Tan, S. C. et al. (Eds.) (2013). Workshop Proceedings of the 21st International Conference on Computers in Education. Indonesia: Asia-Pacific Society for Computers in Education

Enhancing Learning Achievement Using Affective Tutoring System in Accounting

Ya-Ping HSUEH, Hao-Chiang Koong LIN & Meng-Shian OU*
Department of Information of learning technology, National University of Tainan, Taiwan
*markoms2000@Hotmail.com

Abstract: This paper shows an affective tutoring system which enforces accounting remedial course and hopes to be useful for student's learning achievements. In order to make the low-achievement students to be more willing to learn, there are more and more colleges implementing the remedial education to promote student's learning achievements. Because of the innovation of technology, computer becomes a main tool for e-learning. Besides study and work, there are more and more computer's developments of the interaction with people. For example, there are some studies about making computer to perceive human's emotions, express emotions and feedbacks in time. Recently, many studies also show evidences that the emotions is an important factor to affect learning.

Our participants are some low-achievement students who are freshmen in Taiwan. We try to know the usability of the affective tutoring system using in accounting remedial course for learners. We also want to realize whether the accounting remedial course using affective tutoring system affect the learning achievements and motivations. We adapt observational survey in the experiment and make a learning achievement questionnaire at the end on experiment. The questionnaire contains learning achievements, system's usability, and learning motivation. We also implement focus group to get some feedback and quantitative data to analyze with statistical software. In conclusions, we find learner have good usability and satisfaction at using affective tutoring system to do accounting remedial course. The tutoring agent also has the benefit to enhance learner's learning motivation. The value of learning achievement is 0.93 and is highly significant.

Keywords: Affective tutoring system, remedial education, learning achievement, affective computing, accounting.

1. Introduction

Computer has become a necessary tool for lots people in their lives. More and more digital applications are developed for work, leisure, and study. When human-and-computer interactions are taken into consideration in the design of both hardware and software, computers are no longer a machine but human-like existence. Therefore, some studies focus on how to increase the interactions between people and computer, how to make the computers to perceive human emotions, and even how to make computers express emotional responses immediately. For example, the Ph. Picard's team of MIT media lab is devoted to the field of Affective Computing and has many outcomes.

"Affective Computing" means to obtain some face-emotion and physiological signals which are triggered for human feelings through different sensors and to analyze these signals to provide suitable replies or feedbacks (Manovich, 2001). Affective computing is a study on emotion perception, the establishment of proper emotion-models, and the expression and transmission of emotions by ways such as the Internet (MIT Media Lab, 2008). Recently, the affective computing has been applied to different fields such as education learning, multimedia processing, and human-machine interface (HMI). Hupont, Abadía, Baldassarri, Cerezo and Del-Hoyo (2012) designed a tool-T-EDUCO which can detect the emotions of people. In order to enhance student's learning achievements, teachers can use it not only to get some messages of students' academic or emotion states, but also to detect students' learning progresses and to provide them proper teaching strategies and learning information when needed.

Accounting is not an easy subject to learn so that students usually have some difficulties to learn. For example, we can realize student's learning statue from their accounting grade. If students do not learn well, they will be low patient in learning. In order to help those students who do not learn well, schools implement strategies such as teaching assistants, teacher's office hours, and on-line remedial courses. However, some students resist to face teachers in person so this research plan to make distance remedial course.

There are many reasons affecting learning such as emotion; for example, positive emotion will promote learning motivation but negative emotion will not. So if we can realize learner's emotion when they learn, we will have more ways to help them. Affective Tutoring System combines Intelligent Tutoring System and emotion recognition mechanism. With Affective Tutoring System, learners can take the remedial course by themselves and the affective tutor can detect learner's emotions to give them proper feedbacks for promoting their learning motivations.

This paper presents the design and development of an affective tutoring system for the accounting class. A virtual tutor would recognize the students' emotions and give feedbacks in time. Affective Tutoring System (ATS) inspires students' learning motivations in the process of interacting with the virtual tutor and provide students with proper course materials to enhance learning achievements. The research uses questionnaires to investigate students' satisfactions to ATS and to evaluate the usability of ATS.

This work focus on following problem: (1) Does it have good usability when add accounting course to ATS? (2) Are there significant differences in learning motivations when learners use ATS to learn the accounting course? (3) Are there significant differences in learning achievements when learners use ATS to learn the accounting course.

2. Literature Review

2.1 Affective Computing

Affective Computing means that we give computer the ability to recognize, express, have emotion and emotional intelligence. Most of studies focus on the field recognizing emotion and expressing emotion (Picard & Klein, 2002). Affective Computing also tries to know human's emotion which how to trigger or what can it affect. Picard's study team has ever tried hard to make a computer program that has ability to recognize emotion, transmit human's emotion and do some proper feedback.

