to increase students' interest in science and to promote their creative activity; development of the necessary methodological tools for the implementation of this process, implementation in the educational process; co-ordinating students' active cognitive activity with the managerial role of the teacher; to achieve the interrelated, dialectical nature of the topics covered; Creating favorable conditions for achieving positive results. creative, lateral thinking, that is, non-standard thinking;

Psychological criteria: to perceive, describe, visualize the object under consideration; read the object graphically; to develop a spatial representation of a student;

Didactic criteria: visual modeling, use of methods for performing field-specific tasks, differentiated graphic tasks, test tasks, questionnaires.

Didactic means in the pedagogical process, the principle of didactics in relation to theory and practice; the principle of personal orientation; the scientific principle; the principle of exhibitionism; the principle of assimilation; the principle of continuity and continuity; adherence to interdisciplinary and interdisciplinary links should be based on principles [64; 35 b].

Technical criteria: video clip (graphic assignment), video tutorial (themed) and other software tools.

The spatial graphic representation is a more complex process that involves several processes. Its composition is directly related to concepts such as skills and qualifications, generalization, and thinking, and is formed on the basis of a person's spatial graphic representations. Therefore, the ability of a student to visualize each graphical regularity, especially a graphic concept or algorithm of a task, to extend it, depends on their skills and knowledge. Each graphic qualification is based on knowledge and skills and has a positive impact on the development and expansion of graphic space vision. From a graphical point of view, spatial imagery is the ability of a student to represent the product of a given drawing or technical work, the quality of understanding and logical reading [88; 26 b].

Methodical system - a collection of all pedagogical and methodical works used in meaningful organization of educational activities "Computer Graphics" (electronic manuals based on 2D and 3D modeling, textbook, multimedia electronic textbook, 3D modeling, interactive methods used in teaching process) statement:

The multimedia electronic textbook is a lecture and practical lesson on "Computer Graphics", as well as hypermodels describing the progress of the tasks and the used literature and web sites. It represents the process of implementation of graphic tasks on the subject "Computer Graphics" in practical and laboratory lessons. Students can learn how to use graphical tasks for each topic.

Graphic Task Technique: 1. Determine the zero line (horizontal 40) and the points (A40 and B40). The ground is drilled to the right of the zero line and the soil is shed to the left. The slopes of the slope plane are Qi, Qi, Pi and Pi, Pi ', Qi, perpendicular to the outline of the site to make cross-section lines of the ground and sloping slopes. 2. From the ground surface of the topographic surface, l m is allocated for the ditch, starting from the ground contour. 3. Given the slopes i = 1: 2 and i = 1: 1.5, l = 1m and l = 1.5m are defined and the slope scale of the slope planes is graded. As a result, horizontal lines of the slope planes are drawn.

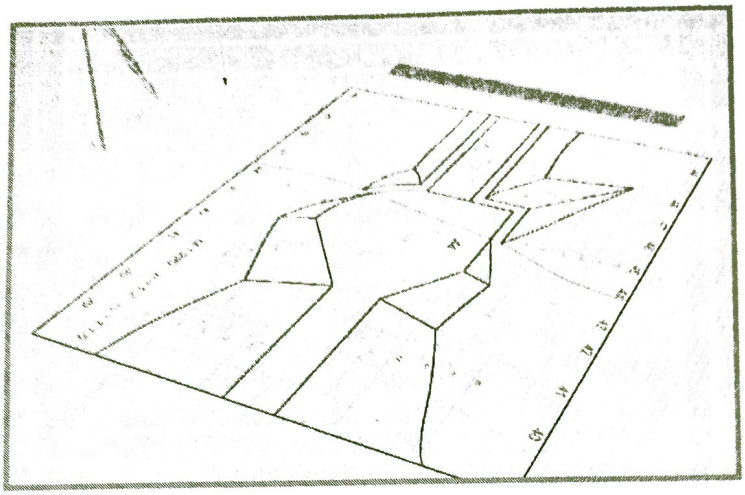

Figure 1. Video-track observation of the Apparel platform (2D) project completion sequence.

