THE USE OF MIXED REALITY FOR CULTURAL AND HISTORICAL EDUCATION

I. Peteva, S. Denchev, I. Trenchev

University of Library Studies and Information Technologies (BULGARIA)

Abstract

Promoting cultural and historical heritage through information technologies (IT) is an extremely working formula for the proper use of technologies in the process of perception and study of human cultural heritage. The opportunities offered by the modern technologies allow more attractive, adequate and correct way to enrich the options for accessing elements of the cultural and historical heritage (CHH).

Cultural and historical heritage education is a complex and multidirectional process that requires interdisciplinary approaches, in order to achieve deeper knowing of the existing knowledge and at the same time create a capacity to research, preserve and promote new discoveries. Today, the training of these professionals is opening up more possibilities for the application of mixed reality. The creation of virtual reconstructions, through 3D models, enriches the forms for providing a learning environment and improves the ways to providing information and new knowledge.

This paper provides a brief retrospective of the R&D project "Mixed Reality Application in Learning and Promoting Cultural and Historical Heritage in a University Information Environment". The results of the survey of young people' attitude studying CHH to the application of new 3D technologies and their introduction into education are presented. The results of the analysis of the obtained data among students studying computer science are presented regarding the sufficiency of their hours for studying 3D technologies and their desires to continue their career development in this field.

The results presented confirm our initial hypothesis that young people are open to the new 3D technologies. They want to touch this unfamiliar world. Students are eager to get involved in such research projects. They want new technologies to become an invariable part of their courses.

As a natural part of this paper, we will also demonstrate some of the scientific and practical results of the project – the creation of complex 3D objects related to CHH through open source software.

Keywords: Mixed reality, cultural and historical education, 3D.

1 INTRODUCTION

Virtual Reality (VR) can be presented as computer generated 3D models of a realistic experience. In most cases, VR replaces the real world with the Virtual World. The digital world can be simulated by a computer or by presentation or by other means of reproduction. Examples are Google Street View with Earth VR, computer games, NASA design systems, etc.

Augmented Reality (AR) is a similar concept. With this technology, reality is augmented by computer-generated content that is added to or embedded in the real-world experience. Unlike VR, the two can 'co-exist' together. Milgram and Chishinu [1] suggest a new approach – a combination of the two technologies between the real and virtual world, giving rise to a 'mixed reality'. The concept of this technology is not yet fully understood, and many authors dispute the scientific formulations and ways of reproducing and combining real objects.

Mixed Reality (MR) is the confluence of the real and virtual worlds to create new environments and visualizations where physical and digital objects coexist and interact in real time. Mixed reality is not exclusively realized in the physical or virtual world, but is a hybrid of reality and virtual reality, encompassing both augmented reality and augmented virtuality through the so-called immersive technology [2], [3].

MR can be seen as connecting the real and virtual worlds to create new visualizations. The advantages of this technology are that real and digital objects interact in real time[1]. Mixed reality is trying to combine the two technologies and take the best of both.

[1] https://en.wikipedia.org/wiki/Mixed_reality

According to Johnson, Levine, Smith, & Stone (2010) [2] AR dates back to the 1960s as the first system was used for both AR, and VR. They use an optical visualized header display, which is tracked by one of two different methods: a mechanical and an ultrasonic tracker. Due to the limited processing power of computers at this time, only very simple wireframe drawings could be displayed in real time (Sutherland, 1968) [3]. Since then, AR has been used by a number of large companies for visualization, training and other purposes. The concept of "augmented reality" is thought to have been coined by former Boeing researcher Thomas Caudell, 1990 [4], [5], [6].

Johnson, et al. (2010) claimed that “AR has strong potential to provide both powerful contextual on-site learning experiences, and serendipitous exploration and discovery of the connected nature of information in the real world“ [2], [7].

According to the article by Lee [4] AR and MR can be applied, both in the school and in the business environment, albeit not so much. Numerous new examples can be discovered as to how technologies creating AR can be applied not only in academic places through personal PCs but through mobile devices as well. The application of wireless mobile devices such as smart phones, tablet computers and other electronic innovations introduce the MR deeper into the mobile environment, where applications promise a lot, especially in education and training [8].

2 METHODOLOGY

With the development of 3D technology, virtual walks have become an important factor in exploring CHH. They provide a realistic way to better represent architectural sites, museums and galleries in the digital space. The 3D representation of models should include the necessary information so that users receive the same [3] knowledge as when they actually visit the site.

