The Innovative Application of Learning Companions in Virtual Singapura

(Extended Abstract)

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ABSTRACT

Virtual Singapura (VS) is a virtual world based learning environment designed to facilitate learning of the plant transport system. During field studies of VS, we observed that students in virtual world tend to be attracted by visual and auditorial stimuli and be distracted from learning objectives. Also, intensive cognitive load can affect students' learning experience. To address these issues, we propose two types of companion agent, namely curious companion and remembrance companion. Results collected from the field studies indicate advantages of learning companion augmented virtual world in enhancing students' learning experience.

Categories and Subject Descriptors

H.4 [**Information Systems Applications**]: Miscellaneous

General Terms

Design, Human Factors

Keywords

Learning Companions, Virtual Worlds, Curious Agent, Remembrance Agent

1. INTRODUCTION

Virtual worlds offer an advanced "hard" infrastructure to simulate learning environments that can be impossible to access in real world. However, a stand alone virtual world lacks "soft" intelligence to monitor and scaffold students in real time during the learning process. Many studies have shown the advantages of intelligent software agents in computer-based learning environments to achieve educational goals [1]. We believe, the infusion of various lightweight learning companions in a virtual world can potentially enhance immersion, by realizing interactions that are challenging or expensive to achieve in real world. For example, a personalized mentor to monitor a student during the learning process and provide situational assistance; or a private learning companion that can study with a student and provide a social learning environment.

In light of this, we have developed a learning companion augmented virtual world - Virtual Singapura (VS) [1]. It is designed for lower secondary school students in Singapore to learn the plant transport system. In order to scaffold students in the learning process, two types of intelligent companion agent have been incorporated: curious companion and remembrance companion. The curious companion is designed to cope with the problem that students tend to be attracted by visual and auditorial stimuli and be distracted from learning objectives [2]. It can select potentially interesting learning concepts for students to focus their attention on the learning content when distraction is detected. The remembrance companion is designed to reduce students' cognitive load. It can help students organize knowledge and connect new situations with previously acquired knowledge.

VS has been deployed in two local secondary schools in Singapore and involved over 500 students to participate in field studies. To our best knowledge, this is the first work on large scale deployment of a learning companion augmented virtual world in schools. Results from the studies demonstrate the advantages of such a system in retaining students' attention on learning and helping them solve problems.
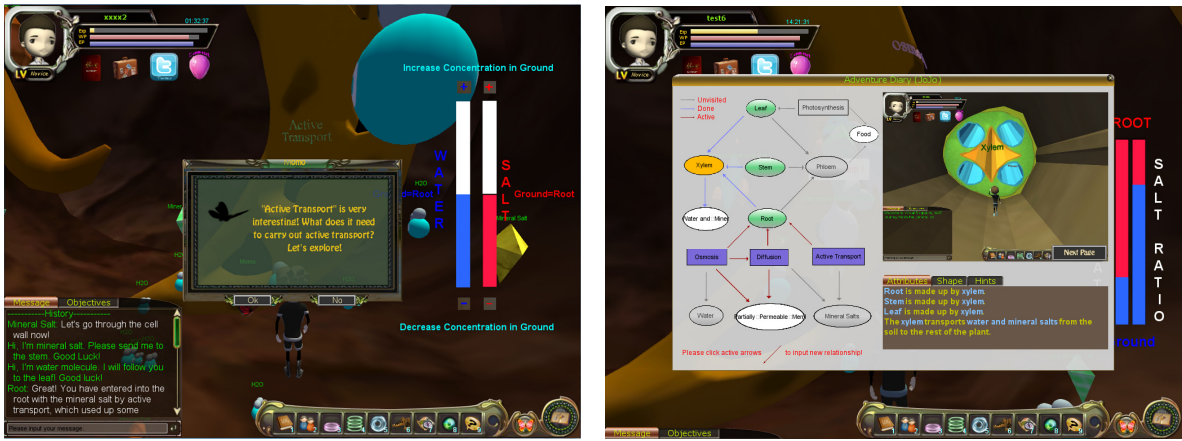
2. CURIOUS COMPANION