4. The straight lines a ', b ' and c ', d ' intersecting the points of intersection of the horizontal lines, where the numerical signs of the slope planes are the same, are the intersection lines of the slope planes in the areas where the soil is spilled and excavated. 5. To determine the boundaries of soil works, the points of intersection of the apparatus lines and their intersections are defined and intertwined on the basis of the horizontality of the topographical surfaces and the numerical signs of the slope planes. 6. Using the Apparel Field Planning (2D) project, based on the given height, a spatial (3D) model will be constructed (Figure 1).

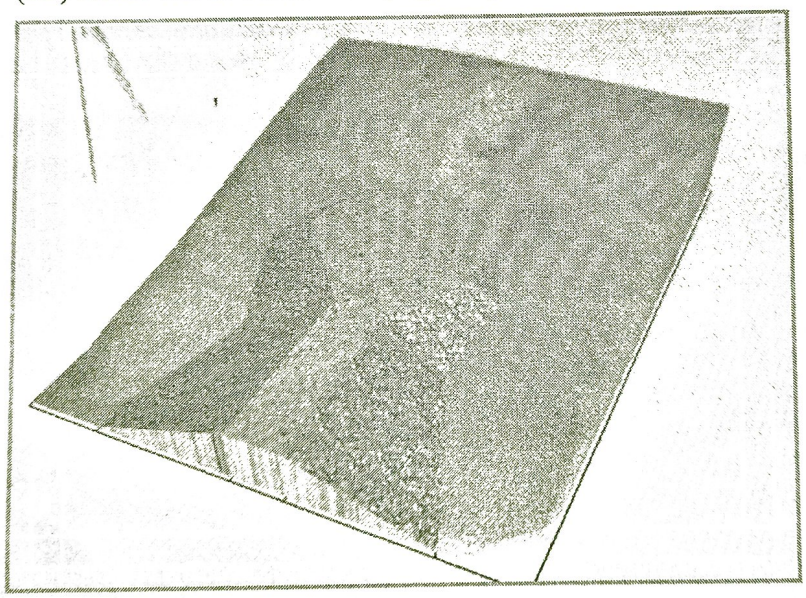

Figure 2. Video-tutorial process of spatial (3D) algorithm modeling of Apparel platform graphic task.

Apparel will construct a spatial (3D) model of the platform using the ground (2D) design based on the given height. (Figure 2).

Thus, the process of completing each graphic assignment in the "Multimedia Electronic Textbook" used in the course "Computer Graphics" is comprised of video lessons, and the algorithm is created using the capabilities of AutoCAD and 3DMAX graphics software.

Effective organization of teacher and student activity as a result of the use of multimedia electronic tutorials for the organization of practical lessons on "Computer Graphics" gives the following results in independent learning:

To the teacher: presenting the materials in the modern form; step-by-step rendering of graphic works; demonstrating multimedia performance of details of various complexity; provides a large amount of information to the student in a short time.

The student will be able to: fully understand and consolidate the acquired knowledge; studying the process of using graphic software capabilities in the implementation of graphic tasks; developing the ability to perform graphic tasks independently; editing task (2D) and space (3D) views; provides the ability to strengthen graphic knowledge.

In Independent Education: Tutoring; allows students to learn independently as a result of re-examining what they do not understand. Students use computer graphics in the Tashkent Institute of Irrigation and Agricultural Mechanization Engineers (NIHMI), Namangan Engineering Construction Institute (NamSMI), and the Tashkent State Pedagogical University named after Nizami using an automated questionnaire developed by the author. activities to identify their interests and initial knowledge. The experimental work was carried out in 11 groups of TIIM (275 students), 12 NamSMI (337 students) and 4 groups (132 students) of TSPU. The results of the experiments are given in Table 1-2.

Table 1. The results of the experiment on this questionnaire.

		Results of the questionnaire					
№	HEI	Groups quantity	R	S	T	U	Student number
1	TIIAME	9	28	78	71	35	212
2	NamMPI	10	45	97	78	54	274
3	TSPU	2	9	27	17	13	66
	Total:	21	82	202	166	102	552

Table 2. The results of the experiment on the given "Test".

