PROBLEMY NOWOCZESNEJ EDUKACJI

The problems of modern education

Tom X (Jubileuszowy)

Rozwój – Potencjał – Deficyty (III)

Development – potential – deficiency (III)

**Pod redakcją
Edyty SADOWSKIEJ
Agnieszki M. MARKOWSKIEJ**

Częstochowa 2020–2021

Spis treści

Inokentii KORNIIENKO
Mukachevo State University, Ukraine

Augmented Reality in Education

Problem's statement

Augmented Reality can be applied for learning, entertainment or edutainment by enhancing a user's perception and provide interaction with the real world. Augmented Interface is one of the important ways to improve learning because it enables the manipulation and study of three-dimensional virtual objects.

Numerous devices exist to enable the teachers to make their students study, including games and encounters that are both simple and advanced, each taming the intensity of multi-tactile learning. Nevertheless, none of those apparatuses appears as encouraging in conveying learning through embodied cognition as the new kind of innovations, such as Augmented Reality. Augmented Reality (AR) is a kind of technology where students can interact with subject materials in the ways never available before.

Immersing learners to real world and make them to interact with that world's concepts and features is, in many spheres, not very possible or rational. Although the natural world is three-dimensional, we prefer to use two-dimensional approaches in education which is the simplest, familiar, universal and what is the most important – cheap. But it is static and offers no dynamic content. Instead, augmented reality created by machines can be used. Such approach needed high-performance computer graphics that were far more costly, but now even an average smartphone can provide a satisfactory level or AR support.

While there could be plenty of possibilities for teaching and learning in simulated environments, it is challenging to have an appropriate degree of realism. When people are very absorbed by Virtual Reality, they separate themselves from the actual environment. Nevertheless, Augmented Reality instead, proposes modeling on top of the existing physical environment and gives simulated and merged virtual and real environments.

Analysis of recent researches and publications

Augmented Reality technology is not a very new idea in the world. It has already been used in spheres such as military; medicine; engineering design; ro-

botic; telerobotic; manufacturing, maintenance and repair applications; consumer design; psychological treatments, etc. (Azuma, Baillot, Behringer, & Feiner, 2001). Augmented Reality has become a topic of numerous explorations recently. Both theoretical and experimental framework allowed receiving valuable results and proofs of beneficial use of AR technology in teaching.

Govindarajan, Singaravelu & Sivakumar, A. in the paper "Augmented reality in teaching and learning process" introduce the technology of augmented reality and its possibilities for education. Key technologies and methods are discussed within the context of education. Yadav, Savita & Chakraborty, Pinaki & Kochar, Gurtej & Ansari, Deeheem discuss interaction of children with an augmented reality smartphone app. The objective of this study was to determine the age at which children become capable of using smartphone apps with augmented reality. The authors developed an augmented reality smartphone app. They studied the interaction of the children aged between two and eight years to determine their interest in using the app. A proficiency test was used to determine the ability of the children to use the app. Lasica, Ilona-Elefteryja & Meletiou-Mavrotheris, Maria & Katzis, Konstantinos provided an overview of a Teacher Professional Development program that has been designed, pilot tested, and implemented to investigate the impact of augmented reality (AR) on: Teachers' level of technology acceptance, adoption of inquiry-based instructional approaches, and confidence towards teaching twentieth-first century skills in STEM-related courses; students' potential enhancement of specific twentieth-first century skills and motivation and interest during a STEM – (science, technology, engineering, mathematics) – related course supported with AR. Wells, Trent & Miller, Greg indicated the teachers generally held favorable opinions about VR technology intertwined with a considerable degree of uncertainty about the technology and its uses. To facilitate opportunities for VR technology-related professional development, the authors recommend teacher education faculties to develop their own knowledge and skills related to VR technology applications.

Using augmented reality in education gives the possibilities to use 3D data, objects and models being inside the reality. Mark Billinghurst states that Augmented Reality proposes unique features, such as:
— Support of seamless interaction between real and virtual environments
— The use of a tangible interface for object manipulation
— The ability to transition between reality and virtual reality.