The curious companion (shown in Figure 1(a)) perceives three sources of information: the world knowledge WK, the user's knowledge UK, and the user's context UC. WK is the expert knowledge represented by Concept Maps (CM), and is embedded in the virtual world as part of the virtual objects and learning tasks. UK is also represented by CM, and is updated in real time by users through a GUI. UC contains information about users' behavior, such as current goals, current interactions, etc. The curious companion performs two functions: distraction detection and curious reasoning. The distraction detection module continuously monitors UC, and once distraction is detected, the agent will perform curious reasoning to calculate the intensity of curiosity stimulating factors in learning concepts, by comparing WK and UK. Based on the ranking of curiosity value, it can select the potentially most interesting learning concept to prompt users.

3. REMEMBRANCE COMPANION

The remembrance companion (shown in Figure 1(b)) also perceives three sources of information: WK, UK, and

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[1] http://virtualsingapura.com/game/project/

(a) The curious companion embodied by a butterfly   (b) The remembrance companion embodied by a diary

Figure 1: The learning companions in VS

UC. UK is collected through users' interaction with learning concepts in WK. The interaction data are first stored in the agent's episodic memory (EM), and then consolidated into the agent's semantic memory (SM). The consolidation is solved as a multi-label episode classification problem, where each concept in WK is considered as a class label. When a player is detected as being stuck (e.g. at answering questions) in UC, the agent will extract the most relevant episodes in EM or learning concepts in SM to help solve the problem.

4. EVALUATION

In this section, we present the result of one field study in Catholic High [2]. A total of 63 Secondary Two level (equivalent to Grade 8 in the North American high school system) students were selected to participate. The students are rated as having average academic abilities by their teachers. The topic chosen for the study was the plant transport system from their science class curriculum. Before the study, both groups have not learnt this topic at the secondary school level (but they did encounter it during their primary school years).

The study includes 3 sessions, one session (30 minutes) for the students to draw concept maps of plant related knowledge points, and two separate sessions (45 minutes each) for the students to go through all the learning activities in VS. During the study, the test group learnt the topic through the learning companion augmented VS, and the control group learnt the topic through the stand alone virtual world of VS without learning companions. Upon finishing the three sessions, the students completed a survey questionnaire, which consists 28 questions on the scale from 1 (strongly disagree) to 7 (strongly agree).

We performed statistical test for the survey result with respect to the two learning companions. The hypotheses for curious companion are H_0 : the curious companion has no effect on retaining students' attention in the learning content and H_1 : the curious companion can retain students' attention in the learning content. Based on one-tailed T-test, we accept H_1 with 95% confidence ($T = 2.786 >$

$T_{df=61,p=0.05} = 1.670$). The hypotheses for remembrance companion are H_0 : the remembrance companion has no effect on assisting students in retrieving their knowledge and H_1 : the remembrance companion can assist students in retrieving their knowledge. Based on one-tailed T-test, we also accept $H1$ with 95% confidence ($T = 2.633 > T_{df=61,p=0.05} = 1.670$).

From the study, we observe that for curious companion, the curious reasoning module can reasonably select interesting learning concepts for students when distraction is detected, which helps retain students' attention in learning. For remembrance companion, the consolidation algorithm can successfully organize acquired knowledge in its semantic memory, which helps the retrieval of knowledge when students get stuck.

5. DISCUSSION

In this paper we report our experience designing and deploying a learning companion augmented virtual world-VS. Through two types of novel companion agent: the curious companion and the remembrance companion, we infuse advanced learning intervention techniques into this environment. User studies have demonstrated the effectiveness of these agents in improving students' learning experience. Based on the lessons learnt, we plan to incorporate more lightweight learning companions in the future to form an unobtrusive pedagogical environment. Extensive educational gaming data collection will also be carried out through our system to enable educational data mining for producing more relevant findings.

6. REFERENCES

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[2]http://www.catholichigh.moe.edu.sg/