2.2 Intelligent Tutoring System

Intelligent Tutoring Systems (ITS) means that computers are used to analyze, feedback, and provide individual teaching to students. Intelligent Tutoring Systems also can simulate real tutors to implement different teaching and provide student adaptive teaching methods based on his/her personality and situation. There are four parts of Intelligent Tutoring Systems as following: interface, expert, student and tutor mode (Koedinger & Corbett, 2006).

2.3 Affective Tutoring System

Kort et al. (2001) brought up a new model to conceptualize what affect learning emotion and create a model based on computer to recognize learner's emotion status, give proper feedbacks, and make learners learn in best status. Affective Tutoring Systems (ATS) means to add Affective Computing to Intelligent Tutoring Systems (ITS) so that it can make virtual tutor to have abilities to recognize learner's emotion in learning, adapt learner's emotion status, give proper feedbacks and arouse learners' learning motivations. Affective Tutoring Systems refer to computers that work like a real human to effectively adapt students' emotion status (Sarrafzadeh et al., 2003; Sarrafzadeh et al., 2004).

2.4 Remedial Education

Remedial education is multiple according to teacher's ideas, student's need and equipment in learning. There are some usual types used in teaching course such as compensatory program, tutorial program, adaptive program, supplemental program, basic skills program, learning strategies training program. In our work, we apply supplemental program and basic skills program to design our accounting course.

Supplemental program provides some extra knowledge which is not available in normal course but important for students. For example, we can provide low-achievement students some supplemental program.

Basic skills program focus on some basic skills which students cannot learn on normal course. Basic skills program believe that learning is a linear progress and students should learn progressively all course under basic knowledge; for example, if the students of sixth grade only have the written ability of third grade, the remedial course should adapt written abilities of third grade to enhance their skills. For the reason, we should find student's learning difficulties and know student's level of education and abilities.

3. Experimental Design

This work focuses on those students who have low-achievement in accounting. We take the midterm score as pretest. The experiment lasted 80 minutes approximately and 10 minutes for expert explanation. Figure 1 shows the experiment process that learners used affective tutoring system to have the remedial course about accounting and took the post-test for learning achievement, questionnaires of learning motivations and system usability about 20 minutes in the system. Finally, conduct the Focus Group interview and analyze the results from the post-test.

Figure 1. Research Environment

3.1 Participants and Environment

Forty five college students with commerce background were recruited to participate our experiment cause their low achievement in accounting course.

The experiment took place in a multimedia computer classroom. For each participant, we provided a computer with Internet connected and had installed the Affective Tutoring System, 19-inch monitor and 13 million pixels webcam.

3.2 System Structure

This work bases on two main topics: Affective Computing and Teaching. We divided into four modules: emotion recognition, tutoring agent, accounting course and teaching strategy.

(1) Emotion recognition module:

It has two parts: facial recognition and word recognition. Facial recognition uses webcam to capture learner's face and detects his/her facial emotion status. Word recognition allows user to enter

his/her learning ststus or mood for realizing learner's emotion. The ATS would adjust proper teaching strategies for the learners by the results above. Figure 2 shows the emotion recognition module.

Figure 2. Emotion Recognition Module

(2) Teaching agent module:

Like a bridge between the Affective Tutoring System and learners. Through the agent, we can inform the learners about the status and movements of the system, and we also can get learners' emotion status and care about what they need and provide proper feedbacks to help adjusting the teaching strategies for enhancing learners' learning motivation. During learning, the tutoring agent will provide some indications for learners to go on when they finish their current step or meet the end of the course. Tutoring agent has six facial feedbacks such as joyful, sad, confused, angry, boring and normal. Figure 3 shows the tutoring agent feedbacks.

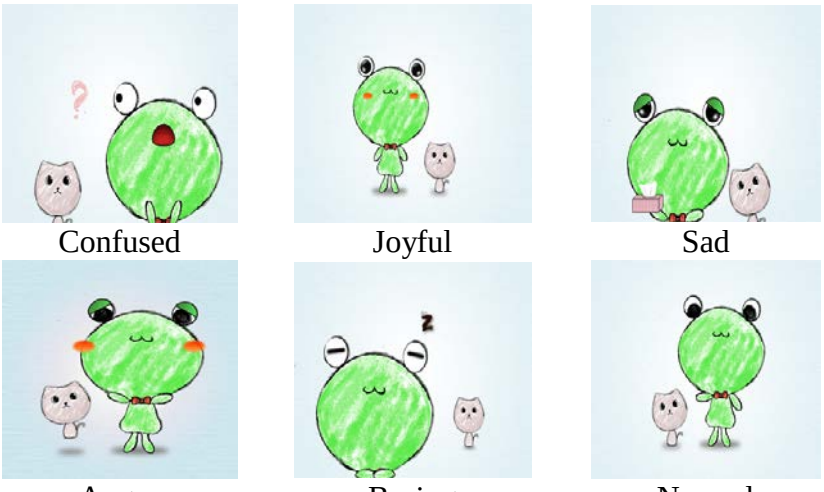

Figure 3. Tutoring Agent Feedbacks

(3) Accounting course module:

The accounting course was adapted from the first two chapters of IFRS Accounting (8e) about theory description.