The purpose of the research

This study has a dual aim. Firstly, definition of augmented reality (AR) is given. Augmented reality device capabilities and application innovations are listed. Secondly, the possibilities of AR in educations are discussed.

The results of the research

A modern technology dubbed "Augmented Reality" gives us special affordances, merging tangible and simulated environments. This is the latest option we can communicate with the unavailable science or nature environment. This system improves interactive experience on top of the physical environment by updating the actual reality and providing the user with a hybrid image, integrating the actual world seen by the user with the simulated scenes created by the machine. By integrating augmented reality interfaces with educational content, we can provide learners a seamless experience between the physical and virtual worlds. The latest method increases teaching and learning productivity and attractiveness. The capacity to overlay computer generated virtual objects inside the physical world changes our way of communicating and training in the direction of dynamic, rather than static learning.

To improve natural and intuitive user experience in real time, AR attempts to extend virtual objects on the actual ones. It is an immersive world in which simulated items change real life in real time. According to Azuma (1997), Augmented Reality needs to be characterized by three features: the integration of actual and virtual environments, real-time user interaction and applications of 3D environments. Augmented Reality allows the user to see the real world without immersing the user entirely into the virtual environment and aim to incorporate both simultaneously.

A Virtual reality and Augmented reality use the same hardware technology which share features, such as computer-generated realistic images, 3D models and interactivity. The only distinction is that Augmented technology attempts not to substitute the physical world but with the expanded realism – to complement it.

Smartphones, computers, helmets, glasses, gloves and other input and output systems are the key tools for AR. Two main types of displays used in the augmented reality, which are See-through (Monitor-based displays) and Video-see through systems. Head-mounted device (glasses) is a kind of display which is worn on the head or as part of a helmet. It has that has a small display optic in front of each eye. Video-see through systems are useful when you need to experience something remote or using an image enhancement system. Optical see-through systems combine computer generated scenes with "through the glasses" image of the real world. As a result – merged reality is reflected in the user's eyes.

Handheld devices are another kind of tools that use video-see-through technology, used to superimpose images over the real world. They are small electronic tools that can be held in hands by the user. With the modern computing power modern smartphones and tablets are almost the only affordable mass

handheld AR devices. The portability of mobile devices and the unique nature of high-quality cameras on modern gadgets are two key benefits of mobile augmented reality. The drawbacks are that the consumer will still hold the handheld unit in front and obscure the effects of classically wide-angle gadget cameras compared to the real world.

Spatial displays are presented in video-projectors, optical elements, holograms, radio frequency tags, and other tracking technologies to display graphical information directly onto physical objects without requiring the user to wear or carry the display (Bimber, Raskar, & Inami, 2007). Another way used to combine physical objects and computer-generated information is Projection displays. In this physical three-dimensional model computer image is projected to create a realistic looking object.

Pinch gloves with multiple sensors signal its position and orientation for the main computing devices and widely used in augmented reality. Pinch is a pair of stretch-fabric gloves, which contains sensors in each fingertip that detect contact. A remarkable system used gestures for a wide range of control and interactive functions. Cameras, multiple optical sensors, accelerometers, GPS, gyroscopes, compasses and other wireless sensors are used as tracking devices for positioning of the user's head or hand the whole body in the environment. Such technologies have a wide range of precision and accuracy.

The variety of devices and interaction of systems between the user and the virtual content of augmented reality is defined by systems user interface. There are four main ways of interaction in augmented reality: tangible, collaborative, hybrid and multimodal interfaces. Using these devices, we can develop different augmented reality systems. These are fixed indoor/outdoor systems and mobile indoor/outdoor systems. Mobile systems allow the user to walk and interact with changing outside world (as in Pokemon Go game) and fixed ones are the systems when the user has no flexibility to move outside the small allowed position.

