Development and Usability Evaluation of VR-based Appropriate Technology Teaching Model: Based on Situated Learning Theory

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Abstract

This study aimed to develop an appropriate teaching model for technology classes using Virtual Reality (VR) and to evaluate its usability. This model can help students learn better in technology classes by solving problems through interactions with various surrounding objects in virtual reality. This teaching model presents practical tasks to learners by applying the situated learning theory in a virtual place, a desert island. Through each task, learners can acquire knowledge through student-led learning in the process of problem-solving. The Unity program and Oculus Rift S were used to develop this VR instructional model. It was designed with class guidance and an evaluation plan so that it could be used in actual classroom classes. In addition, UI usability evaluation was conducted to score 3.83 points in intuition, 3.58 points in aesthetics, and 3.25 points in convenience out of 5. Through usability evaluation, the user UI of the instructional model was intuitively expressed, but the convenience was low. The expected effect of this instructional model can suggest the possibility of using various media in the school field, and it can be an example of a more flexible application of the Edu-tech instructional model to the school curriculum. In addition, creativity can be cultivated through technical problem-solving in VR-based learning.

Keywords: situational learning theory, Technology Class, Usability evaluation, Virtual Reality

Introduction

With the advent of the Fourth Industrial Revolution resulting from the convergence of information and communications technologies, various attempts to incorporate Virtual Reality (VR) technology into education are actively being made. Using VR technology, we intend to increase the learning effect by utilizing the knowledge learned in school in a meaningful context. Since virtual game-based experiences increase learners' motivation to learn and inform them of a new approach to rewards, education through VR will be a new tool for creative learning (Choi Jae-hong, 2016). For learners who are familiar with the Internet and games, newly reformed learning materials could be effective. The researcher emphasizes the importance of creating VR games so that students can have a positive learning experience (Lau & Lee, 2015). However, the development and research of learning programs incorporating VR are

insufficient (Hyun-woo, 2018). Thus, there is a need to develop teaching models that can be used in classes using various learning materials such as VR. Further, VR applied to the field of Edu-tech has positive effects on learners' immersion and motivation, thus helpful in improving academic achievement.

VR has the advantage of providing a realistic experience in science education and increasing learners' interest and concentration (Yoo et al., 2018). Unlike text- and image-based textbooks, VR materials provide a vivid three-dimensional effect (Kim & Choi, 2018). It was noted that VR programs mimic a realistic environment closer to daily life. The situated learning theory suggests the utilization of knowledge for solving problems that are similar to those encountered in daily life. It is important to use specific and diverse examples applied in various contexts. VR promotes motivation by providing a 3D computer environment and leverages interactive experiences and modeling to promote students' understanding and application of concepts (Piovesan, Paserino, & Pereira, 2012). In addition, VR classes can experience places that are impossible or expensive to explore at a low cost (Jackson & Fagan, 2000). The following research questions are addressed to examine the effectiveness of the VR-based learning programs for appropriate technology classes.

1. Can VR-based learning programs be developed and applied in classroom settings?

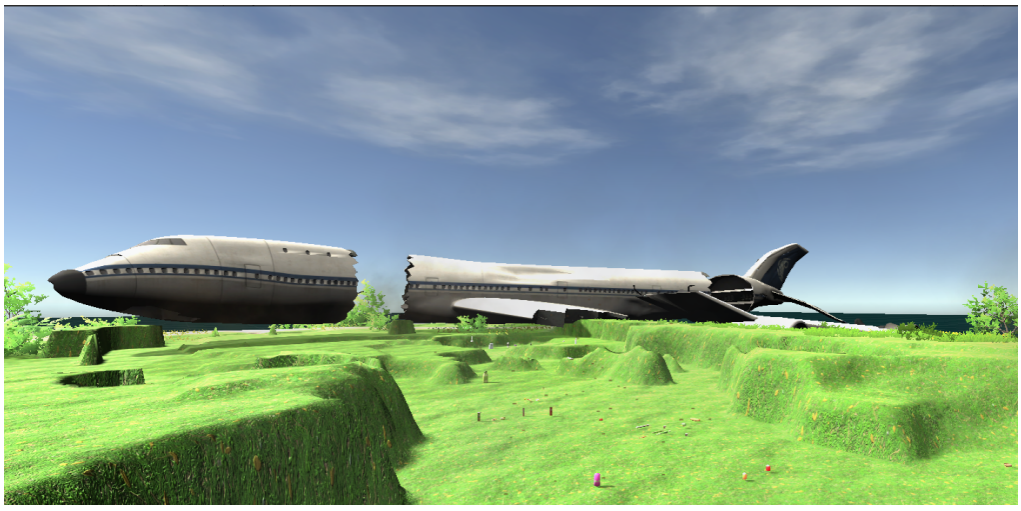
2. How to improve the teaching model using VR technology based on the result of usability evaluation?

