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## Using 3D-modeling to improve the quality of bachelors' training in the field of socio-cultural activities

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**Abstract.** *Problem statement.* The implementation of 3D modeling elements in the in-demand specialists' training of the socio-cultural sphere is in line with the recommendations of UNESCO and the priorities of Russia's state cultural policy. The study aimed at substantiating the effectiveness of the three-dimensional computer graphics usage for specialists' training to improve the quality of their education. *Methodology.* Theoretical and methodological analysis and generalization of fundamental scientific works on the research problem, processing of test results, and three-dimensional models of cultural objects are applied. The pedagogical experiment involved 49 students of the direction of training 51.03.03 Socio-cultural Activities (level – bachelor's degree) of Orel State Institute of Culture. Pearson's  $\chi^2$  test was used as a statistical processing method. *Results.* The features of the use of three-dimensional computer graphics in the training of specialists in the socio-cultural sphere to improve the quality of their training are determined: activation of information communication; support for solving economic and engineering problems as components of socio-cultural activities; automation of a large number of calculations, etc. Statistically significant differences in qualitative changes in the pedagogical system were revealed. *Conclusion.* The use of three-dimensional computer graphics in the training of specialists in the socio-cultural sphere will help to increase the level of their professional training while providing a set of conditions: a combination of design, educational and research activities; orientation to the performance of labor functions; application of fundamental theoretical information on technologies for organizing leisure activities in real socio-cultural activities, etc.

**Keywords:** digitalization of society, information interaction, 3D technologies, graphic editor, leisure organization, Paint 3D

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## Применение 3D-моделирования для повышения качества подготовки бакалавров в сфере социокультурной деятельности

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**Аннотация.** *Постановка проблемы.* Включение элементов 3D-моделирования в подготовку востребованных специалистов социально-культурной сферы соответствует рекомендациям ЮНЕСКО и задачам государственной культурной политики России. Исследование направлено на обоснование эффективности использования трехмерной компьютерной графики при обучении специалистов социально-культурной сферы для повышения качества их подготовки. *Методология.* Применяется теоретико-методологический анализ и обобщение фундаментальных научных исследований по рассматриваемой проблеме, обработка результатов тестирования и трехмерных моделей объектов культуры. В педагогическом эксперименте задействовано 49 студентов Орловского государственного института культуры по направлению подготовки 51.03.03 «Социально-культурная деятельность» (уровень – бакалавриат). В качестве метода статистической обработки использован критерий  $\chi^2$  Пирсона. *Результаты.* Определены особенности применения трехмерной компьютерной графики в обучении специалистов социально-культурной сферы для повышения качества их подготовки: активизация информационной коммуникации; поддержка решения экономических и инженерных задач как компонентов социокультурной деятельности; автоматизация большого объема вычислений и т. д. Статистически значимые различия обнаружены в качественных изменениях, произошедших в системе образования. *Заключение.* Использование трехмерной компьютерной графики при обучении специалистов социально-культурной сферы будет способствовать повышению уровня их профессиональной подготовки при обеспечении комплекса условий: комбинирование проектной, учебно-познавательной и научно-исследовательской деятельности; ориентация на выполнение трудовых функций; применение фундаментальной теоретической информации по технологиям организации досуга в реальной социокультурной деятельности и др.

**Ключевые слова:** цифровизация общества, информационное взаимодействие, 3D-технологии, графический редактор, организация досуга, Paint 3D

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**Problem statement.** The Charter of UNESCO determines that “in order to maintain human dignity, it is the duty of all peoples to widely disseminate culture and education among all people on the basis of justice, freedom and peace, ...the relationship of culture and thinking...”<sup>1</sup> In Russia, for the integration of the norms of international law and the priorities of Russia's state cultural policy, it is of particular importance to form the abilities of a future specialist to implement such tasks as:<sup>2</sup>

- implementation of effective information interaction of people while preserving and disseminating significant cultural values;
- implementation of innovative design in the field of social and cultural activities;
- application of digital technologies and methods of modeling objects of cultural heritage.

