S. L. Wong et al. (Eds.) (2010). Proceedings of the 18th International Conference on Computers in Education. Putrajaya, Malaysia: Asia-Pacific Society for Computers in Education.

E-learning system design with humor and empathy interaction by virtual human to improve students' learning

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Abstract: Students' affections have a significant impact on motivation and learning performance. Many researches revealed that humor has a great effect on students' learning motivation and emotion. And some researchers thought empathy can increase students' interests and self-efficiency and ease off negative emotions. Therefore, we try to add several emoticons into e-learning system to capture learners' emotions and design a humorous and empathic virtual human to respond to learners' emotions at proper moments. In this paper, we had done a preliminary experiment which showed the virtual human with humor and empathy can enhance learners' motivation, learning performance, and ease learners' emotions.

Keywords: E-learning, humor, empathy, virtual human

Introduction

Many students have an experience, which they always feel sleepy, bored, and some negative emotion, in their learning life. When students have these negative emotions, they usually do not learn well. Students' emotions can impact how motivated student is to continue with the learning process and the way student perceives the learning process significantly. However, in e-learning system, it is difficult and important to capture learners' emotions and give them feedback at appropriate moments. Moreover, tutor may not interact with learners well in e-learning because there is no gaze and emotional communication between their interactions. Therefore, we try to improve these problems in e-learning by the design of a humorous and empathic virtual human.

Studies have indicated that a learning system with affective interaction may increase student' motivation, makes the system more engaging, and persuade learners during the interaction [23][26]. Students' emotions are varied and complex, so they are difficult to be recognized and be responded appropriately by computer systems. Researchers have tried to detect user's affective states and give appropriate feedbacks. Jaques used the BDI approach to infer student's emotions and use an affective pedagogical agent to give an appropriate affective feedback according to these emotions [13]. To make the computer recognize emotions, many researchers used sensors to read their emotional parameters [7][24]. Picard developed an affect-sensitive system that can detect student's emotion via sensors such as cameras, posture patterns, screen-capturing software, etc, and an embodied pedagogical agent would give empathetic or motivational statement to students [7].

Empathic reaction can increase students' interests and self-efficiency [17]. The definitions of empathy that based on Roger's explanations is the process of putting oneself in the place

of another person, seeing matters from the other's perspective, perceiving the other's feelings and thoughts and conveying this awareness to that person [5]. An empathic interface may improve human–computer interaction and reduce users' frustration [18]. Existed study also indicates that an empathic learning system can encourage and persuade students [26]. Hence, we use empathy as one of the emotional responses.

Humor also can help students learn well. There are many researches revealed that humor could exert a positive influence on students' learning. Teachers often use humorous performance to motivate students, attract their attention, and increase their remembrance in traditional learning environments [1][15]. Humor can also release students' negative emotion, such as anxiety, stress, or nervous, and promote the relationships between students and teachers in learning processes [16]. Classroom information is kept longer when presented in a humor manner [19]. Humor which is relevant to the learning materials can enhance the retention of the concepts being taught [15]. In addition to applying humor to the traditional learning environment, it has also been applied to the e-learning environment. Houng thought humorous virtual human applying to e-learning can enhance students' learning motivation and ease their emotion [11]. A great deal of e-learning systems was built, but no humorous performances were designed in most e-learning systems. Consequently, we design a humorous database for supporting emotional feedback and interaction.

In recent years, virtual human was applied extensively in e-learning environments to improve human-computer interaction. Actually, the most successful application of virtual human is to serve as a supporting role in e-learning environments, especially instructor, trainer, and companion, to assist students to learn [1][2][14]. Some researchers showed the virtual human with abundant face expressions and body movements can enhance students' learning motivation and will [3][20]. The virtual human with plentiful emotion can enhance students' motivation intensively [14]. Among these studies, we use virtual human to give feedback in this study. The performance of virtual human could be adjusted freely to what we want. The virtual human could be a useful style of computer interface to interact with students. Students could feel more interested and attractive in humorous learning processes by using virtual human.

