HOW VIRTUAL REALITY IS TRANSFORMING LEARNING

In today's developed world, universities are innovation centers. Typically, innovations are not limited to technological development; innovations in pedagogy are equivalent to technological ones, but nowadays the extended reality (XR) technologies that cover virtual reality (VR) and augmented reality (AR), already significantly affect pedagogy in higher education. XR is a generic term that covers a wide range of technologies, which combine real world with full immersion in simulation. Over the past few years, various technologies of extended reality have become increasingly widespread, as their cost is decreasing and their ease of use is increasing. Consequently, they have a truly significant impact on the educational process.

In order to understand the power of this impact, Educause (US), a non-profit association, together with the leading American IT company Hewlett-Packard (HP), has been exploring the potential of XR technology in higher education. The Campus Future project was devoted to the study of a subset of XR technologies related to 3D modeling, modeling and production: VR, AR, 3D scanning and 3D printing. The aim of this study was to determine the innovative impact of these technologies in HEIs, as well as their impact on teaching and learning, and to determine the future prospects for using these technologies.

The project was launched in early 2017. Although it was not the first one in the field of studying the XR technologies impact on the educational process, unlike the previous projects (for example, a joint project with Yale University), this one is the most extensive, since it covers a larger and more varied sample of institutions and learning environments, as well as more users. Eleven American universities and colleges were selected to participate in the project, which had already been among the leaders in term of integration of 3D technologies in pedagogy, hence they had the experience of using 3D-technologies available for learning (although there appeared additional opportunities for all of these institutions during this project): Case Western Reserve University, Dartmouth College, Florida International University, College of Communication, Architecture + The Arts (CARTA), Gallaudet University, Hamilton College, Harvard University, Graduate School of Education, Lehigh University, The Wilbur Powerhouse, MIT, Scheller Teacher Education Program, Syracuse University, Newhouse School of Communications, University of San Diego, Yale University. The reason for choosing such an unrepresentative sample, besides the mentioned above, was the very purpose of the study — determining the leading point of using this technology at an educational institution and thus attempting to demonstrate the future of 3D technology in higher education.

For the research purposes, HP provided HEIs with the training facilities and technical support, and Educause provided methodological expertise. During the academic year 2017-2018, the institutions involved were required to use the equipment provided for active training using 3D technologies as a component of research projects, as well as to track how teachers and students use their equipment, and to collect data for analysis. The study also involved the staff of the educational institution, which develops training courses and tasks, and staff members of information technology departments and campus centers that provide technical support.

Within the process of the study it was assessed how the educational institutions use 3D technology, the obstacles in its implementation were identified, the projections of the possible future of 3D technology in higher education were made, and the provisions of guidance on technical requirements, support needs and organizational policies for institutions wishing to deploy 3D technology on campus were made. In addition, 3D technologies which are most effective for various learning purposes were determined, interesting and new ways of their usage were identified, as well as the types of 3D technologies that have the greatest potential for learning and further research.

The key finding of the study is that the usage of extended reality technologies in higher education provides active and experimental learning, facilitates collaborative experience and collaboration, and supports a wide range of educational goals across a wide range of disciplines. Such achievements become possible primarily because they:

- Create the "presence effect". Thus, a good simulation of virtual reality provokes the same emotional and physiological reactions as the real world does. In addition, technology is constantly evolving, and the visual effects of VR and AR gradually are enriched by audio and tactile functions. For example, with the virtual reality helmet in Google Earth, one can visit any part of the world during a geography lesson;
- Provide training based on "personal experience". Thus, virtual simulations allow creating and using objects in ways that are not available in the real world: for example, to look through the surface, or read data from objects. With 3D printing, one can create physical objects that can not be made from other materials. In practice, zoo-archaeologists from Stanford had digitized animal skeletons with the help of these technologies. 3D models help students learn to identify bones of different animals by their fragments, and they can view these fragments from all sides;
- Provide individual practice and acquisition of skills. In medical specialities, for example, VR allows students to gain practical experience that can not be obtained in another way. For example, medical students may train to cut tissues and test emergency measures for rare diseases. Repeating operations for many times, the students refine their skills;
- Allow gaining experience related to objects that might otherwise not be available in educational and research contexts. Thus, the added reality allows users to interact with an object with "super capabilities", such as the ability to view the surface or view objects that overlap data. With 3D printing, users can quickly create physical objects that otherwise can exist only in simulation;
- Allow expanding the possibilities of high-speed and expensive training. Indeed, the development of a simulation lab requires significant investment, but it is much cheaper than building and maintaining a real-life laboratory. In addition, a simulated lab may be available to people from various locations. Therefore, VR and 3D technologies allow access to laboratory use by a much larger number of users, even at the same time.

The use of VR, AR and other technologies faces a number of challenges and contradictions. In particular, regarding the possibilities and constraints for the use of technologies, the results of the study determined that:

- Extended reality technologies help enhance, and sometimes even require collaboration between institutions and universities. The deployment of new technologies often contributes to new co-operation in campus. For example, the support of 3D technology users in campus requires various knowledge that encourages (or even requires) collaboration between campus IT departments and instructors. The use of 3D technologies also facilitates collaboration with students and lecturers in various academic disciplines. In addition, many students and university teachers need support to learn how to use this technology.
- Development of training sessions and workshops dedicated to 3D-related issues is extremely important in order for this technology to be widespread. It takes time for the benefits of 3D technology to be realized in an educational institution. And while the usage of extended reality technologies is gradually becoming easier, they still need customization: software must be installed and constantly updated. In addition, users need time to learn how to use technology, and instructors need time to figure out how to best use technology in learning.
- Implementation of 3D technology should be gradual. The first year of deployment of this technology may be mainly devoted to studying the ways of its usage, integration into learning processes, and may last up to two years; and training courses using 3D technology must first be tested and may be further improved.

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