CHH training is a complex and multifaceted process that requires interdisciplinary approaches to achieve in-depth knowledge of existing knowledge and at the same time create the capacity to discover, explore, preserve and promote new findings [8] [9]. In order to explore how young people are open to new technologies and want to include new teaching methods in their lectures, we conducted two surveys [10], [11]:

- Among students in Computer Sciences programs and
- Among students in the humanities.

The purpose of the empirical study is to identify, analyze and summarize the students' understanding of the application of 3D technologies in university lecture courses, as well as their attitude to the problems of preserving the tangible and intangible cultural and historical heritage, according to the documents of UNESCO [4], [12 -15].

The aims of the study are to be explored:

1 the level of knowledge and awareness on the issue – what is mixed reality.

2 the attitude to the issue – applying mixed reality in the training and the promotion of CHH.

Within the empirical research, the objective is to be achieved by solving the following research problems:

1 to determine the degree of students’ awareness of issues related to the nature of 3D technologies and their application in training;

2 to identify and analyze students’ level of competency in the application of mixed reality in promoting CHH.

3 To determine the effectiveness of training and the application of 3D technologies in the field of social communications and information sciences and the need to introduce such training in universities that do not offer it.

4 To determine the attitude and willingness of the interviewed students to participate in projects using mixed reality in education and to promotion of CHH.

The two studies were carried out within the project “Application of mixed reality in the teaching and promotion of cultural and historical heritage in a university information environment” [10], [16], [17].

Today, 3D modeling is used even more widely than medicine to engineering applications. It (3D modeling) and visualization have made it possible to refine the technology, especially with animations

[15], [18]. It turns out that the use of these models is already becoming more common than before. Early computer graphics are vector graphics made up of thin lines, while graphics today is based on pixels.

We can summarize that the search for opportunities to extend access to cultural content through digitization and creation of 3D models also helps to overcome the problems of social exclusion, the digital divide, and facilitate access to cultural heritage throughout the territory of the Republic of Bulgaria [19], [20].

The trend was examined through a survey. We tracked, through pre-set indicators, the change in the number of users interested in digitalized cultural values. And we have synthesized the conclusion that the advent of these new forms of promotion of cultural heritage contributes significantly to its promotion to a wider audience, which in turn is a prerequisite for stimulating, for example, cultural tourism.

3 RESULTS

Modern education must follow and adapt to the development of technology. Its environment should resemble the natural environment of the lives of schoolchildren and students – there should be spaces for shared learning and teamwork; a technique that will be of service to the students; classrooms should be organized into corners, especially for younger students. Globally, this is extremely popular, and the idea of the rows of desks and the podium for a teacher must be completely forgotten (in our opinion sometimes this archaic topology has its advantages and should not be excluded from use in educational institutions)

The specialized survey conducted among students studying computer science was conducted mainly in two universities – the University of Library Studies and Information Technologies – Sofia, Bulgaria and Southwestern University 'Neofit Rilski' – Blagoevgrad, Bulgaria. The total number of respondents in the two universities is 215, of which 101 are women and 113 are men. The total number of BAs in both universities is about 760 people. Our survey covers 30 percent, which gives representativeness. A large percentage of the respondents are between 19 and 28 years old – 77.2 percent. Fig. 1. The survey continues at three more universities in the Western Balkans: Mediterranean University of Tirana, Albania; University of Niš, Serbia and Trakia University of Edirne, Turkey.

Our research includes not only a questionnaire survey but also an analysis of the application of new technologies in a university environment, with lectures being used by second- and third-year students using new technologies such as photogrammetry, mixed reality, etc.

Figure 1. Presenting the gender and age of those interviewed

Our results have confirmed that students are open to new technologies. They naturally perceive them Fig. 2. More than 85% of all respondents wish to use 3D technologies in the lectures.

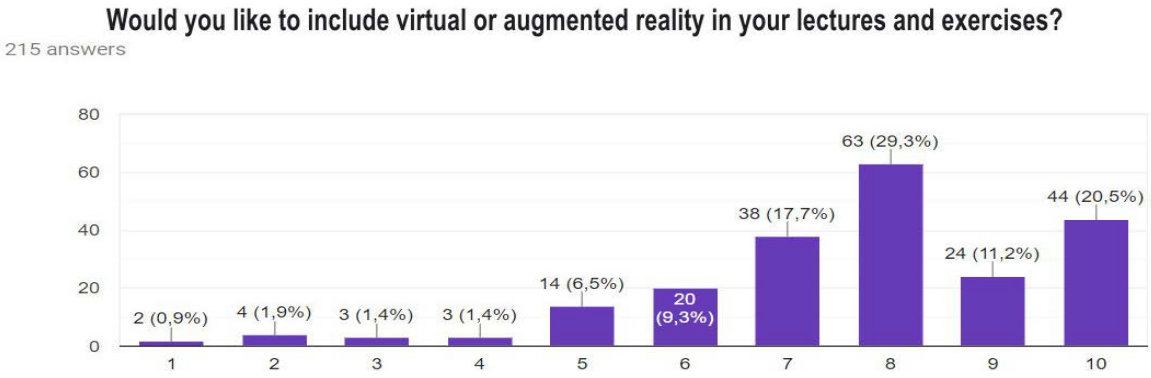

Figure 2. Presents students' desire to use mixed reality (virtual and augmented) in the lectures. 1 - I do not wish, 10 – I would like a lot.