This situation is related to the growing demand for quality graduates with competitive advantages in the field of socio-cultural activities [1]. The Orel State Institute of Culture makes a significant contribution to the development of socio-cultural technologies and educational programs. In particular, the areas of training are being improved in the profile “Management of state institutions and non-governmental organizations in the socio-cultural sphere”, “Designing socio-cultural activities. Teaching special disciplines”, “Methodology and organization of social and cultural activities. Teaching special disciplines”.

On the university portal, it is noted that the advantages of the educational program in the direction 51.03.03 Socio-cultural activities (bachelor's level) are the high-quality humanitarian education, the possibility of choosing an educational trajectory, participation in active design and research work, employment demand.

V.V. Grinshkun, summarizing the problems and ways of effective use of informatization technologies, concludes that the reaction of the education system to the recently appeared and future technologies is necessary [2]. However, there are objective difficulties in including modern digital tools in the training and effective activities of qualified specialists in the socio-cultural sphere [3]:

1) insufficient orientation of higher school teachers to the use of 3D technologies as didactic support for the educational process and organization of various types of practices;

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<sup>1</sup> UNESCO. Constitution. Available from: <https://www.unesco.org/en/legal-affairs/constitution> (accessed: 06.01.2023).

<sup>2</sup> Decree of the President of the Russian Federation of January 25, 2023 No. 35 “On Amendments to the Fundamentals of State Cultural Policy, approved by Decree of the President of the Russian Federation of December 24, 2014 No. 808”. (In Russ.) Available from: <https://www.garant.ru/products/ipo/prime/doc/406130451/> (accessed: 09.02.2023).

2) weak mutual use of digital resources and three-dimensional models between various entities that support mass cultural activities: libraries, museums, theaters, etc.

The analysis of these scientific papers reveals the problems related with the need for further research of the application of three-dimensional computer graphics in the specialists' training in the socio-cultural sphere.

This paper presents a study **aimed** at establishing the effectiveness of three-dimensional computer graphics used in the specialists' training in the socio-cultural sphere to improve the quality of their professional training.

**Methodology.** Theoretical analysis and generalization of the literature were used to identify difficulties and prospects for three-dimensional graphics usage in higher education, while clarifying the didactic potential of digital technologies for training specialists in the socio-cultural sphere.

Tools for three-dimensional graphics, 3D editors were analyzed: 3DS Max, Maya, LightWave 3D, SoftImage XSI, Rhinoceros 3D, Zbrush, Blender, Wings 3D, Paint 3D. Comparison criteria: quality of image presentation in social and cultural institutions; convenience and ease of use; cost and Russian-language interface; availability of detailed instructions in the public domain; opportunities for visualization and creation of an emotional background for users; tools for automating the processing of raster images; a set of filtering commands, etc. Paint 3D was chosen for detailed study and practical application in social and cultural activities. Its advantages:

- simple and understandable service for working with images of different sizes (2D, 3D);
- multifunctional graphics editor built into the operating system;
- Russified and simplified interface;
- accessibility for each user, regardless of his experience with skills;
- lack of high requirements for the material and technical base of institutions of the socio-cultural sphere;
- development of a system of lessons on using the editor.

The students applied the skills of three-dimensional modeling on the basis of institutions of the social and cultural sphere of the city of Orel and the Orel region. The institutions are: The I.S. Turgenev State Memorial Museum and Scenery Preserve “Spasskoye-Lutovinovo”, the Leonid Andreev House-Museum, the museum of I.A. Bunin, Orel Museum of Fine Arts, T. Granovskiy's House Museum, the theater for children and youth “Free space”, the central city model library named after. A.S. Pushkin, Orel Regional Special Library for the Blind, Church of the Icon of the Mother of God of Iverskaya in Orel, Orel College of Music, Orel Art School named after G.G. Myasoedov.

