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Exploring Factors toward a Virtual Hospital Situated Learning System

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Abstract. In human anatomy, computer network and multimedia technologies are useful tools to help overcome the limitation of two-dimensional course materials for medical education. For situated learning, knowledge resides in the learning environment. Learners construct knowledge or acquire skills through participating activities in the environment as well as actively interacting and exploring things and phenomena inside the environment. In this manner, learning performance will be improved. A Virtual Hospital Situated Learning System (VHSLS) providing virtual learning environment was developed. Human organ anatomy serves as the main subject of the learning system. The results are evaluated to be statistically significant and indicated that situated learning helps to improve the motivation to learn.

Keywords: Virtual Reality, Situated Learning, Learning motivation

1. Introduction

Various researches on educational information technology indicate that 3D virtual reality and network technologies will raise learners' motivations, enhance their attitudes towards learning and improve learning efficiency. Moreover, these technologies can help construct inexpensive and specialized learning environments for individual courses. Through the specialized learning environment, learners' motivations will be induced and their learning performances will be improved. Nevertheless, for some disciplines realistic learning environment cannot be provided in a traditional classroom. Fortunately, current computer and multimedia technologies are able to supplement this deficiency.

Human anatomy is one of the most important foundation disciplines in medical educations. The information conveyed from 2D course materials can not cover everything in our 3D real world. To provide inexpensive and enough learning materials, as well as a safe and interesting learning environment for learners, virtual reality technologies allow people to visualize and interact with computer generated 3D objects such body organs.

Many educational applications have successfully employed VR learning environments (VRLEs) (Chittaro & Ranon, 2007; John, 2007; Pan, Cheok, Yang, Zhu & Shi, 2006). Applying desktop virtual reality in education has become extremely popular in recent years for classroom. Virtual reality technology allows the visualization of three dimensional (3D) data and provides interactive environments that reinforce the sensation of immersion into computer-generated virtual world. VR offers real time simulation where three-dimensional computer graphics is used to mimic a real world (Burdea, 1999). By using virtual reality technologies, realistic virtual environment can be simulated. In medical education, learners will have better understandings when 3D organ models are presented along with lectures.

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In this research, we designed and built a virtual hospital situated learning system (VHSLS) for learners to learn body organs knowledge. The VHSLS system deploys VR and computer graphics technologies. Our learning system demonstrates the concepts of virtual reality and how current 3D technologies are used to implement an inexpensive learning environment in medical education. This paper first presents background information regarding current VR technologies and features of virtual learning environments. The section that follows presents the architecture and features of our system. Functionalities and some screenshots will also be shown. Finally, we evaluate the VHSLS system and conclude the paper with a brief summary.

2. A review of literature

VR features and current VR technologies are briefly reviewed. Then, the benefits of Situated learning virtual learning environment are presented.

2.1 Features of virtual reality

Virtual reality includes the three factors, immersion, interaction, imagination (Burdea & Coiffet, 2003).Virtual reality (VR) refers to the use of 3D graphic systems in combination with various interface devices to provide the effect of immersion in the interactive virtual environment (Pan et al, 2006). The success in immersion of a VR world is based on how involved the user becomes (Sherman & Craig, 2003). VR is being used 3D system to combine interactive interface to make learners more effective interaction in virtual learning system, when the user moves, the visual, auditory, or haptic devices that establish physical immersion in the scene change in response (Sherman & Craig, 2003). The learners can see activity transform on screen; they that use all human sensorial to reach the interactive functions. Virtual reality is not only an immersive user interface, but it also has serves as a good presentation objects in many fields such as engineering, medicine, and education. A VR learning environment could improve the human mind's capacity to perceive, imagine in a creative sense, nonexistent things.

2.2 Situated Learning

Knowledge needs to be presented in authentic settings and situations that could involve that knowledge. Social interaction and collaboration are essential components of situated learning. To gain knowledge, learning context are expected to build an instructional environment sensitive to the tasks learners must complete to be successful in practice. The learning context can include experiences of engaging with and interacting in the social, psychological, and material environment in which the learner is situated. Content situated in learner's daily experiences becomes the means to engage in reflective thinking. Retention of content is not the goal of learning. By placing content within the daily transactions of life, the instructor provides opportunities for learners to cooperate in investigating problem situations, and makes content applicable to the ways in which learners will approach the environment.

Many educators exploring the model of situated learning have accepted that the computer technology can provide an alternative to mimic the real-life setting. For example, the virtual reality plays the simulation role to enable learners engage in learning in a realistic-looking environment. VR offers richer perceptual cues and multimodal feedback (eg, visual, auditory, and haptic) to enable the easy transfer of VR based learning into real-world skills (Durlach & Mavor, 1995). Therefore, VR is an application that makes learners interactive with simulating the real environment.

Herrington and Oliver (2011) proposed that situated learning should contain a number of important characteristics. Those features for situated learning environments could contain the following characteristics (Herrington & Oliver, 2011, p.4).

- Provide authentic context that reflect the way the knowledge will be used in real-life;
- Provide authentic activities;
- Provide access to expert performances and the modelling of processes;
- Provide multiple roles and perspectives;
- Support collaborative construction of knowledge;
- Provide coaching and scaffolding at critical times;
- Promote reflection to enable abstractions to be formed;
- Promote articulation to enable tacit knowledge to be made explicit;
- Provide for integrated assessment of learning within the tasks.

3. The Virtual Reality Teaching Hospital

A virtual hospital situated learning system (VHSLS) was built to provide situated learning environment for medical education. VHSLS allows individual students to immerse and to learn in the virtual hospital. Learners can walk around, explore the scene, study course topics and interact with 3D objects inside the virtual hospital.