		The results of the "Test"					
№	HEI	Groups quantity	R	S	T	U	Student number
1	TIIAME	2	3	8	23	29	63
2	NamMPI	2	3	8	23	29	63
3	TSPU	2	8	18	23	17	66
	Total:	6	14	34	69	75	192

3. Results

During the first phase (2011-2012), theoretical data were collected to illuminate the nature of the research problem. In the course of the study the state of teaching of "Computer Graphics", the problems of scientific, scientific-popular, literature, content of educational resources, working experience of professional teachers, methods of using the 3D modeling tool were summarized; the essence of the scientific basis of the thesis is defined; questionnaire on the organization of pilot tests and test questions; Developed theoretical and practical foundations for the development of spatial imagination and creative activity of students from computer graphics using three-dimensional modeling;

in the second stage (2013-2014), theoretical and practical foundations for the development of creative activity of students through three-dimensional modeling of computer graphics training in universities, designated as experimental sites;

The third stage (2015-2016) was completed and the pilot works were completed. The shortcomings of the theoretical and practical foundations for the development of spatial imagination and creative activity of students by means of three-dimensional modeling in teaching of computer graphics in universities were corrected. The results of experimental works were analyzed using mathematical statistics methods; Scientific and methodical recommendations on using a three-dimensional modeling tool, which is one of the possibilities of graphic programs in teaching "Computer Graphics", have been developed.

Although there are various forms of questionnaires and test methods used in evaluating the results of pedagogical practice, there are still many shortcomings in their application and analysis of results, without regard to the duration of the experiments. First of all, the internship should provide the student with the opportunity to gain knowledge, work on it, and see how much of their knowledge can be

improved. Otherwise this experience will only be valid for a certain period of time. Therefore, the pedagogical experiment is in the formative stage and in the process of organizing it: [17]
In the organization of the educational process, the lessons were implemented with the integration of advanced pedagogical technologies with computer technologies. It is based on an automated model of learning activities.

Table 3. The overall results obtained from the trial.

	Test group n=250			Control group m=250		
Estimated value	5	4	3	5	4	3
Number of Matchings	56	106	88	41	100	109
The arithmetic mean of the scores	$\bar{x} = 3.9$			$\bar{y} = 3.7$		
Efficiency coefficient	$\eta = \frac{\bar{x}}{\bar{y}} = 1.05$					
Critical point	$\chi_{n.m}^2 = 4.73 > 4.6$					

When determining the effectiveness of the experimental results, it is important to clearly define the purpose, develop a special program, follow a number of pedagogical principles and principles. Table 3.

In the analysis of the results, the participants compared their knowledge of computer graphics, graphic geometry and engineering graphics, spatial representations, automated questionnaires, test-based test and control groups (Figure 4).

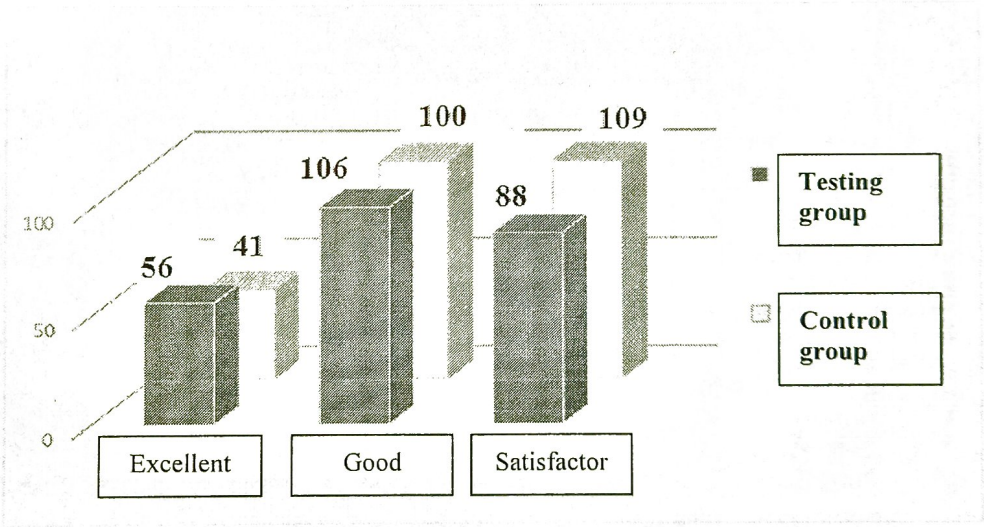

Figure 3. Diagram of general statistical analysis of pedagogical experience.

