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Investigation of the Impact of Augmented Reality Technology on Interactive Teaching Learning Process

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ABSTRACT

Augmented reality (AR) is a growing technology that superimposes 3D images onto the real world. This enhances the user's real-world experience. This potential of AR can be utilized effectively in teaching learning for engineering graphics courses. There is visualization limitation for engineering students entering the first year, and this leads them to face difficulty in understanding and developing orthographic, isometric, and section view of models. AR can empower the students to visualize the actual virtual object in a 3D view to match their imagination with the augmented object. In this regard, initially, a framework of AR is conceptualized for the course of engineering graphics, and an AR application is developed. This paper mainly focuses on the investigation and impact of AR technology on interactive teaching learning processes in engineering graphics. The impact of this technology is measured by student performance in an AR interactive test. The result shows an increase in student performance in written test by 18.52% in engineering graphics and in a mental rotation test by 28.97%.

KEYWORDS

AR, AR in Education, Augmented Reality, Engineering Graphics, Teaching Learning, Virtual Reality, VR

INTRODUCTION

A competency-based learning approach in higher education requires the effective and technological formation for professional competence. Competence requires significant changes in traditional teaching methods which focus on interactive methods of training to encourage interest in the profession, promote acquisition of training materials and provide high motivation. The main strategy for 21st century education is self-learning, experimental and practical training, which cannot be available every time in classroom teaching (Yakovleva & Yakovlev, 2014). Hence, authors want to explore some other option to create experimental and practical training in a virtual environment in classroom. By integrating augmented reality in the learning process, the teacher can capture the attention of the students. Augmented reality helps the students to participate and be able to access models on their own devices. Augmented reality is a technology that combines the real world with the virtual world by allowing users to create an overlay of virtual things on a physical entity (Bronack, 2011). It can help

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to improve design and visualization skills, aid in static simulation and serve as a tool for education. Augmented reality technology has been in research for a long time but with limited application. In the past few years' the application of augmented reality has been receiving much attention and its usage in teaching is worthy of investigation.

In Mechanical Engineering, drawing is one of the important fields which involve lot of imagination to understand the drawing. As Albert Einstein said "Imagination is more important than knowledge", it is need to develop the imagination power of students. The conventional education for engineering drawing, first step includes specific set of descriptive geometric procedure. It is having well proven benefits. These procedures involved an imaginary object need to be represented on 2-dimensional plane in such a way that it appeared in one direction view of 3- dimensional space model and vice versa. It enables the designer to convert research idea into prototype (Milic, 2016). It is difficult to draw imaginary object represented on paper. To support the imagination instead of paper students can visualize the object in augmented form from all direction. Augmented reality can help students to explore three-dimensional model with various level of details and students can concentrate on details of high-quality augmented reality model of existing teaching material (Liarokapis et al., 2004). The literature survey also highlights the above facts.

BACKGROUND

Various study shows that augmented reality technology offers many advantages in teaching and learning process. Akçayır et al. (2016) stated prerequisite for the use of augmented reality such as hardware (head mounted display, mobile devices, tablets etc,) and internet connection. And AR applications are more useful in education when these prerequires are fulfil (Samuel, 2016). Various study shows that augmented reality technology offers Whereas maximum implementation of AR is implemented in science field and lack in mechanical engineering graphics (Cheng & Tsai, 2013). Some application is found in mechanical engineering are scattered over different subject and basically are at research level.

Liarokapis et al. (2004) first used virtual reality and augmented reality in education to allow user to experience 3D web content by using desktop-based application. He developed a XML-based data repository, communication server and desktop application and developed a multimedia content related to teaching mechanical engineering. An application named AR Flite was developed to visualize virtual 3D model at different angle, size by rotation and scaling. He used desktop based augmented reality model camshaft arrangement examining by user in conjunction with real engine components (Liarokapis et al., 2004).

Carrera added digital terrain modeling over traditional cartographic technique. Interpretation skills and map reading skills are needed to visualize and analyze the 2D topographic information. He implemented augmented reality to support students to create visualization of 3D information. He carried out experiment by conducting two workshops, one with a group of 73 engineering students using augmented reality and another with a group of 22 students using 2D traditional technique. He found significant improvement in a group which used augmented reality. In another study, he worked on spatial orientation skill in the field of geosciences, he found out that AR provides 20.14 degrees average gain in spatial orientation skill (Carlson & Gagnon, 2016).

Turkan implemented augmented reality and interactive 3D visualization technology for teaching structural analysis. It enhances the content in structural analysis book with interactive augmented model where structural behavior of different members can be visualized in AR environment with different loading conditions (Turkan et al., 2017).

Dinis developed a virtual and augmented reality game to assist educators with fun base approach to increase student interest and involvement in the education. AR application of the building was created and virtual button differentiates structural, construction and hydraulic element with different color coding (Dinis et al., 2017).