(4) Teaching strategy module:

Many learners usually feel bored when they were learning digital course no matter what media it present (Greenagel, 2002). When learners come into negative emotion, it will affect learner's motivation, pleasure, and achievement. So we should add some interesting elements to transfer students' negative emotion and encourage students to learn when we are designing a digital course (Brown & Voltz, 2005).

Therefore, our system provides learners different learning contents according to learners' emotions. In order to enhance learners' learning motivation and learning achievements, the tutoring agent will detects learners' emotion at any moment by emotion recognition module. The tutoring agent will change the current course into a more interesting one when learners start appearing some negative emotions, and when the learners recover from negative emotions, the tutoring agent will change back the former course for the learners to continue learning.

4. **Evaluation**

4.1 Learning Effectiveness of ATS

For the evaluation, we quantified the 45 participants' pretest and posttest scores using descriptive statistics and paired-sample t-tests for data analysis. We also used Cohen's d for effect size. Based on Cohen's standard, d=0.2 was small, d=0.5 was moderate, and d=0.8 was large.

Table 1 shows the analyzed results of the learning achievements of accounting remedial course using affective tutoring system. The results show a significant difference between pretest and posttest ($p<0.001$ and $d>0.8$). We are confident for this experiment that the affective tutoring system used in accounting remedial course has a good effect for promoting learning achievements.

Table 1: Learning effectiveness analysis of ATS

	Sample	Mean	SD	t value	p	d
Pre-test	45	59.36	28.67	-7.006	0.000***	0.93***
Pro-test	45	78.78	12.93			

*** = $p<0.001$

4.2 Learning Effectiveness of Usability

In order to understand the relationship between learning achievements and the usability of affective tutoring system, Pearson correlation coefficient was used as show as Table 2. The results show negative correlations between learning achievements and system usability.

Table 2: Learning effectiveness analysis of Usability

	Sample	Signification (two-pair)	Pearson relation
Pre-test	45		1
Pro-test	45	.000	.868

5. **Conclusion**

This paper shows an affective tutoring system that allows users to do accounting remedial course and enhance learning achievement effectively. Our affective tutoring system uses facial emotion recognition and word emotion recognition to know learners' emotions in learning process. Positive emotions will promote learning motivations and negative emotions is on the contrary (Eyharabide et al, 2011). In order to change learner's negative emotions, tutoring agent offer signals for the teachers to make adjustments of their teaching strategies such as providing interesting content.

References

Brown, A. R., & Voltz, B. D. (2005). Elements of Effective eLearning Design. *The International Review of Research in Open and Distance Learning*, 6(1). Retrieved May 13, 2008, from the Washington State University database.

Eyharabide, V., Amandi, A., Courgeon, M., Clavel, C., Zakaria, C., & Martin, J. C. (2011, April). An ontology for predicting students' emotions during a quiz. Comparison with self-reported emotions. In Affective Computational Intelligence (WACI), 2011 IEEE Workshop on (pp. 1-8). IEEE.

Greenagel, F. L. (2002). The illusion of e-learning: why we're missing out on the promise of technology. Retrieved in July 1, 2007from http://www.guidedlearning.com/illusions.pdf.

Hupont, I., Abadía, D., Baldassarri, S., Cerezo, E., & Del-Hoyo, R. A. F. A. E. L. (2011). T-EDUCO: A T-learning Tutoring Tool that Cares. International Journal on Artificial Intelligence Tools, 20(4), 639-661. (DOI: 10.1142/S0218213011000383)

J. S. Wu (2010). IFRS: accounting Principles [Dictionary of the Chinese language] (8nded.). Taipei, Taiwan: Hwa-Tai publishing.

Klein, J., Moon, Y., & Picard, R. W. (2002). This computer responds to user frustration: Theory, design, and results. Interacting with computers, 14(2), 119-140.

Kort, B., Reilly, R., & Picard, R. W. (2001). An affective model of interplay between emotions and learning: Reengineering educational pedagogy-building a learning companion. In Advanced Learning Technologies, 2001. Proceedings. IEEE International Conference on (pp. 43-46). IEEE.

Manovich, Lev. (2001). The Language of New Media, Massachusetts: MIT Press. Boston, Ma, USA: Spotlight on Works in Progress.

Sarrafzadeh, A. (2002). Representing domain knowledge structure in Intelligent Tutoring Systems. Proceeding of the International Conference on Information and Communication Technologies in Education, 2,665-9.

V. Eyharabide, A. Amandi, M. Courgeon, C.Clavel, C. Zakaria, J. Martin, “An ontology for predicting students' emotions during a quiz. Comparison with self-reported emotions”, Affective Computational Intelligence (WACI), 2011 IEEE Workshop on, 11-15 April 2011, pp. 1-8