As above-mentioned, many researches revealed the design of emotion capturing, empathy, humor, and virtual human may be effective on learning separately. Empathic interface may improve human–computer interaction and reduce learners' negative emotion. But, only using empathy to interact with learners sometimes is not enough when learners' feel confused or frustrated because it may not help them to solve their problems in leaning. Therefore, we proposed humor performance to let learners understand and impress on learning. In this paper, we design an affective interface and learning process with a humorous database by virtual human to interact with learners to improve existing e-learning system. The aims of our learning system are as follows:

1. To help students deal with negative emotions and keep their attention
2. To enhance students' learning motivation, interest, and performance

1. System Description

Figure 1. System Interface

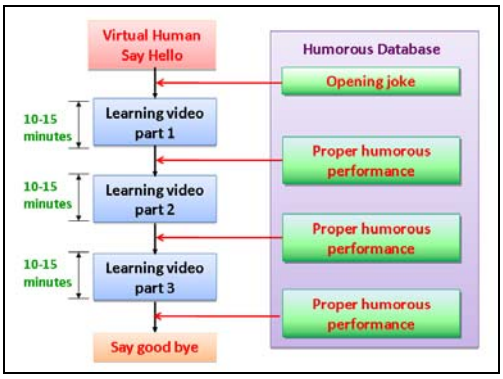

Figure 2. Learning Process

The purpose of our study is to (1) design several emotional buttons for capturing and empathizing learners' emotion, (2) search proper humorous performance from the humorous database, which was built by us, and add these into the existing learning materials at proper moments. For the purpose, we designed an empathic and humorous learning system to promote students to enhance their learning motivation and performance (Figure 1). Figure 1 show our system interface which was composed of video playing part and emoticon part that learners can express their learning emotion freely.

1.1 Learning Process

In this study, we divided the learning process into several segments (each segment is 10-15 minutes) and take 1-2 minutes break between each learning segment which was suggested by Weaver et al. [27]. For keeping students' learning interest, attention and impression on the previous learning, we queried the proper humorous performance which is related with the previous learning segment from humorous database into this learning process (Figure 2). Figure 2 shows the learning process in this study; in the beginning, virtual human introduce herself and say an opening joke for motivating students to learn and release their stress, tension, anxiety, and other negative emotions [2]. And then move to the learning video part to learn lecture. During the learning video part, students can follow their emotion to click the emoticons we designed to interact with virtual human and release students' emotions. In the following sections, we will describe emotion capture, responses, and humorous database in detail.

1.2 Emotion Capture

We want to know the critical emotions that have influence on learning, first. Many studies have proposed models of learning-related emotions [21]. Learners are less effective at learning when distracted, boredom, and stressed [6]. Students usually cannot learn well and take in information efficiency when they have negative emotions. Based on the studies above, we choose the negative emotions boredom, dissatisfied, confusion, and frustration. Besides these negative emotions, we also choose two positive emotions joy and interested that may occur in our system.

In this study, we let learners to express their emotions only by mouse-clicking. The reasons are as following: First, complicated software and hardware systems also might not be easy to promote to the public. These systems will take a lot of money, too. The second reason is that people would disguise negative emotions because of social pressures, so these emotions

would be difficult to be detected. So when the users can freely reflect or report their emotions, they will prefer to express their emotions. To make learners more willing to express their emotions, we let they can use emoticons to express their emotions. We choose some sets of emoticons that are commonly used on internet.

1.3 Emotional Responses

Students' motivational beliefs depend largely on how tutors provide feedback, so how to give feedback to learners is an important problem. In this paper, we use empathy and humor as the emotional response. According to social psychologists, empathy is defined as " putting oneself in the place of another person, seeing matters from the other's perspective, perceiving the other's feelings and thoughts and conveying this awareness to that person" [12]. We design our virtual human with empathy by considering the three important elements of empathy as follows: Firstly, putting ourselves in the place of the target and seeing matters from his/her perspective. Secondly, understanding and perceiving correctly the target's thoughts and affective states. Thirdly, conveying empathic considerations to the target [12]. For another emotional response we used, some researchers thought humor has the ability to decrease students' anxiety, improve students' learning, and boost their self-esteem [2]. Humor can enhance emotional and social involvement, and through humorous conversations are enlivened, become more interesting and enjoyable [8]. And it is also a way of getting students to pay more attention, and enhancing the recall of classroom information [22]. Therefore, we try to design the virtual human with humor for responding learners' emotions.

