PROBLEMS OF MOTIVATION OF STUDENTS TO STUDY COMPULSORY SUBJECT "ENGINEERING GRAPHICS"

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1. ABSTRACT

Paper deals with a problem on how to raise an interest to the students during preparation for practical training exercises and individual home assignments in the course of Descriptive Geometry and Engineering Graphics. The methods of teaching used for the decades should be reviewed taking into account a new generation of students, their habits of learning and the existing challenges provided by contemporary information technologies. An attempt was made to create new educational materials which would motivate the students to work autonomously with the theoretical materials. An Augmented Reality (AR) based applications were used to entertain the students during the studies of the development of spatial reasoning in the first year studies. The efficiency of the regular tests on understanding the theoretical issues of descriptive geometry and engineering graphics was evaluated. For this purpose a portal ORTUS of Riga Technical University (RTU) was used. ORTUS – a multifunctional educational portal developed by IT Department of RTU – links together all the individual online applications required for studies within one framework in order to simplify the use of it and have a single access. As one of the numerous modules in this portal is a Moodle based Learning Management System. The recommended study materials like theoretical lectures, examples of completed graphic exercises, video lectures, didactic toolkit for development of spatial skills and tests are available to the students online with individual authorization. An approach used was supposed to facilitate the students to acquire more practical skills in solving graphic exercises and improve the quality of graphic education.

KEYWORDS: Engineering Graphics, Moodle Learning System, Augmented Reality

2. INTRODUCTION

Being one of the fundamental subjects of engineering education, the descriptive geometry shall and may be brought into line with changes in the overall system of

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education. Experiments in various areas where the discipline might be updated have been conducted over and over again. With the world changing, the methodology for teaching descriptive geometry, which has been honed to perfection for years or decades, suddenly becomes ineffective. The main challenge is to update both the course in descriptive geometry and the methodology of its teaching within existing time limitations, identify the ways to improve the efficiency of learning delivery and make qualitative changes in both the process of professional training and its results.

The special nature of teaching students in their first years of studies should not be omitted [1]. For students, yesterday's schoolchildren, the first year is a period of adaptation to the university's requirements and new forms of learning. The trends currently observed in the development of professional education bring forward an independent work of students as the main form of learning.

In the presence of computer games a new generation has grown up. Today's students represent the first generations to grow up with this new technology [2]. They have spent their entire lives surrounded by and using computers, videogames, digital music players, video cams, cell phones, and all the other toys and tools of the digital age. Our students today are all "native speakers" of the digital language of computers, video games and the Internet. The children initially begin playing games and only later they begin to learn writing and reading or the processes are parallel. It is now clear that as a result of this ubiquitous environment and the sheer volume of their interaction with it, today's students think and process information fundamentally differently from their predecessors. They would like to get necessary information quickly. They like to parallel process and multi-task. They prefer their graphics before their text rather than the opposite. They prefer random access. They prefer games to "serious" work.

From the trend of reducing the number of contact hours in the class, there is a need for more time to study the subject independently. On the other hand, it must be borne in mind that this new generation of students is already at the university. Thus there is an urgent need to change an approach to teaching and practical exercises.

In this paper we share our experience of the use of newly developed training materials which take into account those special factors related to the new generation of students tailored to study the material independently. It is assumed that these practical exercises are more applicative, attractive and more entertaining to students.

3. COURSE IN MOODLE ENVIRONMENT

Moodle is an open-source learning course management system which helps the educators to create effective online learning communities. Moodle is an alternative to proprietary commercial online learning solutions, and is distributed free under open source licensing. All the study materials of Department of Computer Aided Engineering Graphics courses have been located in the Moodle based portal of RTU named ORTUS and they help the students in mastering the topics of these courses.

The use of Moodle environment provides an alternative opportunity to get theoretical materials in electronic form rather than in printed books, to communicate with an instructor and test the knowledge of understanding current topics of study.

The course “Descriptive Geometry and Engineering Graphics” (3 ECTS) is organized in weekly format. Theoretical material was presented in the form of chapters of textbooks, materials of lectures and examples of drawings performance step-by-step as PDF documents as well as video training materials and video lectures.

Participants of the course have to complete the tests located in Moodle system. Performance of the test provides an opportunity to independently estimate a level of the knowledge about studied theoretical material. Presented on a Figure 1 is an example question from the test on a topic ”Intersection of a plane and solids”.