Methods

Appropriate technology is an example of sustainable development that has recently attracted attention. It is designed to enable sustainable production and consumption in the region in consideration of the political, cultural, and environmental conditions of the social community. [Figure 1] is a representation of the class situation of VR. The student who participated in the class made an emergency landing in an unknown place after their plane crashed on an uninhabited island. The students should use the surroundings and objects found on the island to solve problems and survive.

We used SketchUp and Unity programs to develop classes. Oculus lift S was used as a VR device. We used this program to create our own items to be used in class, constructed an environment, and allowed students participating in class to be more immersed in the situation.

Figure 1.
The situation of virtual world



Before seeking participation, we provided the students with guidance on Cybersickness, a self-diagnosis checklist, and a consent form. We also developed a VR timer to prevent students from exceeding 8 minutes once they wore the VR device. The self-diagnosis checklist used the checklist of virtual reality user safety guidelines in the field of education developed by the Korea Education and Research Information Service (KERIS).

We conducted a UI usability evaluation for the newly developed VR class. The usability evaluation survey was conducted by modifying the usability evaluation contents in the VR situation proposed by Chung and Jang (2019). The usability evaluation questionnaire was composed of the Likert 5-point scale and was classified into three items: intuition, aesthetics, and convenience. Each of the five questionnaire questions was organized and conducted. Usability evaluation was conducted after four graduate students watched the VR class situation.

Results

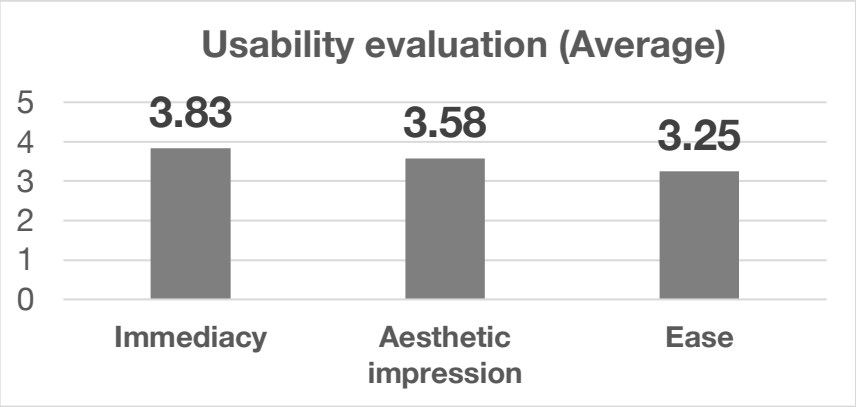
In order for this model to be used in actual class situations, we have created a lesson plan for the unit on sustainable development of technology for the first year of high school. The goals are to understand problem situations related to appropriate technology in VR and to creatively explore and implement solutions. In the 1st and 2nd class, learners get to know the meaning and goals of sustainable development, definition, and examples of appropriate technology in advance. In the 3rd and 4th classes, they can apply the knowledge learned in the previous classes.

Figure 2.
A map in virtual world

As shown in Figure 2, students perform five missions in the virtual world where learning takes place. Students can carry out five missions, finding answers to the material papers provided in class, and then suggest new ideas. After the class is completed, the teacher performs an evaluation based on the achievement standards of the 2015 revised curriculum technology home subject in Korea and records the score. While using VR devices, the teacher should often check the students' health and cognitive conditions.

As shown in Figure 3, the usability test results are as follows: intuitiveness - 3.83; aesthetics - 3.58; convenience - 3.25 points. The usability assessment shows that the intuitiveness factor of the user UI represents low results.

Figure 3. Results of usability evaluation



Conclusion

We were able to draw the following conclusions through the development and usability evaluation of appropriate technology classes model applying VR-based situational learning theory. First, through this model, it is possible to use various learning media in the school. It will be able to suggest ways to increase the effectiveness of classes by using various media away from lecture-style classes. Second, it can be an example of applying the Edu-tech class model more flexibly to the school curriculum. Various applications to the school curriculum will be possible at a time when Edu-tech is attracting attention globally. Third, through VR learning, creativity can be cultivated through the process of solving technical problems during class. VR class activities based on the situated learning theory will serve as an opportunity for students to cultivate creativity through various stimuli and problem-solving processes. Finally, the results of the application of the newly developed VR class model showed that the user UI was intuitively presented through user evaluation, but the user convenience was low. Through this, there is a need to increase the convenience function so that learners can use the class situation more comfortably in this class model.

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