3.1 Design of VHSLS

VHSLS is design by Virtools 4.0. 2D animations is a Flash program written in ActionScript. 3D graphic modules in VHSLS are drawn and rendered by using 3DsMax. The design of VHSLS system follows object oriented programming paradigm.

3.2 Functionalities and features

3D components of VHSLS provide sources from Turbo Squid Company. By using 3DsMax and Flash, 3D graphic modules are rendered and created animation. To provide the highest interactivity and enable multiple-angle observations, a lot of efforts had been spent on developing camera and character control management. Camera and character movements are associated because proper views are necessary for easy and intuitive character control. VHSLS allows users to control the character from first-person perspective or third-person perspective.

In the first-person perspective, the view camera's orientation and location coincide with virtual character's eyes. Fig 1 and Fig.2 depict as samples to view from first-person perspective. In this perspective, users can command the character to walk, run, strafe, turn and circle around a focus. In the third- perspective person, the view camera is by default located somewhere near and above the character and stares at the character as shown in Fig. 3. In addition to player control, users can also control camera in this perspective. Users can freely move the view camera to any location and change its orientation. The view camera can also be set to circle around an object. It is particularly important for organ observation. Moreover, the doctor is introducing the respiratory tract related diseases as shown in Fig. 4.

Fig 1: Learner interacts with the doctor.

Fig 2: The doctor is introducing the patient's heart diseases symptom.

Fig 3: The lobby in VHSLS.

Fig 4: A screen shot of course contents.

4. Evaluation

We evaluate the learners' perceptions of a virtual hospital situated learning system (VHSLS). After using this system, the participants will fill in the questionnaire for analysis of the experimental results. The data resulting from the experiment questionnaire evaluation on the five point Likert scale ranges from 1 (very disagree) to 5 (very agree). The participants were medical university students for the study. There are a total of 76 participants (31 females and 45 males) taking part in the experiment.

4.1 System evaluation

This research attempts to explore how the relationships among VR feature, perceived usefulness, situated learning and the learners' as shown in Fig.5.

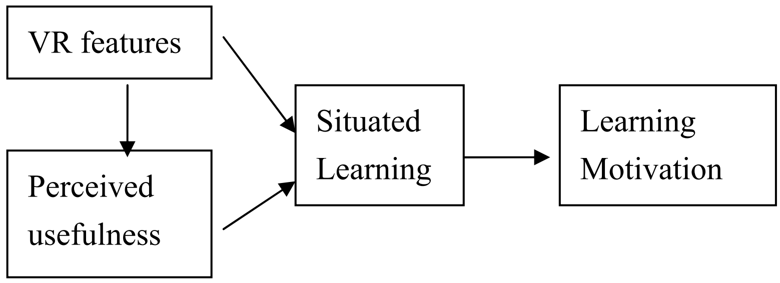

Fig 5: Research model of this study

5. Results

According to the results, 41 out of 76 participants had used virtual reality environment (53.9%) and 18 of the participants had used virtual reality environment for learning (23.6%). Moreover, 72.3% learners had learned body organs related courses. Multiple regression analysis has been widely adopted for empirically examining sets of linear causal relationships. A regression analysis was conducted to check the effect of VR features on perceived usefulness. The results explained that VR features variable was the predictor for perceived usefulness ($p=0.000$, $R^2=0.178$) as shown in Table 1. The learners feel useful by using VHSLS based upon VR features such as interactivity by operate 3D virtual human body organs. In addition, the regression analysis was conducted to check the effect of VR features and perceived usefulness on situated learning. The results explained that VR features and perceived usefulness variables were predictors for situated learning .The perceived usefulness was the biggest contributor (18.0%) for situated learning, as shown in Table 1. Finally, situated learning provides 18.9% of contributions for students' motivation to learn by using VHSLS.

Table 1: Regression analysis results

Dependent variables	**Independent Variable**	**R^2**	**F**	**p**
Perceived usefulness	VR features	.178	16.053	<0.001
Situated learning	VR features	.056	5.421	=0.023
	Perceived usefulness	.180	16.169	<0.001
Learning motivation	Situated learning	.189	17.217	<0.001

6. Conclusion

More and more theories and disciplines pay attention to the 3D application of virtual reality learning in the future. VHSLS serves as an example of building situated learning environment in medical education by employing inexpensive VR technologies. VHSLS provides immersive situated environment for students to learn human organs in a virtual hospital.

From the results of this study, there are three reasons to understand that why the students are willing to use VHSLS for learning. First, the learners can scale and rotate 3D models by using VHSLS. On the other hand, learners feel immersed in the virtual hospital learning environment. Therefore, they feel the features of VR are useful for their learning. Secondly, VR features were not only useful for learners' learning, but also help creating the situated learning environment. On the other hand, learners' perceived usefulness of VHSLS was a predictor for situated learning. Thirdly, situated learning contributes 18.9% to enhance learners' learning motivation, since learners can study and learner more the human organs knowledge by using VHSLS.

Overall, the learners had positive attitudes towards VHSLS. The majority of participants had increased their interest and motivation for learning. The results are evaluated to be significant contributions and hence positively influence 3D technology for virtual reality learning. In recent years, although many researches study the virtual learning system and create the virtual system at the computer or the internet, more and more educators establish the technology of virtual reality learning system applied to touch mobile in the future. Learners' curiosities and interests are motivated through realistic models, immersive environments and interesting course contents. Future improvements will include opening up more characters for learners to act, allowing collaborative tasks (such as surgery), and refining course contents. On the other hand, we believe that it will also be beneficial to apply VR technologies to the education of other disciplines.

7. Acknowledgment

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