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Universität Innsbruck

1st edition

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www.uibk.ac.at/iup

ISBN 978-3-902936-46-2

DESCRIPTIVE GEOMETRY EDUCATION BY USING MULTIMEDIA TOOLS

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ABSTRACT: This paper proposed integration of multimedia and 3D animation tools in the descriptive geometrical education. This transdisciplinary and hybrid visual dynamic educational tool is aimed toward students of technical and applied arts. Computer technology in the function of geometry learning tools offers new and fascinating possibilities. Students and teachers can explore the most diverse theoretical and practical problems with the aim of understanding the dynamic and complex spatial relationships.

The multimedia consists of short animated forms supported by concise textual explanations. Sixteen integrated animated short forms are five minutes duration in average. DVD title is "Geometric education using the principles and tools of 3D animation". Following descriptive geometrical areas are covered: 1. Platonic solids: cube, tetrahedron, octahedron, dodecahedron and icosahedrons. 2. Ruled surface: conoid, rotational hyperboloid, helicoid and hyperbolic paraboloid. 3. The revolved surfaces: torus. 4. Mutual intersection: conic sections, cone and cylinder, sphere and cylinder and two half-cylinder. 5. Experimental design (freeform): generating a surface with the two profiles as guidelines, generating free form using lattice deformer and generate free-form by the duplicating along curves tool. The aim of this learning method is to simplify the perception of geometrical forms, the process of their constructions, and to inspire the users to freely and without fear further explore this complex subject.

Geometrical education using 3D animation principles and tools represents a new methodology approach and its final result is presented on new way, as multimedia tool. Its originality is based on interdisciplinary approach and use of new technologies. The method derived from the overlapping of multiple disciplines such as descriptive geometry, computer animation, structural systems and programming. The results are multilayered and are the base for further scientific research and new development in practice.

Aspects and research results presented in this paper are: the final application in education, production methodology and the basic structure of multimedia learning aid.

Keywords: Descriptive geometry, education, computer animation, multimedia

1. INTRODUCTION

Perception and shaping space is the most essential process in the education of art and engineering students, especially at the technical and technological group. Geometrical education includes spatial understanding and mental visualization of space structures. This paper is based on the hypothesis that the application of CG computer animation in education could be used as additional education tool in Descriptive geometry subject. This work is research in the field of application of methodological innovation in the area of space

geometry and computer animations. The geometrical education involves the geometry in the plane and space geometry. The applicability of dynamic 3D geometry in education provides improvement of spatial ability [6]. It is pedagogical stimuli for users in terms of encouragement for the further geometry exploration [5]. The proposed form of educational environments is a new potential for the study of geometry.

2. THE PERCEPTION IN EDUCATION

Of all the sensory sensations inherent to physiology of the humans more than 70%

belong to the field of visual perception or the sense of vision. For the human vision, without doubt, can be argued that it is most important sense for the human race. A special feature of visual perception is the capacity to grasp the three-dimensional space [4].

The comprehension ability of three-dimensional space means to estimate the relative distances between objects as well as the inner sense of form shape, i.e. the third dimension of space [7]. From this reason the animations on multimedia DVD are presented as a short animations with a concise text explanations (Figure 1.).

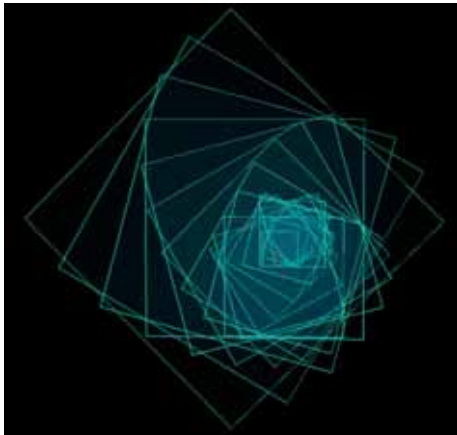


Figure 1: Cover page of the multimedia DVD: Geometrical education by using principles and tools of 3D animation

3. DISCUSSION

Application of CG computer animation as additional tool in education helps students to solve geometrical problems and to perceive the geometry in 3D space [2].

To analyze the application of the proposed method in practice in the education, multimedia material is presented as a supplementary tool in teaching Descriptive geometry [3].

The proposed method is presented to 40 students on first and second year of studies on the Descriptive geometry subject in regular

classes at Department of Landscape architecture and horticulture, Faculty of Forestry, University of Belgrade.

On the first year of studies students learn Geometry by using paper and pen as well as multimedia DVD. Students also made some geometrical models using paper in conventional way (Figure 2.).



Figure 2: Students of Landscape architecture made geometrical models

On the second year of studies students of the Landscape architecture learn geometry using computers and also using DVD multimedia teaching materials.

After two years in geometrical education using different type of educational material students are kindly ask to answer our mixed type of questionnaire.

