



Editorial: Learning Strategies in Engineering Education Using Virtual and Augmented Reality Technologies

Jorge Martin-Gutierrez
Universidad de La Laguna, SPAIN

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The year 2016 was heralded as the date on which Virtual Reality and Augmented Reality would revolutionise the world. But has this forecast proven true? At this stage, the reality is that significant efforts have been made towards identifying potential uses for Virtual Reality and Augmented Reality and towards filling society with this technology, and such efforts will continue to be made.

Large technological companies are leading the charge when it comes to introducing Virtual Reality and Augmented Reality technologies into society and shaping Augmented Reality and Virtual Reality trends. The strategy that they have employed involves purchasing companies specialising in Virtual Reality and Augmented Reality with the goal of designing and developing universally accessible hardware and software. In recent months, the news has been awash with information detailing the release of new devices - oft referred to as VR goggles, glasses, or headsets - that allow consumers to immerse themselves in 3D content, films, or videogames.

In the short term, the use of mobile devices and the functionality of apps will change in order to provide greater user interactivity. Head mounted displays, and their more budget friendly cousins that serve as goggles for Smartphones, will offer a wide range of services for use in a variety of environments. In particular, low-cost goggles should prove to be a particularly useful tool in the field of education by facilitating virtual environments that can be used to enhance teaching and learning.

Virtual Reality and Augmented Reality are here to stay and will increasingly become part and parcel of our surroundings and day-to-day lives. As educators, we must familiarize ourselves with their potential uses and view them as a useful resource rather than a threat to the status quo. We should explore how they can be used to increase student motivation and, consequently, how they can improve student learning both inside and outside the classroom.

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Correspondence: Jorge Martin-Gutierrez, *Universidad de La Laguna, Av. Angel Guimerá sn La Laguna, 38202, Spain*

✉ jmargu@ull.edu.es

Augmented Reality allows us to add virtual information to a real environment that is being viewed via technology. This means that not only are we able to see and touch our natural surroundings, but we are able to add in virtual features, such as images, videos, and sound. The implications of which are enormous when it comes to education.

Virtual Reality allows us to operate in artificial environments as if they were real. This not only allows training to be carried out in environments in which all variables are entirely under the user's control, but also in settings that would otherwise be impossible to access otherwise.

In terms of education, much debate has praised the most innovative current trends and has made mention of project-based learning, competency-based learning, active methodologies learning, gamification in learning, learning-by-doing, knowledge management, leadership, creativity, and so on, but concerns have also been raised about educational institutions not supporting creative tendencies, and arguments suggest that the educational models being used should be changed. One reason for this is that students fail to learn in the classroom-based setting because they get bored or cannot understand the lecture. Obviously, when content is taught in the classroom and thus taught out of context it tends to be boring, even more so if delivered monotonously by teachers. What is more, nowadays students are accustomed to being exposed to a wide variety of stimuli, most of all interactive and audiovisual content and feel something is left wanting if such stimuli are not employed in the classroom setting.

Today's generation is the first to live surrounded by a multitude of screens: the Smartwatch, the Smartphone, tablets, laptops, desktop computers, televisions, and cinema screens. However, in most cases our classrooms are barren of any interactive technologies despite the consensus that Virtual Reality and Augmented Reality technologies can and do help teachers motivate students to learn whilst also making learning easier. That said, it is of vital importance that we reflect on the pedagogical approach used to deliver content and ensure that didactic materials are in line with accepted pedagogical approaches: we must ensure that any content is suitable for its recipients, and to link pedagogical elements to functional aspects, such as: interest in the content, ease of use, attractiveness to students, and lastly, but of increasing relevance for the educational field, access on mobile devices.

Motivation plays a fundamental role when it comes to achieving the goals that have been set, most notably in the teaching-learning process. Student behaviour is affected by factors that include attitude, perceptions, expectations, and self-image, as well as the goals that have been set. The teacher's task is to guide students towards a change in attitude that is conducive for fruitful learning, and that makes students full participants in their own learning. Methodologies developed using adequate strategies - and why not say technologies - will produce good results for the proposed objectives.

This Special Issue of *Eurasia Journal of Mathematics, Science, and Technology Education* offers thirteen articles relating to the tasks befalling teachers. A total of thirty-six researchers from seven different countries representing seventeen different universities have come together to share their knowledge and experience with readers. These articles offer a general and international overview of how VR and AR technologies are being used in higher education and what the expected uses are for the future. However, the editors felt it important to also include some contributions being made to education that fall outside of the higher educational setting. Here are some ideas of what to expect in the issue.

The authors of the article *Virtual Technologies: Trends in Education* provide a look at how virtual technologies are being used in higher education. It points at educational institutions benefitting from better access to virtual technologies in the forthcoming years which will make it possible to teach in virtual environments that are impossible to visualize in physical classrooms. For example, students will be able to participate in practical sessions taking place in virtual laboratories, or visualize large-scale machines and industrial plants, or explore challenging medical scenarios over and over in the virtual setting. The possibilities for access to difficult environments offered by virtual technologies are huge and will help to break down the boundaries now faced by formal education.

Next, readers are given with a comprehensive overview of relevant research relating to the emergence of augmented reality and the links to pedagogy and educational outcomes, specifically in the context of formal education in the article *The use of augmented reality in formal education: A scoping review*.

This journal also includes four articles covering tools that can be used to promote learning in different areas of Engineering. One of these tools helps students learn about conic sections; students can interact with the cone and the plane as virtual objects in real time and real space. They can visualize their own creation of the different curves: parabola, circle, ellipse and hyperbola. The authors analyse the motivational impact and benefits of this application and also discuss correlations between its use and a drop in levels of anxiety typically associated with the study of mathematics. Researchers from the Universidad de La Laguna (Tenerife, Canary Islands) and Las Palmas de Gran Canaria (Gran Canaria, Canary Islands) present their experiences having performed two different types of training, one based on the use of Virtual Reality and the other based on the use of Augmented Reality to improve the spatial awareness of Engineering students. The Poznan University of Technology (Poland) has provided two articles: the first explores the possibilities for adapting low-cost devices (HMD) to immersive educational applications; the second provides a methodology for developing virtual medical training. The methodology is named “knowledge-oriented medical virtual reality” (KOMVR), and uses basic knowledge-engineering tools during the processes of planning, building and verifying interactive educational solutions.

The virtual laboratory proposed by the authors from Mexico is used to explore how to work with machinery by having students use virtual machines while performing manual

operations. Their proposal is founded on a learning model that is based on cognitive techniques and usability whilst the user is totally immersed in the virtual environment. The authors from Columbia analyse how different types of virtual content (static or dynamic) affect the perceptions and performance of Engineering students, and consequently, overall learning.

Another of the papers included in this issue deals with a topic that is extremely relevant to student life: procrastination. The authors analyse the effect of using Augmented Reality tools on teacher resources. The study reveals that introducing this technology has a visible effect in reducing academic procrastination.

Three articles that have been included in this special issue are focused on the use and effectiveness of Augmented Reality in preschool, primary school and secondary school educational settings, and how it affects student motivation. This technology is not limited solely to the realm of higher education and there are a great number of potential uses that can be found for it, especially when combined with other pieces of technology such as Table Top, interactive whiteboards, hologram projectors, etc.

The articles in this issue provide an overview of current and future possibilities of virtual technology use in the classroom. There are many challenges to overcome, primarily how to convince teaching staff to use these technologies to add a fresh edge to their work. We hope this issue encourages all those teachers who are interested in motivating their students and improving student learning to start to make use of virtual technologies in the classroom.