The potential of utilizing smartphones and AR in education is massive. AR may provide students with additional digital knowledge in any topic in various ways and promote comprehension of complex information.

In education around the world today, we can find some excellent examples of using Virtual or Augmented Reality. The ability to connect realities and digital content has improved steadily, offering teachers and students more possibilities. An increased amount of reality animated content in class could draw students' attention and inspire them to participate in gaining additional knowledge.

While doing homework, students may scan certain elements of a book and receive text, audio or video tips from teachers. Or they may find useful information about the course, a teacher or other students which could lead to better communication.

Concept learning, practical skills training, quiz solving etc. lead to having a better knowledge of every class. For example, medical simulations can be one of the ways human anatomy is studied and discussed in a much greater depth.

Augmented Reality implies contact with 3D models, basically. The rotation, transparency, colour scheme, styles etc. can be described. Finally, realistic animations can be rendered using special devices such as holographic lenses rather than smartphones.

Theoretical knowledge is already not enough in technical fields for the learning of proper skills. Students should not be just listeners or passive observers anymore. Technical specialities students need professional and practical experience in their fields. Unlike VR, AR technology will contribute to a virtual practice through interaction, with enhanced tutorials, digital modelling and imagery. It is no secret that students who are inspired and dedicated understand and learn a subject better.

Within augmented reality in education, we can find different apps. Here we present just some the most profound examples.

E l e m e n t s   4 D by DAQRI studio is an app for studying chemistry. It allows combining different elements as the simulation, to see how they would react. To start it special triggers on printed cards are used. On their website, you can find lessons plans suitable for high school, secondary and elementary school programs.

A n a t o m y   4 D is best suitable for medical students. By scanning printed targets, the application shows 3D models of a human body and allows to interact with it. Users may change and adjust any part of the human body, learn more about parts, joints, functions etc.

H u m a n   H e a r t   3 D app with less content, but more specific is made to explore human heart in detail. 3D model of a heart completed with various animations and textual tips about it is presented.

A u g T h a t, is the application that brings AR in a classroom. AugThat mainly targets students who lack motivation with help of 360-degree virtual photos and multiple 3D experiences.

G o o g l e   T r a n s l a t e is just great for studying foreign languages without a dictionary. By using Google Translate special "AR mode" you may instantly check up unknown words. Works well both for students and tourists, to navigate in cities abroad.

A m a z i n g   S p a c e   J o u r n e y ,   S k y O R B   3 D ,   a n d   S t a r   W a l k. All of them have one purpose which is to study the space with all its features. It allows to learn more about stars, constellations, planets of the Solar System, galaxies, etc.

Augmented Reality can also be used to enhance group tasks. Augmented computer interfaces by merging virtual and real worlds enhance face-to-face and

remote collaboration. These augmented reality applications are more similar to natural face-to-face collaboration than to screen based communication (Kiyokawa, et al., 2002).

Web and Internet technology are common everywhere in the developed world, but many people still prefer reading books rather than facing screens. The Virtual Reality textbooks have another important application of this technology.

Using 3D objects and views, miscellaneous and imaginative media, simulations with different types of interactions is the easiest ways of connecting the two isolated worlds.

Conclusions and perspectives of further researches

Despite the increased use of the Augmented Reality in education it remains still new and unresolved in many points. While AR's teaching/study possibilities are excellent, new learning methods are implemented not very intense. Teachers can attract and inspire students more, as students are presented with new resources to imagine and develop realistic skills in their subjects and complex concepts. In addition, even parents will benefit from it by engaging children to develop themselves in playful applications.

Despite the rising use of Augmented Reality in many areas of the modern era, the possibilities of AR in teaching/studying are not used wide enough. Augmented Reality can change the experience with our interaction with different gadgets and provides seamless combination of the real and virtual worlds. Augmented Reality is in power to change the whole idea of world perception and its advance in education is just at the start.