In our lectures we used models created through the Unreal engine program. The students showed great enthusiasm and were interested in creating 3D objects themselves. When we first introduced the program, we did not mention to them that it was a program for creating complex scenes, nor did we say it was for modeling / creating primitives (Fig. 3).

We gave them the opportunity to determine the capabilities of the program themselves. Very quickly they intuitively discovered that another 3D modeling program such as Maya, Blender, 3Ds Max, and so on should be used alongside the major one.

Figure 3. Unreal engine for creating AR

Another survey was conducted among students studying humanities at four universities:

- Veliko Tarnovo University 'St. St.Cyril and Methodius';
- University of Library Studies and Information Technologies;
- Shumen University 'Konstantin Preslavski';
- Southwestern University 'Neofit Rilski'.

The reason for this is that only at these universities is the specialty of Cultural and Historical Heritage offered.

The total number of respondents was 316, of which 175 were women and 141 were men (Fig. 4). The universities are Veliko Tarnovo University 'St. Cyril and Methodius' – 12, University of Library Studies and Information Technologies – 59, Shumen University 'Konstantin Preslavski' – 207, Southwestern University 'Neofit Rilski' – 38. Those interviewed comprise about 25 percent of all students at those universities, which is representative enough for our study.

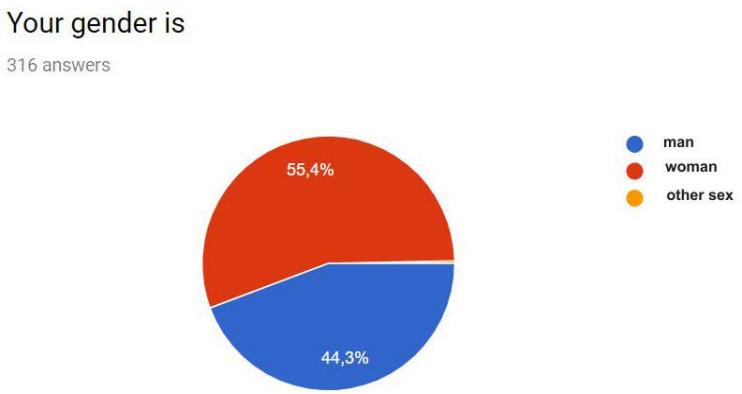

Figure 4. Presenting the number of those surveyed

Contrary to our expectations that the use of 3D technology will make it difficult for these students, the survey showed that students not only want to study and enjoy mixed reality, but would be keen to be involved in protecting and promoting CHH projects. 238 (75.3%) state that they are familiar with 3D technologies. 71.2% of those surveyed believe that learning about 3D technology would enrich their learning. The link between 3D technology and CHH training is presented in the following figure (Fig. 5).