Testing contained two blocks: “Theory and methods of social and cultural activities” (30 questions), “Fundamentals of information culture and computer graphics” (30 questions). The author's tests are compiled in accordance with the current standards in the field of higher education, and work programs approved by Orel State Institute of Culture. Therefore, the test materials can be considered reliable and valid for the study.

The study involved students of the Orel State Institute of Culture from the faculties of documentary communications and socio-cultural activities. The students studied the courses “Information Technology”, “Computer Graphics and

Design”, “Methods of Sociological Research of Social and Cultural Activities”, “Pedagogy of Leisure”, “Fundamentals of socio-cultural design”, “Technological foundations of socio-cultural activities”. The experiment involved 49 students of the direction 51.03.03 Social and Cultural Activities (undergraduate level). Training profile – “Methodology and organization of socio-cultural activities. Teaching special disciplines”. The research was conducted between 2021 and 2022. The average age of the respondents was 21 (55% girls and 45% boys).

The results were statistically processed using Pearson's  $\chi^2$  test.

**Results and discussion.** T. Terzidou, T. Tsiatsos, H. Apostolidis reasonably conclude that in any professional activity a person of modern society has to deal with a variety of information (text, graphics, fabric, textiles, stone, etc.) [4]. A large array of digital data, according to J. Forman, M.D. Dogan, H. Forsythe, H. Ishii, must be processed, presented, structured and analyzed daily [5].

The development of these types of activities, the implementation of appropriate algorithms using ICT tools require additional resources, effort, and time from the teacher [6]. According to P. Jääskelä, S. Nykänen, P. Tynjälä, an effective means of enhancing cognition, training, and education is 3D modeling [7].

Three-dimensional graphics, as a branch of computer graphics, according to A.I. Benzer, B. Yildiz, supports the user's work with objects in three dimensions – width, height, depth [8].

B. Liu, Y. Wu, W. Xing, Sh. Guo, L. Zhu consider 3D modeling technologies to be a trend in the struggle to attract and retain the attention of students [9]. 3D design and 3D printing is an important part of the training of specialists of various levels in the field of design, fine arts and architecture [10].

According to J.-H. Kim, N. Nguyễn, R. Campbell, S. Yoo, R. Taraban, D. Reible, ensuring the accuracy of the representation of a three-dimensional object in the information space presupposes the ability and readiness of higher education graduates to create three-dimensional models [11]. Therefore, in the specialists' training in the socio-cultural sphere, dedicated to the development of skills in the application of innovative pedagogical technologies, it is necessary to allocate study time to work with editors of three-dimensional computer graphics [12].

According to the results of the analysis of the literature on the research problem, carried out by E.A. Mamaeva, N.I. Isupova, T.V. Masharova, N.N. Vekua, it can be concluded, that in the training of specialists in the socio-cultural sphere it is effective to use two methods of three-dimensional modeling: creating a model using software tools for 3D graphics or transforming a real object world into a digital model using a 3D scanner [13].

The specifics of the educational program 51.03.03 Socio-Cultural Activities (bachelor's degree level), training profile – “Methodology and organization of socio-cultural activities. Teaching special disciplines” involves three-dimensional documentation of unique free-form objects from all periods of human culture.

The main objective of the experimental work was to test the effectiveness of the use of 3D computer graphics to improve the quality of training for professionals in the socio-cultural sphere.

At the preparatory stage, the teacher analyzed the modern achievements of science and technology regarding the potential of using innovative digital technologies to support social and cultural activities [14].

It was found that the specific labor functions of a specialist of the profile “Methodology and organization of socio-cultural activities. Teaching special disciplines” refers to: planning, organization and practical implementation of cultural and leisure activities, including with children and youth abroad, in the field of tourism, with people of mature and old age, for people with special physical development [15].

The next test consisted of 60 questions. The questions were divided into two blocks: “Theory and methods of social and cultural activities” (30 questions), “Fundamentals of information culture and computer graphics” (30 questions).

Sample questions from the first block.