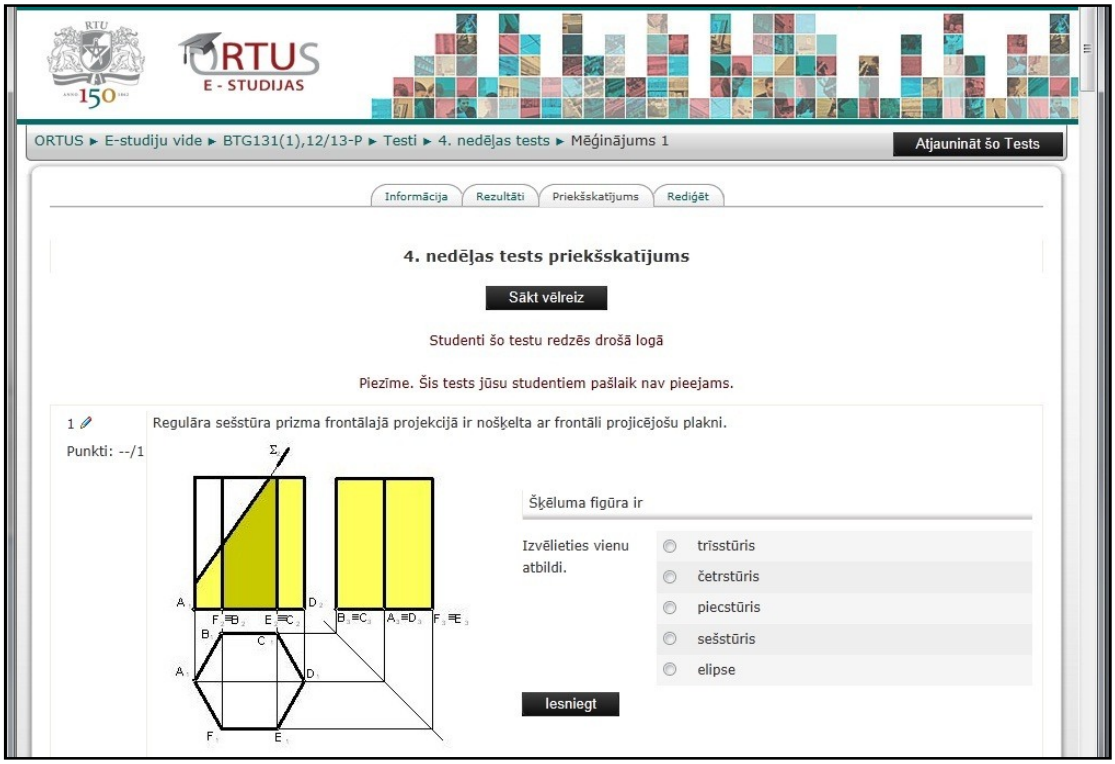

Fig. 1. An example question from the test
on a topic ”Intersection of a plane and solid”

To provide an encouragement for students to study, the previous two academic years’ the tests were obligatory. Each week the course participants had to complete one test based on the topic/s discussed in the class during contact hours. The tests were accessible for two or three weeks depending on the complexity of the topic. The test time was limited to 60 min; before Spring 2013 semester there was only one opportunity for the students to perform the tests and only final score was accessible to the students. As an experiment in Spring 2013 semester, the number of attempts for

the test completion was increased to three. After completion of each test the students could see not only final points but also the correct answers. During the repetitive tests the Moodle system provided the questions in a new sequence and the provided answers also were in a new rearranged order.

According to our previous research [3], the students very actively used the provided video materials in the learning process. In the surveys at the end of the course many students described the video materials as a required tutoring resource. Therefore we created video lectures for the following courses: Descriptive Geometry and Engineering Graphics, Interactive Computer Graphic, Computer Aided Design.

Video lectures are prepared by lecturer and the students can view and study them repeatedly as many times as needed to accommodate to their individual learning abilities. Lectures are detailed step-by-step explanations of the materials covered in the classroom lectures and are presented at a delivery pace that is significantly slower than what can be accomplished in the limited time available in the classroom. They can be paused and repeated and, thus, can be studied by students at their own learning pace. In addition the video lectures are much more focused on the learning experience rather than the traditional study from the written textbook. Textbooks usually contain a broad range of topics and they cover the theory in the sequence that might be inconsistent with the instructor's presentation of the material in the classroom. The video lectures are exclusively targeted to what the student needs to learn according to the course syllabus.

Video lectures allow the instructor to shift the classroom time spent on basic, less challenging material to more complex and difficult subject material [4]. By including more-complex information in classroom lectures, they are faster paced and provide the stimulation of more interesting material. Students who cannot fully understand and learn at this pace have the video lectures as a slower and very thorough second-lecture they can study at their own learning pace.

4. AUGMENTED REALITY TEHNOLOGY IN LEARNING PROCESS

Engineering graphics is the subject which is important for the transferring technical information from design into manufacture. Developing ability to create and read graphical representation of engineering structure is essential for any individual modern engineering student. However, in the classroom, where lecture time is very limited, it is hard for the instructors to clearly illustrate the relationship between the 3D geometry and 2D projection using only one kind of presentation technique.

Augmented Reality (AR) application enables faster comprehension of complex spatial problems and relationships which will benefit the students greatly during their learning processes [5]. Augmented Reality is a new technology that lets you interact with the real world and virtual objects at the same time.

To facilitate the students' perception of the study materials in the course "Descriptive Geometry and Engineering Graphics" we prepared the 3D objects from manual graphic exercises into AR environment. The 3D Augmented Reality scenes

were created using BuildAR software. The virtual 3D models were overlaid on the real world environment as observed through the computer's web camera, making them to appear as part of the surrounding environment (Fig. 2). BuildAR uses marker-based tracking, which means that the 3D models appear attached to a physically printed markers. For each object both its individual marker and 3D model were created and in that way the AR scene was built up. The 3D models were modelled with SolidWorks and saved as STL files for later import into AR scene.