3.1 Analysis of the results in the practice

Results were analyzed after the Course of Descriptive geometry and Landscape - architecture graphics through questionnaire.

Questionnaire had the following structure divided in three parts:

1. Whether students were previously known or familiar with the use of multimedia in education;
2. Students compared multimedia educational tool to conventional, printed materials that are already in use;
3. Students gave analysis of presented geometric areas and named the areas that they feel the need to be processed in this way and were not shown on multimedia DVD.

The responses to the questionnaire were as follows:

1. Use of video tutorials available over the Internet in various fields is not unknown to students. As for the specific application, in this field of Descriptive geometry, they perceive it as an innovation.
2. The present material was very well accepted. Material presented on multimedia DVD kept student's attention. They even expressed a desire to DVD has sound and narration. The largest percentage of them see this as an excellent supplementary material tool in the education. In students opinion advantages of printed material are: possibility of depth analysis and great quantity of information and the ability to take notes. The main advantage of using multimedia DVD is that students could see the spatial forms and understand the problem in 3D space. In particular, the positive evaluation refers to possibility to follow gradual construction of objects, both form and constructions process in several projections which in classic textbooks is not possible.
3. In this context they expressed a desire to use multimedia DVD as a learning tool in other geometrical areas such as perspective which is not produced in multimedia form yet.

4. CONCLUSIONS

New instruments allow students, teachers, artists, researchers, engineers, designers, etc.. empowerment in terms of strengthening the contribution in their field of work. Results are richer, it is possible to learn more than you can learn only from books and often simpler for using than working with paper and pencil.

Students and teachers can explore the most diverse theoretical and practical problems with the aim of understanding the dynamic and complex spatial relationships [8].

These capabilities offer a new way of conversation and communication between

teachers and students which at conventional ways of teaching are not obvious or possible. The use of multimedia computer animation in the teaching related to the geometrical education improves and greatly speeds up explanations of teachers intentions [1].

Experience in the use of multimedia computer animation in the learning process demonstrates significant progress in the perception of huge possibilities working with each model.

The analysis of the questionnaire shows that the innovation positively evaluates the use of multimedia in its dynamic dimension as animation have feature which highlights process in constructing geometric shapes and solving geometric problems.

Dynamic geometry education achieves much higher insight into the actual structure and construction, where through the movement directly and experimentally we learn about the changes in the construction of the structure [9].

The original contribution of this paper is in the implementation of multiple disciplines, and this interdisciplinary hybrid approach, overlapped several disciplines such as architecture, descriptive geometry, computer animation and programming.

ACKNOWLEDGMENT

Authors are supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia, Project No. TP 36008

REFERENCES

- [1] Čučaković and B.Jović. Constructive Geometry Education by Contemporary Technologies. *SAJ_2011_3_Serbian Architectural Journal*, original scientific article, UDK 514.18:62 ID 184977420 pp. 164-183, Belgrade, Serbia, 2011.
- [2] Čučaković, M.Nestorović and B.Jović. Contemporary principles of geometrical modeling in education. *Abstracts - 2nd Croatian Conference of*

- Geometry and Graphics Scientific-Professional Colloquium of CSGG(Šibenik, Croatia, September 5-9)*, pp. 10-11, Šibenik, Croatia, 2010.
- [3] Čučaković and B.Jović. Optional Course Engineering Graphics On Department For Landscaping Architecture At The Faculty Of Forestry, University Of Belgrade. (*International Conference SUNGIG moNGeometrija, June 24-27*), Belgrade, Serbia, 2010.
- [4] Jović. Geometrijska edukacija na polju vizuelizacije i eksperimentalnog dizajna primenom virtuelnih tehnologija. Doktorska disertacija, Arhitektonski fakultet Univerzitet u Beogradu, Beograd, Srbija, 2012.
- [5] H. Kaufmann. Geometry education with augmented reality. Dissertation, Technology University of Vienna, Austria, Vienna, 2004.
- [6] U.H.Kortenkamp. Foundation of Dynamic Geomery. PhD Dissertation. Swiss Federal Institute of Technology, Zurich, Switzerland, 1999.
- [7] H.Stachel. "[*What is Descriptive Geometry for?*](#)" In *DSG-CK Dresden Symposium Geometrie: konstruktiv & kinematisch (Dresden, Germany, Feb. 27 - March 1, 2003.)*, (ISBN 3-86005-394-9): pp. 327-336. TU Dresden, 2003.
- [8] N. Teofilović. Umetnost pokreta u prostoru praznine (tehnologija i praksa virtuelnih karaktera). Arhitektonski fakultet Univerziteta u Beogradu, Srbija, Beograd, 2011.
- [9] N. Teofilović, 1:1(3D karakter animacija i instalacija). Doktorski rad. Univerzitet umetnosti u Beogradu, Interdisciplinarne doktorske studije, Grupa za digitalnu umetnost, Beograd, 2010.
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