1. In what movement of postmodern art the goal of the artist is the spontaneous expression of the inner world in chaotic forms not organized by logical thinking? Answer options: surrealism; abstract expressionism; pop Art; hyperrealism.

2. From the proposed list, select those institutions that do not belong to the field of culture: theaters; museums, spa centers; schools, hospitals, gymnasiums, art galleries.

Sample questions from the second block.

1. In order to attract the attention of the “digital generation” the text should: have a clear structure divided into small paragraphs; include visual elements (drawings, photographs, diagrams, infographics); be interactive (with the possibility of feedback); all options are correct.

2. In relation to the request, information can be classified into: a) verbal (this class includes, for example, verbal information); b) non-verbal (for example, graphic, symbolic); c) relevant (corresponding to the wording of the request); d) pertinent (corresponding to the information needs of the person – the author of the request); e) correct answers A and B; e) correct answers C and D.

Thus, as a result of the primary diagnosis, each student received a score from 0 to 60 points. Therefore, “low” (0 to 29 points), “medium” (30 to 50 points) and “high” (51 points and above) levels of preparation were introduced to determine the level of preparation on the basis of the total score on the two blocks. For the correct completed task, a student got 1 point.

Level “High” – the student actively applies innovative technologies (including three-dimensional computer graphics) in the socio-cultural sphere, understands and takes into account their advantages and disadvantages. When working without errors, it composes search queries, manipulates files of various formats. The student knows the laws of perspective, is the foundation of competent drawing and graphics. The student understands the mechanisms and ways of displaying any objects and objects in space.

Level “Average” – the student uses digital technologies (including three-dimensional computer graphics) in the socio-cultural sphere, mainly according to the instructions. Understands, but does not always take into account the advantages and disadvantages of new information processing tools. Allows typos in search queries. Manipulates files of various formats with the support of a mentor. The student knows the laws of perspective, but with one or two mistakes forms the foundation of competent drawing and graphics. The student understands the mechanisms and ways of displaying not all objects and objects in space.

Level “Low” – in all other cases.

The control group (25 participants) and the experimental group (24 participants) groups were formed based on the materials of the control work.

For the design of three-dimensional images and their subsequent use in the socio-cultural activities of the experimental group, the following system of classes was determined:

1. Analysis of graphic editors and 3D modeling tools focused on visualization, animation, imitation of 3D modeling. The goal is to identify the main didactic possibilities of three-dimensional graphics in the context of the educational program in the profile “Methodology and organization of socio-cultural activities. Teaching special disciplines”.

2. Analysis of the needs and opportunities of institutions of the socio-cultural sphere in the city of Orel and the Orel region. The aim is to identify the main logistical problems, potential projects for 3D modeling.

3. Comparison of the results of the analytical activities of the two previous stages. Division into groups for creating 3D projects.

4. Work in a graphics editor to create a three-dimensional illustration.

5. Presentation of a three-dimensional socio-cultural project.

When studying the disciplines “Psychology”, “Methods of sociological research of socio-cultural activities”, “Pedagogy of leisure”, “Fundamentals of socio-cultural design”, “Technological foundations of socio-cultural activities”, students received the necessary theoretical information about the specifics of future work and practice, studied fundamental theoretical facts and regularities. In particular, the technique of critical thinking technology, formulated by B. Bloom [15]. The essence of the technique: the teacher offers the student not ready-made knowledge, but a problem. In reality (for example, paper) Bloom's Cube consists of 6 faces: “Why...”, “Explain...”, “Name...”, “Suggest...”, “Think up...”, “Share...”.

Further, the teacher studied with students the interface and functional features of the editor for three-dimensional computer graphics as a part of the courses “Information Technology”, “Computer Graphics and Design”. It was justified above that for the preparation of students of the profile “Methodology and organization of socio-cultural activities. Paint 3D service is optimal for teaching special disciplines. The Paint 3D toolkit allows you to use the didactic potential of 3D modeling to create spectacular computer objects. In addition, you can insert pre-created models from the 3D library and manage these objects.

