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The Challenges of Immersive Virtual Reality (VR) Learning in Architectural Structure Study, Polytechnic Ungku Omar

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Abstract

Virtual Reality (VR) is becoming the new trend of immersive learning environment especially in this digital age. Specifically, in Architecture Program in Polytechnic Ungku Omar, VR teaching and learning is gradually incorporated in architectural structure learning. A group of Diploma students was selected to evaluate the challenges encountered throughout the learning session. An experimental study and questionnaires were conducted to evaluate the factors of challenges which affecting the success in VR learning process. The hardware tool used for experimental application is HTC Vive and for simulation purposes, a combination of Revit Architecture and Enscape 3D software was used to create the immersive learning environment. The study shows that some of the main challenges effecting VR teaching and learning process holistically are time consuming, availability of tools, knowledge on VR technology and costs.

Keywords: Virtual Reality (VR), design exercise, challenges

1.0 Introduction

Virtual reality (VR) was a concept introduced back in 1950's and gradually developed until we are able to replicates the real environment as a testing ground (Velev & Zlateva, 2017). Nowadays, VR is not a concept anymore. It has been developed to be a physical environment simulation that can be immersed to allow user experienced the replication of the real world. In corresponding with our aim to fulfil the needs of 4th. Industrial Revolution (IR 4.0), education in Malaysia especially in polytechnics has evolved so much in internet of things (IoT) which includes VR. Specifically, in Architecture Program, VR has been implemented for architectural construction course. This is because VR has the potential to strengthen and diversified learning method through representational characteristics that imitate real-life interactions (Cook et al., 2019). However, there are challenges to be improved to ensure the effectiveness of learning.

Architecture structural course involves theory of construction system, calculation of load, layout, and materials to highlight a few. For the whole semester, not included other courses students need to quickly understand the fundamental of construction to allow them to practically apply in design proposal. Thus, VR is one of the preferable tools to increase theoretical understanding and involvement during learning process. It is seen as motivational, interactive, interesting, and enjoyable (Checa & Bustillo, 2020) for learning and training. However, certain criteria need to be attended to make sure it works well, easy to maintain and dependable in long term usage. A successful implementation of VR in learning has to be easily accessible and financially affordable, efficient facilities and location provided, user preferences and expectations fulfil, institutional business strategy and industrial readiness achieved (Horne & Thompson, 2008).

2. Problem Statement

Architectural structures learning could be more interesting and fun if it involves movement and constructive education instead of listening and watching videos. VR support interactive learning process by providing simulation of designated environment to be explored in real time.

Nevertheless, to ensure continuous intact during learning session students need to space is well equipped with VR tools and strong internet coverage. In this study, the challenges foreseen is limited to perception and sensational behavior while experiencing VR in learning architectural structures.

3.0 Research objective

The hypothesis is to highlight the challenges of VR implementation during architectural structure learning session as follows:

i) Unfamiliarity with computer-generated 3D environment simulation could create distraction and uncertainties
ii) Time frames need to be adjusted to avoid uneasy sensational feelings while using VR equipment
iii) Expected outcomes is unachievable because of the incompetency using VR tools

4.0 Methodology

4.1 Experimental study

Data collection and analysis development was assembled from the learning session in December 2018 of the Diploma in Architecture program, Politeknik Ungku Omar. It involves sample of academic practice in 3D modelling exploration. Project was develop using commercially available VR and 3D- modeling software and hardware to measure attitudes, perceptions and opinions during the learning process. The experiment is conducted using HTC Vive hardware and Enscape 3D software in VR lab. Students were given maximum 30 minutes to solve the game approach simulation for theoretical understanding in architectural structure.

Figure 1: HTC Vive hardware at Politeknik Ungku Omar

Figure 2 and 3: Some of the Content of the Architectural Structure Lesson

4.2 Questionnaires

Students behavior, perception and opinions were observed and recorded by means of pre-test and post-test evaluation. Pre-test question was distributed before the experimental study started. Questionnaire was developed to highlight issues in VR learning process. Criteria of evaluation is described in Table 1.

Criteria	Pre-test	Post-test
Equipment handling	/	/
Time consumption	/	/
Sensations response	/	/

Table 1: Criteria of pre-test and post-test questionnaires

5.0 Results and Discussions

5.1 Pre-test and Post-test Review

A sample of 30 students were tested to evaluate the compatibility of implementing VR in architectural structure lesson. From the experiments, 52% need to be assist during the whole process. User needs assistant on how to wear the device properly, how to control the wand/handheld controller and how to move. It takes around 3 to 5 minutes to ensure user's properly wear the headgear and trying to move around. All users agree that hand's on training must be done regularly to make them feel comfortable hence to get them familiar with the device. Along the one-hour session to complete the test, users request a break after 15 – 20 minutes continuous usage because it made them feel tired. 88% user inform that the head mounted displays (HMD's) make them feel noxious and it felt heavy after a while. Moreover, 80% have difficulties to handle the wand/handheld controller during session.

6.0 Conclusion and Recommendation

From the experimental study, the challenges of VR implementation for architectural structure learning session has strong impact to user experience. They need to be knowledgeable in VR devices and software, and well verse in structural fundamental theory to understand the questions. It is also found that time consumption to complete tasks given and the aftereffects towards mind and body. Even though a game like experience is embedded to improve learning experience, it is highly recommended that lecturer or tutor is always around to observe the effectiveness of each session. Students agree that immersive VR learning is more interesting to improve understanding of materials and components, layout, and the like while offering freedom to experience the real simulated environment. However, the accessibility of device for practices and training is the most important aspects in improving user experience in knowledge development.

Nowadays, a complete set of VR hardware and software with designated program development such as architectural structure costs around RM 10,000.00. For a user to use the program efficiently, at least an estimated amount of RM 1000.00 to RM 3000.00 need to be prepared for a headset and controller. Hence, students are not willing to spent so much to get their own headgear and wand. The institutions must provide sufficient quantity of equipment related to VR to ensure effective learning environment using in VR.

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