It is essential to coordinate a team of specialists to advance augmented reality solution in educational system of Ukraine. In order to achieve realistic solutions, we need to design and coordinate multi-disciplinary research project to enhance content and environments. Educators must work with researchers to develop local Augmented Reality interfaces. Software and hardware technologies play an important and key role to produce Augmented Reality applications. There are engineers, who can design different augmented reality environments. However, for learning, in educational technology field, there is a big need for instructional designers, who can design learning activities for augmented reality.

Bibliography

Azuma R.T.: *A Survey of Augmented Reality*. Teleoperators and Virtual Environments 6, 4 1997.

Azuma, R., Baillot, Y., Behringer, R., Feiner, S., Julier, S. and MacInTyre, B.: *Recent Advances in Augmented Reality*. IEEE Computer Graphics and Applications 2001, 21, 34–47.

Billinghurst M.: *Augmented Reality in Education*. Seattle WA: New Horizons for Learning – Technology in Education 2002.

Bimber O., Raskar, R., & Inami, M.: *Spatial Augmented Reality*. SIGGRAPH 2007 Course 17 Notes. CSM. 2011. Augmented Reality. Retrieved from Colorado School of Mines Division of Engineering 2007.

Cook S.W., Mitchell & S. Goldin-Meadow Z.: *Gesturing makes learning last*. Cognition 2008 Feb; 106(2): 1047–1058.

Govindarajan Singaravelu & Sivakumar, A. *Augmented reality in teaching and learning process*. Mukt Shabd Journal Volume 2020, IX, Issue IV.

Kiyokawa K., Billinghurst M., Hayes S., Gupta A., Sannohe Y., & Kato, H.: *Communication Behaviors of Co-Located Users in Collaborative AR Interfaces*. IEEE and ACM International Symposium on Mixed and Augmented Reality (ISMAR 2002) (pp. 139–148). Darmstadt, Germany: IEEE Press 2002.

Lasica Ilona-Elefteryja & Meletiou-Mavrotheris, Maria & Katzis Konstantinos.: *Augmented Reality in Lower Secondary Education: A Teacher Professional Development Program in Cyprus and Greece.* Education Sciences 2020.

Weiss Charles: *Augmented reality for the 2020 classroom.* 14th International Technology, Education and Development Conference 2020. P. 7117–7122.

Wells Trent & Miller Greg.: *Teachers' Opinions About Virtual Reality Technology in School-based Agricultural Education* 2020. 61. 92–109. 10.5032/jae.2020.01092.

Yadav Savita & Chakraborty, Pinaki & Kochar, Gurtej & Ansari, Deeheem.: *Interaction of children with an augmented reality smartphone app.* International Journal of Information Technology 2020. 10.1007/s41870-020-00460-6.

Summary

AUGMENTED REALITY IN EDUCATION

The technology of Augmented Reality as one of the important ways to stimulate people's gaining experience is quite urgent today. Numerous devices exist to enable this process possible both simple and innovative way. The purpose of our study is dual. Firstly, to give the definition of augmented reality (AR), describe the features of this new artificial augmented environment and list augmented reality device capabilities and application innovations. Secondly, to discuss the possibilities of AR in education. Augmented reality is in power to change the whole idea of world perception and its utilization in education can be gainful enough. The results of this theoretical study are important for institution managers and teaches as a description of the new possibilities to catch the attention of students and motivate them better visualizing different subjects and complex concepts, as well as the possibilities change the whole paradigm of the interactivity in education.

Keywords: augmented reality, education, applications, virtual environments, hardware.

МУКАЧІВСЬКИЙ ДЕРЖАВНИЙ УНІВЕРСИТЕТ

89600, м. Мукачево, вул. Ужгородська, 26
тел./факс +380-3131-21109
Веб-сайт університету: www.msu.edu.ua
E-mail: info@msu.edu.ua, pr@mail.msu.edu.ua
Веб-сайт Інституційного репозитарію Наукової бібліотеки МДУ: http://dspace.msu.edu.ua:8080
Веб-сайт Наукової бібліотеки МДУ: http://msu.edu.ua/library/