Let us describe the algorithm of practical work of the students of the experimental group in the 3D modeling environment using the example of Paint 3D.

1. Launch Paint 3D. Open the application, explore the interface. Select the “Create” menu – the “working canvas” will open.

2. On the top panel, select the type of tool used, and in the right part of the window, the parameter selection panel. To create a Cube, go to the “3D Shapes” tab. On the right panel – “3D Objects” – “Cube”.

3. On the “working canvas” draw a Cube. Hint: in order for the faces of the Cube to turn out the same, “click” once with the left mouse button in the empty space of the canvas.

4. Learn the function keys for managing objects. When choosing a model, pay attention to the arrows for moving: the “up” arrow will rotate the object along

the Z axis; the right arrow will rotate along the X axis; arrow “down” – rotation along the Y axis; the left arrow will scroll the model back and forth in space.

5. The work involves painting the cube so that all faces are of a different color. To do this, select the tab on the top panel “Brushes”. Next, the brush type is Fill and the fill type is Side.

6. Then it is necessary to determine the color for painting the visible face (press the left mouse button). After that, another color is selected, the cube is rotated using the auxiliary buttons. The result is painting all the faces of the cube in different colors.

7. Next, you should sign each face of the cube with the appropriate word: Name; Why; Explain; Suggest; Come up with; Share. Completing the task involves using the “Text” tab.

In order for the text to be attached to each face of the Cube, you need to create a 3D text.

So, choose the type of text “Three-dimensional text”, the font and size are set in the settings at your discretion. Before inserting text, we advise you to expand the cube so that only one of the faces is visible. This edge must be perpendicular to the screen.

Enter the desired text. Next, move the text to the Cube area. Using the Position Z tool, and holding down the left mouse button, move the label so that it is aligned with the Cube face.

8. To do the same with the other sides of the Cube, you need to rotate not only the cube itself, but the entire structure. To do this, select the entire area of the Cube and apply the Group tool. Now you can rotate the Cube along with the inscription.

9. Do steps 7–8 of the algorithm for the remaining faces of the cube.

10. Save the Bloom Cube as a Paint 3D project, or as a video or gif image. To do this, select “Menu” – “Save As” – “Paint 3D Project”/“Video”/“3D Model”.

The system of training tasks could be transformed: building a combined model (from already created cubes) according to the teacher’s drawing, developing a combined model (from already created cubes) according to a drawing from the Internet, developing your own 3D model, integrating your own 3D graphics with a classmate’s project.

After that, the participants of the experimental group at practical classes and seminars of other specialized disciplines, for example, “Public Relations in the Socio-Cultural Sphere”, “Organization and Methods of Leisure Activities with Children and Youth Abroad”, “Organization of Park Recreation”, “Methods of Organization entertainment and gaming leisure”, “Organization and methods of organizing social and cultural activities of children and youth”, “Art therapy” developed three-dimensional illustrations on a specific educational topic or to solve the problem of practice (educational, industrial, etc.).

Let's present some 3D projects developed by the students of the experimental group according to the algorithm described above and implemented in the cultural institutions of the city of Orel.

Project “Legendary city”. The project consists in the implementation of theatrical quests based on the legends of the abandoned historical buildings of the city of Orel. A team of students developed five games that involve the use of



three-dimensional illustrations. Thanks to this popularization of abandoned architectural monuments, the team plans to restore the facades and interiors of three historic buildings in the city.

Orlovsky Yard project. The project team implemented a historical and cultural three-dimensional model at the site of the Orel Museum of Local Lore. Now in the courtyard there is an open-air museum of three-dimensional images “Serve the Fatherland All Your Life”. Excursions, promotions, concerts and holidays are held at the new location. The plans include holding festivals, creating historical videos and 3D animations for schoolchildren.

The project “Media club for schoolchildren and youth “Community” for mastering relevant professional skills of the digital society. The team created a unified 3D media platform based on the children's art house. At the moment, students are actively maintaining the social networks of the project, filmed 42 videos, more than ten stories on local television, and conduct master classes in three-dimensional graphics.