When the learner expresses his/her emotions in our system, the virtual human will encourage and persuade them with empathy and humor into persistent learning according to learner's emotional states. For example, if learners feel bored, virtual human will says" I am sorry that you seem to feel bored, let me tell you a joke to make you happy". For another example, if learners feel confused, virtual human will soothe the learner and tell a proper humorous story which was queried from humor database to assist his/her learning. With regard to humor database, we will describe it next section.

In the case of the design of virtual human, we referred to several studies as follow. For the facial expressions of virtual human, we designed it refer to the design of facial expressions proposed by Ekman [9]. For gestures and body movements, we designed this aspect by referring to some researches of psychologists, behaviorists, and arts performers [10]. Figure3 and Figure 4 show the virtual human, Maggie, care and encourage learners by plentiful facial expression, gesture, and body movement for transferring learners' negative emotion to positive emotion (Figure 3, Figure 4).

Figure 3. The virtual human cares for learners.

Figure 4. The virtual human encourages learners.

1.4 Humor Database

For supporting humorous learning system, we build a humor database. We search and collect the humorous materials which are composed of humorous figural, verbal, physical and auditory, and so on [25]. According to some famous researches, this database is composed of humorous performances with avoiding ridiculing students, not related with learning materials, inimical humor, taboo humor, using humor to weaken serious things which is such as drinking, drug taking, drunk driving, and so on [25].

According to above-mentioned researches about humorous virtual human and humor how to be designed, we found the database we designed is not all humorous performances related with learning materials. Therefore, we created some humorous performances which were learning-related by the principles suggested by Chiou et al. [4]. They found most often used humor-creating skills were homonym, word-combination, lexical ambiguity, syntactic ambiguity, erroneous inference, reinterpretation, and metaphorical inference. After their evaluation, they found homonym, word-combination, lexical ambiguity, and syntactic ambiguity have much better effects on creating humor. Hence, we queried humorous jokes from the database and created proper humorous performances which were much related with learning materials by above-mentioned four skills and several humorous strategies in teaching proposed by Berk, such as opening joke, humorous questions, humorous examples, and so on [2]. Figure 5 shows a part of the humorous performance which was related with learning materials and expressed by virtual human and funny pictures in order to make learning interesting. Figure 6 reveals that the virtual human was telling a humorous riddle as a humorous example. The purpose of these humorous performances is to relax learners and increase their impression on their learning.

Figure 5. The humorous performance with funny pictures.

Figure 6. The virtual human is telling a humorous riddle.

2. Experiment

The purpose of this experiment was to understand whether providing an empathic and humorous virtual human environment in which students interact with animated virtual human results in more motivated, interesting, and effective learning than providing the same information as an on-screen traditional learning video environment. To verify the effect of empathic and humorous virtual human, the experiment included two treatments. One treatment was experimental group which was to evaluate the situation of students using the system with empathic and humorous virtual human. The other treatment was control group which was to test the situation of students using the system with non-empathic and non-humor virtual human for comparing with experimental group.

2.1 Participant and Procedure

Participants in the evaluation were 16 college students (12 males and 4 females) in National Central University. 8 participants served in the experimental group and 8 participants served in the control group. Each participant was randomly assigned to a treatment group (experimental group or control group). For each participant, the paper-and-pencil materials consisted of a pre-test, a post-test, and a questionnaire. The computerized materials consisted of a multimedia computer program on teaching Chinese history. It would take about 30 minutes to interact with the system. To measure the participant's level of history before and after learning, paper-and-pencil pre- and post-tests were administered.

In the beginning of this experiment, all participants were asked to complete a pre-test. When the participants had completed the pre-test, the experimenter presented oral instructions that how to interact with the system. After the participant logged in the learning system, the virtual human, Maggie, would introduce herself and tell an opening joke. When participant began to learn, he/she could express his/her emotion by clicking emoticons. After he/she expressed his/her emotion, Maggie would give response according to his/her emotion. After interacting with the learning system, the participant was asked to complete the post-test. And then the participant in experimental group had to complete the questionnaire with a five point Likert scale (5 = strongly agree; 1 = strongly disagree). Finally, we interviewed each participant who was in experimental group to know the participants' viewpoints about our design.

