

A VIRTUAL REALITY GAME THAT ENHANCES EDUCATIONAL OUTCOMES FOR A SURFACE ENERGY LABORATORY

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ABSTRACT

This paper presents the development, implementation, and results of a 3D Virtual Reality (VR) game utilizing a Samsung Gear VR headset. The VR game allowed students participating in a surface engineering laboratory to immerse themselves in a VR environment that was designed to reinforce core concepts introduced by the laboratory. We show that using the VR game can result in enhanced performance on post-laboratory quizzes when compared to students that did not get the VR experience. Furthermore, questionnaire results indicate a strong interest and desire for VR games and that these types of opportunities can enhance interest in topic areas.
Keywords: Virtual Reality, Educational Games, Biomedical Engineering, Teaching Tools, Gamification

INTRODUCTION

Virtual reality (VR) is utilized extensively by the entertainment industry due to its ability to immerse users in experiences. In recent years, evidence has mounted that gamifying education can be effective in enhancing educational outcomes. When controlling for the entry-level knowledge of students on the topic, "the experimental group achieved significantly higher mean scores in physics academic achievement and science process skills" [1]. Gamifying education creates a stronger connection to the material and has been shown to increase assessment scores [2]; combining this with VR could lead to increased immersion in the gamified experience and, consequently, further improvement in educational outcomes.

Sufficient immersion and freedom of movement and interaction for the user are some of the most important factors in VR and gamification. Examples of current HMDs include the Samsung GearVR and Oculus Go, which use gyroscopes and accelerometers to track users head movements and correctly correlate these movements to the visual feedback. This immersion has shown to be useful and has been implemented in clinical education and training to facilitate undistracted attention and to fully develop retention beyond that of a computer screen [3].

VR as Teaching Tool

Many of the studies conducted using VR show that it provides better outcomes on learning when compared to a typical lecture or laboratory instruction. One challenge with VR is overcoming the issue of experiencing a new user interface which may increase cognitive load [4] and negatively impact understanding overall [5]. Because VR education can be viewed both passively or actively, great pains have been made to explore whether interaction yields greater knowledge gain than passive viewing in the environment. In a meta-analysis of desktop virtual reality, interactivity showed a statistically significant improvement on learning outcomes compared to non-interactive virtual scenes [6]. This lends further credence to the idea that interaction with a virtual environment increases student understanding, engagement, and retention rather than passive viewing. There is a lack of research in this area—conference proceedings have been published on the creation of HMD-based VR educational tools to promote recycling [7], simulate a body-swap for surgery [8], and explore cellular anatomy [9], but few have attempted to study the pre-post effects of these devices regarding education. The novelty of the HMD in the consumer market makes this a field ripe for exploration.