Students in the control group also studied new digital technologies, materials of the above disciplines, courses “Practical work on recreational and animation activities”, “Theory and practice of ethno-cultural animation”, “Animation of historical and cultural objects”, “Socio-cultural technologies of public associations”, “Volunteer animation”, “Methods of organization of corporate programs”. However, they were not involved in the special work of designing and creating three-dimensional illustrations and 3D projects.

Information about the results of evaluation “before” and “after” experiments and research work with three-dimensional computer graphics in the training of specialists of the profile “Methodology and organization of socio-cultural activities” is shown in Table.

**The influence of three-dimensional computer graphics on professional development in the socio-cultural sphere**

Students' level	Groups			
	Experimental (24 students)		Control (25 students)	
	Before the experiment	After the experiment	Before the experiment	After the experiment
High	3	10	4	5
Average	6	11	6	9
Low	15	3	15	11

Thus,  $\chi^2_{\text{obs.1}} < \chi^2_{\text{crit}}$  ( $0.122 < 5.991$ ), and  $\chi^2_{\text{obs.2}} > \chi^2_{\text{crit}}$  ( $6.420 > 5.991$ ). Therefore, the transition to a higher level of specialists' training in the socio-cultural sphere in the experimental group can be considered non-random.

The participants of the experimental work highlighted the following positive aspects of the inclusion of three-dimensional graphics in the training program for specialists in the socio-cultural sphere:

- the educational process becomes visually voluminous;
- a visual and accessible explanation of complex scientific (fundamental theoretical) facts is supported;
- the student naturally “immerses” in the topic of the subject/phenomenon being studied;

– there is a variety in the ways of presenting information in the organization of cultural, leisure activities;

– reconstruction and 3D modeling of cultural values (monuments).

As difficulties that complicate the use of three-dimensional models in socio-cultural activities, the following were indicated: the high cost of 3D printers and 3D scanners; dependence on commercial software, technical failures of equipment in cultural institutions; doubts of the heads of cultural institutions about the effectiveness (commercialization) of three-dimensional forms of leisure organization; coordination of activities of employees of libraries/museums/houses of creativity, accustomed to working according to traditional methods, and visitors.

The conclusion that three-dimensional computer graphics has didactic potential in terms of improving the quality of education and the formation of general spatial thinking skills of people working in the socio-cultural sphere is confirmed by the results of the study of E.A. Mamaeva, N.I. Isupova, T.V. Masharova, N.N. Vekua [13], T. Terzidou, T. Tsiatsos, H. Apostolidis [4]. An important result of this study is the description of the main ideas of the approach that extends N.N. Yaroshenko's ideas about the potential of innovative pedagogical technologies to support socio-cultural activities in Russia [3].

**Conclusion.** The results of this study show the following features of the use of three-dimensional computer graphics in the specialists' training of the socio-cultural sphere:

1) creation of additional conditions for working with images in architectural visualization, in cinema, for scientific research, etc.;

2) intensification of feedback, activation of information communication while preserving and disseminating culture;

3) support for solving economic and engineering problems as components of socio-cultural activities;

4) the possibility of working with both realistic images and “virtual moving pictures”;

5) automation of a large number of calculations;

6) the emergence of new tools for the socio-cultural study of an object, phenomenon or process.

The proposed system of classes for the use of 3D-modeling in the specialists' training of the socio-cultural sphere allows:

– to contribute to the formation of the core professional competencies of a specialist: the organization of creative activity in culture; planning and practical implementation of leisure (children, youth, tourists, the elderly, people with special needs); preservation and creation of values;

– to promote the development of demanded soft skills (teamwork skills; emotional intelligence, spatial thinking, etc.);

– to get experience in project, educational and research activities;

– to perform essential job functions;

– to implement the theory about ways for organizing leisure activities in real socio-cultural activities.

Due to the results obtained, one can organize the socio-cultural activities of students and develop applied cultural studies.

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