2.2 Results

The score of the pre-test and post-test were conducted for the learning performance. We compared and analyzed the score of post-test subtracting pre-test of each group by T-test analyzing. According to the result of our analyzing, we found the experimental group was significantly better than control group in learning performance ($P=0.025$, $t=-2.503$, $P<0.05$). Therefore, we can know our design has a significant effect on students' learning performance.

Table 1 shows some of the results of the questionnaire. According to the results, the participants thought that the virtual human can facilitate to increase their attention and interests. In motivation, they told us that the humorous performance expressed by virtual human can let them relax and be willing to continue learning.

Table 1: The means of questions

Questions	Mean
1. The proper humorous performance expressed by virtual human in the learning process can increase my learning attention.	4.5
2. The proper humorous performance expressed by virtual human in the learning process can make learning material interesting.	4.2
3. Putting the proper humor performance into the learning system can motivate me to use the learning system	3.9
4. The proper humorous performance expressed virtual human in the learning system can help me learn better.	4.3
5. The virtual human's humorous performance do not interfere me during the learning process.	4
6. For the empathic expression of virtual human, I can feel her cares for me.	3.6
7. I can get rid of the negative emotions after interacting with the humorous and empathic virtual human	3.8
8. Interacting with the humorous and empathic virtual human can increase my positive emotions.	4

In this study, we let the users freely express their emotions. According to the systematic logs,

the emotion that participants expressed the most was confused and interested. They told us that they usually clicked confusion button when they need the humorous performances to help them remember. According to our observation and interview, the probability that they expressed their emotions when they were really in these emotional states was about 60%. Sometimes they did not express their emotions when they had these emotions. According to the interview, some participants said that they did not express their emotions because they thought they can deal with emotions by themselves then. Most participants like virtual human's humorous performance more than the empathic responses because they thought those performances can help them understand the learning materials and get great effect on tests. Overall, most of the participants are willing to use this system again.

3. Discussion

In this paper, we design a system that students could freely express their emotions and the virtual human would use humor and empathy to deal with student's emotions. The first problem that we encountered was how to know student's emotional states. Many studies used automatic affect recognition and automatic respond to users. Although this is a good solution, sometimes students like to have rights to control in the learning process. According the interview, some participants said that they prefer to decide the time that virtual human to appear. The reasons are as following: The unexpected response may interrupt their learning then. Sometimes the students can deal with emotions by themselves. The other problem that we encountered was that students did not express their emotions. One of the reasons is that the experimental period was too short to experience some emotional states for some participants. Besides, we also found the emotions that they are more willing to express are bored, confused and interested.

In this study, we designed the humorous performances that were learning-relevant to help students remember. There are two kinds of the performances. One would appear at the end of every learning video, and the other appeared when the students expressed their emotions. In our interview, some participants said that they like the humorous performances that appeared at the end of every learning video more than the other one because the performance and learning video didn't link up very well. Sometimes the student would fell strange after the emotional responses. We will keep on improving our design according to the results and interviews.

4. Conclusion and Future Work

This research proposed an approach of interaction with a virtual human with humor and empathy in e-learning system by clicking emoticons. In this study, the humorous performance can motivate learners to learn, make them feel more interested in learning, relax their learning emotion, and enhance their learning performance. Besides, empathic responses can relax their emotions and take a short break even though it is not better than humor performance in learning performance. Overall, the e-learning system with a humorous and empathic virtual human can keep learners' attention and enhance their learning motivation, interest, and learning performance.

In further work, virtual human should be much more empathic to let learners feel truly cared for. The humorous performance should be tightly related with learning materials and be inserted at proper moments. And the humorous database needs to be much stronger for supporting e-learning system. A great deal of participants is needed to verify the performance of each design.

Acknowledgements

The work reported in this paper was funded by the National Science Council of the Republic of China under projects NSC 98-2631-S-008-003 and NSC 99-2631-S-008-004.

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