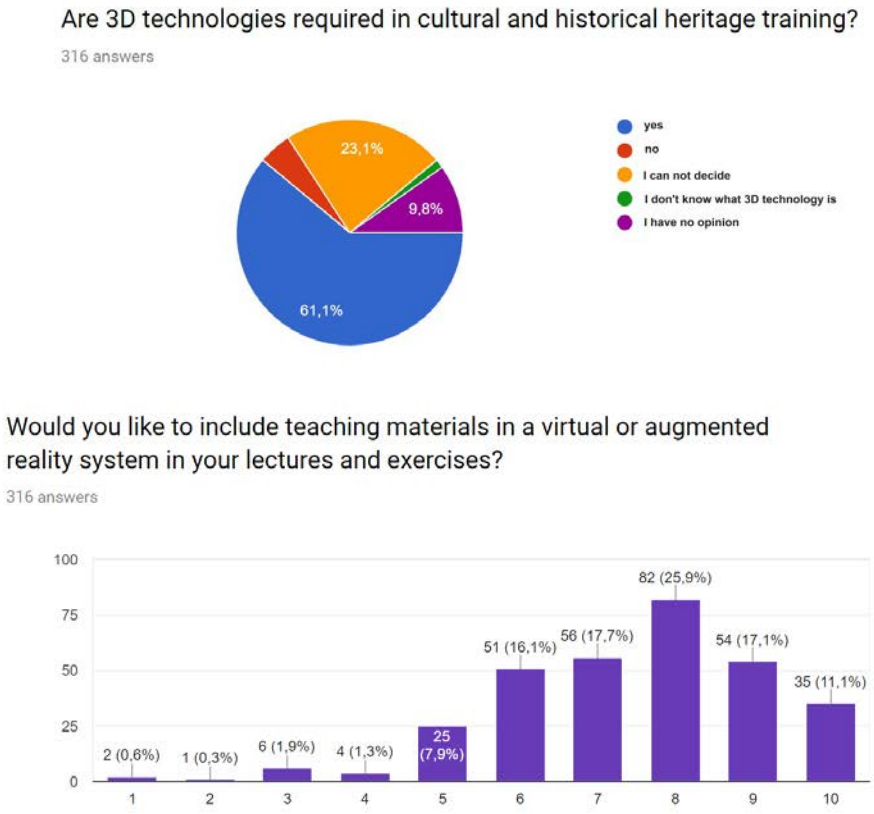

Figure 5. Presents students' desire to use virtual and augmented reality in the lectures. 1 – do not wish, 10 – would like a lot.

In an experiment during lectures with all students whether they would like to try and create a 3D model of a real historical object, only a small part raised their hand. It turned out that those were the ones who could paint. We introduced the students to the possibility of creating a 3D model through photogrammetry.

It is a technique for determining the three-dimensional geometry (location, size and shape) of physical objects by measuring and analyzing their two-dimensional photographs. Generally, photogrammetry is divided into two categories: aerial and terrestrial photogrammetry. In aerial photogrammetry, images are

obtained through aerial photographs of aircraft, providing topographic maps and details of land use. In terrestrial photogrammetry (also called non-topographic photogrammetry), images are acquired at locations near or on the surface of the earth and provide detailed information about the size of an object (Fig. 6).

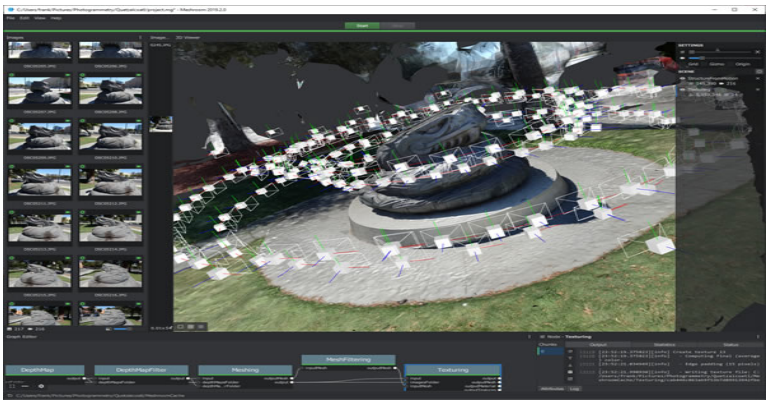

Figure 6. Creating a 3D object by taking photos of a real one
[a copy from https://eleccelerator.com/outdoor-photogrammetry-adventures/]

The advantage of this type of model creation is in its simplicity. We take a series of photos /360 degrees/ around the object. This can be done through a GSM or camera. We put the photos in the program and start the processing. The created object can be used in any 3D program.

Photogrammetry has become very popular in recent years because of its simplicity and convenience.

4 CONCLUSIONS

The advantages of such an approach are obvious. Mixed reality training has been used for a long time by companies, academia and the military. The advantages of this type of training are the following:

- It is more interactive;
- It is more accessible;
- It is cheaper;
- It is remotely managed;
- It is safer;
- The learning material is memorized and reproduced more easily.

One of the trends in modern education is lifelong learning. A 3D model can be used at home, at work or even while walking. If we have to do a computer simulation, it is much safer than the real one and once created we can use it many times.

Modern research shows that the learning material delivered through these new technologies is very fast to learn. The learner cannot be bored because he / she is part of the educational process and if he / she does not react the system does not continue to train.

ACKNOWLEDGEMENTS

This research would not have been possible without the financial assistance of the following project: “Application of the mixed reality in the training and promotion of the cultural heritage in a university information environment” financed by National Science Fund of the Ministry of Education and Science of the republic of Bulgaria with Contract KP 06 OPR 05/14 from 17.12.2018, led by Prof. DSc Irena Peteva.