As a result of the above statistical analysis, the methods of observation in the experimental and control groups were radically different, with the average assimilation in the experimental group 3.9 and the mean in the control group 3.7. Therefore, the methods in the test group are essentially higher and more effective than those in the control group.

4. Conclusion

From pedagogical and psychological research, the student's spatial imagination and graphic thinking are formed from the time he / she is studying at a university. Although most of the students' activities in higher education are focused on developing spatial representations, no specific research on the didactics of organizational, pedagogical, methodological and methodological, psychological, and

physiological and graphic programs for the implementation of these activities in the learning environment. The present study is the first attempt in this regard, which can be considered as one of the tools not only for students in higher education to shape their imagination but also to prepare students for graphic education.

Training on the use of a three-dimensional modeling tool in teaching "Computer Graphics" helps students to form a holistic view of graphic thinking, ie, the unique elements of a three-dimensional scientific worldview. Psychological research shows that since humanity has no universal way of studying the environment, time and space, its regularities, as well as graphic programming, spatial representations play an important role in shaping the scientific worldview.

Using a three-dimensional modeling tool in teaching computer graphics, the student emerges as an active subject of three-dimensional space. The use of a three-dimensional modeling tool in teaching "Computer Graphics" should be considered not only as a solution to a specific technical problem, but even as a social-pedagogical problem, such as preparing a student for a social life, but a solution to the problem of graphic education. [7]

Methods, complexes of tasks, multimedia electronic textbooks, used in all higher educational institutions of the republic, developed on the basis of the scientific analysis of the results of the research and tested in the field of "Computer Graphics" imitation modeling technology of educational process. It serves as an important factor in the formation of an expert.

References

[1] Nasritdinova U 2015 *Modern Problems and Solutions in Teaching Computer Graphics. Monograph* (T.: Navruz Publishing) p 172
[2] Nasritdinova U 2017 *Prepodavatel XXI vek* **1** 13 pp 222–227
[3] Nasritdinova U 2014 *Pedagogical education* **4** 6 pp 53-58
[4] Spearman C 1994 *American Journal of Psychology* **5** pp 201-2
[5] Kuchkarova D, Pulatova H, Haitov B 2009 *Methodical instructions on carrying out practical exercises on "Computer Graphics"* (T.) p 108
[6] Rixsiboev T 2011 *Methodology of Teaching Engineering Graphics* p 144
[7] Jones J 2014 *Computer graphics and programming* (Chinese) p 76
[8] Ward S 2017 *Modelirovanie* (Moscow) p 125
[9] Jallepalli A 2017 *3D modeling of graphics* (USA) p 34
[10] Perenia J 2016 *Computer graphics of design* (Japan) p 45
[11] Yakubov M, Mansurova M 2014 *XVIII International Scientific and Technical Conference "Modern Communications"* (Minsk: Minsk UO VGKS) pp 217-219 pp
[12] Bondarenko M, Bondarenko S 2008 *3d Max 2008 for 26 lessons* (M.: Dialectics Publishing House) p 304 ISBN 978-5 -8459-1358 -6
[13] Mortier Sh 2007 *Autodesk 3ds Max 9 for Dummies* (M.: Publishing house "Dialectics") p 384 ISBN 978-5 -8459-1215-2
[14] Munavarov T 1996 *Pedagogy* (T.: Teacher)
[15] Odilov P, Auezov M 2000 *Educational tests on drawing geometry* (Tashkent: Publishing house of TSPU named after Nizami)
[16] Kosimov J 2019 *Engineering Graphics* (Tashkent: TIIAME)
[17] Ruziev E, Ashirbaev A 2010 *Methods of teaching engineering graphics* (T.: New Century Generation)
[18] Ashirboev A 2008 *Drawing* (T.: Technology of Science)
[19] Murodov Sh and others 2008 *Drawing geometry* (Tashkent: Economics and Finance Publishing House)
[20] Rahmanov I 1996 *The course of drawing geometry and tests on technical graphics* (Tashkent: Publishing house Teacher)
[21] Odilov P, Auezov M 2000 *Educational tests on drawing geometry* (Tashkent: Publishing house of TSPU named after Nizami)