The surveys at the end of the semester revealed the student's opinion on the effectiveness and usability of AR models in the course. All the students considered this approach as being very useful in the solving of graphic exercises. It was acknowledged as very interesting and entertaining for the topic on formation of multiview projections from 3D geometric objects. Especially interesting was the provided freedom of arbitrary observation of the transformation of 3D AR model into 2D projections, which could be interactively manipulated in real time in front of computer with web camera. The overall response of the students about AR model use in the Descriptive Geometry and Engineering Graphics course was very positive.

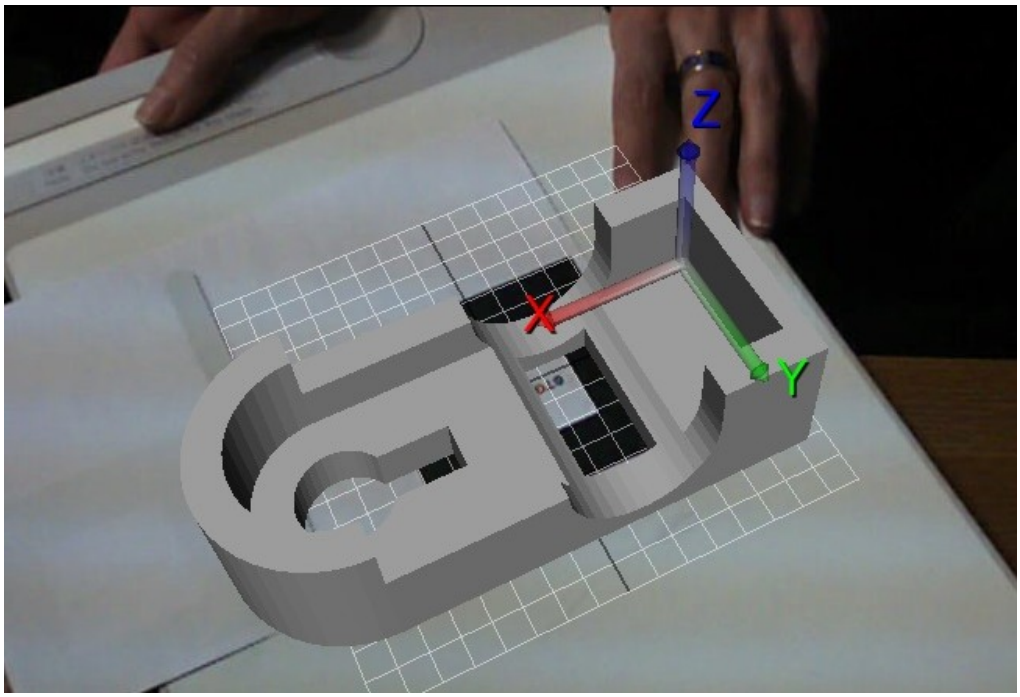

Fig. 2. Three-dimensional virtual model in Augmented Reality environment

5. CONCLUSIONS

The created video lectures and AR models considerably improved the interest of learning, supplied the students with higher degree of flexibility and understanding of the teaching materials and entertaining them in an interactive and augmented way.

Video lectures allowed getting the necessary information very quickly and made the theoretical material more intuitive and understandable. During the study the students could control the rate of perception of huge amount of graphic information. The video lectures supplied with the study material which was more adapted and focused to the learning habits and experience on today's students rather than the traditional study from the textbooks.

The AR application enables faster comprehension of complex spatial problems and relationships which will benefit the students greatly during their learning processes. Applying AR technology to support learning activities may become a trend in the future not only for Engineering Graphics but also many other subjects. However, the lack of financial resources at present situation prevents a further development and implementation of this advanced technology in the study process.

Tests are useful tool for independent estimation of knowledge level of the theoretical material. The compulsory tests facilitated increased students' activities in Moodle environment. This motivated the students to study more and superior in the graphic literacy. The quality of engineering graphics education could be considerably improved, but the preparation of the digitally usable materials in electronic form for graphic subjects which contain a huge amount of engineering information, requires enormous time and human resources.

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Scientific Proceedings of the 12th International Conference on Engineering Graphics BALTGRAF 2013

Editor M. Dobelis

BALTGRAF 2013

June 5-7, Riga, Latvia

RIGA TECHNICAL UNIVERSITY

2013

Support for publishing provided by the European Community under national project "Development of international cooperation projects and capacity in science and technology Riga Technical University".
Contract No. 2010/0190/2DP/2.1.1.2.0/10/APIA/VIAA/003

ISBN 978-9934-507-30-4
Scientific papers were peer reviewed
English (U.K.) was used for the spellchecking of all submissions
iThenticate® was used as plagiarism checker for content originality
BALTGRAF 2013 acknowledges EasyChair conference management system

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Scientific Proceedings of the 12th International Conference on
Engineering Graphics BALTGRAF 2013
June 5-7, 2013, Rīga, Latvia. -300 pp.