REFERENCES

[1] P. Milgram, H. Takemura, A. Utsumi, F. Kishino "Augmented reality: a class of displays on the reality-virtuality continuum", Proc. SPIE 2351, Telemanipulator and Telepresence Technologies, 1995. http://etclab.mie.utoronto.ca/publication/1994/Milgram_Takemura_SPIE1994.pdf

[2] L. Johnson, A. et al., Simple augmented reality. The 2010 Horizon Report, 21-24. Austin, TX: The New Media Consortium, 2010.

[3] I. Sutherland, "A head-mounted three-dimensional display". Proceedings of Fall Joint Computer Conference, pp. 757-764, 1968.

[4] L. Kangdon, "Augmented Reality in Education and Training", Tech Trends, vol. 56, no. 2, pp. 13-21, 2012.

[5] T. Kondo, "Augmented learning environment using mixed reality technology", Proc. E-Learn, pp. 83-88, 2006.

[6] R. Freitas, P. Campos, "SMART: a System of augmented reality for teaching 2nd grade students." Proceedings of the 22nd British Computer Society Conference on Human-Computer Interaction (HCI 2008), 27-30. Liverpool John Moores University, UK, 2008.

[7] S. Mann et al., "All Reality: Virtual, Augmented, Mixed (X), Mediated (X,Y), and Multimediated Reality", HC conference, https://arxiv.org/pdf/1804.08386.pdf pp. 11-26, 2018.

[8] R. Henry Luce (Editor). Special Double Issue: Photography. Life Magazine pp. 112–113, 1966.

[9] E. Tsvetkova, I. Peteva, I. Pavlova. Attitude of Bulgarian Library Specialists Towards Use of Library Resources for Mobile Learning // ICERI 2018 Proceedings, IATED Academy, Seville, Spain pp. 838-842, 2018.

[10] N. Borisova, An approach for Ontology Based Information Extraction (OBIE), Information Technologies and Control (ITC), vol. 12, no. 1, pp 15–20, 2017.

[11] E. Stavrova, , M. Trencheva , E. Koletca, , B. Kostadinova, ,"System for monitoring the economic situation, development and the contribution of the tourist industry to increase the welfare", International Scientific Conference „The cultural corridors of south-eastern Europe: cultural tourism without boundaries", Santorini - Greece, 02-10 October 2018, pp. 88-97, Publication 2018.

[12] K. Planska-Simeonova. Copyright Protection of Photographic Information in Compliance with the New Regulations of The European Union. // 11th annual International Conference on Education and New Learning Technologies Palma de Mallorca (Spain). 1st - 3rd of July, 2019, pp. 5040-504.

[13] E. Zdravkova Media literacy as a key competency for the safe and effective use of media, Proceedings of ICERI2019 Conference 11th-13th November 2019, Seville, Spain, pp. 7467 – 7473

[14] T. Trencheva, E. Zdravkova-Velichkova, "Intellectual property management in digitization and digital preservation of cultural heritage, In Proceedings of EDULEARN19 Conference, 1st-3rd July 2019, Palma, Mallorca, Spain, pp. 6082-6087 , 2019

[15] D. Stoyanova, E. Savova, I. Peteva, R. Yotova. 2018. Academic Research Projects For Students Support And Motivation In University Information Environment. – In: Proceedings of ICERI2018 Conference 12-14th November 2018, Sevilla, Spain, , pp. 9706-9709. 2018.

[16] R. Manolova, Study of the Key Factors Impacting the Motivation of Bulgarian Students to Select Higher Education // ICERI 2018 Proceedings, November 2018, Seville, Spain, 2018, pp. 340-344, 2018.

[17] S. Dimitrova, E-content – intellectual property aspects // International Conference on education and new learning technologies, EDULEARN19 Proceedings, 1st-3rd July, 2019, Palma, Mallorca, Spain, vol. 11, pp. 6061-6065, 2019.

[18] T. Trencheva, T. Todorova, E. Tsvetkova, „Intellectual Property Training of Library and Information Management Bachelor's Students", Information Literacy: Key to an Inclusive Society: 5th European Conference on Information Literacy (ECIL): Revised Selected Papers, pp. 294-302, 2017.

[19] T. Trencheva, K. Planska - Simeonova, S. Dimitrova. “Interaction in Intellectual Training In University Infrastructure: the Experience of the University of Library and Information Technologies”,12th Annual International Conference on Education and New Learning Technologies. Conference Proceedings, 12-14 November 2018, Sevile, Spain, vol. 7, pp. 1142-1149. 2018.

[20] M. Trencheva. “Development of accounting principles in Bulgaria”, In Proceedings of 100th Anniversary of the Accountancy and Analysis Department International Conference on “Accounting and its Contribution to the Economic Science” University of National and World Economy 20 February 2020. In press.