The Emotional Conditions of Learning

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Abstract

Learner performances depend on the external conditions or circumstances that exist when learning occurs. Recent researches have shown that emotions play a powerful role in cognitive processes. In traditional learning environments, the teacher attempts to ensure the best conditions for learning and especially the emotional conditions. For instance, he introduces a joke in the classroom, in order to change the current emotions of the learners, if they are bored or frustrated. Whereas the existing Intelligent Tutoring Systems are lacked of considering the emotional conditions of learning that should exist in order to motivate the learners and to facilitate the achievement of learning.

In this paper, we propose the emotional conditions of learning that should exist in a learning activity according to the cognitive process activated. We describe also two experiments conducted in order to validate the emotional conditions that we propose in the attention and the acquisition processes.

Introduction

The main purpose of Intelligent Tutoring Systems (ITS) is to support and improve the process of learning for any field of knowledge (Rosic et al. 2000). To achieve this goal, it is necessary to look at the conditions of learning. It means to consider the set of circumstances that exist when learning occurs. The conditions of learning are classified into two categories: The first one is the internal conditions which represent the capabilities that already exist in the learner before a new learning starts. The second one is the external conditions which are situations outside the learner.

Gagné have presented the conditions of learning in (Gané 1977) without considering the emotional factor. Whereas, recent researches in neurosciences and psychology have proved that emotions are widely related to diverse cognitive processes, such as attention, long-term memorizing, problem solving, decision-making, etc. (Isen 1999) (Damasio 1994). Positive affects are fundamental in thought processes. In addition, they play an important role to improve creativity and flexibility in problem solving and could enhance performance on the task at hand (Isen 2000). Besides, Estrada et al. have found that positive emotions may increase intrinsic motivation (Estrada, Isen, and Young 1994). However, negative affects like anxiety engender problems in attention (Fox 1994), slowed decision latency (Volans 1976) and deficit in inductive reasoning (Reed 1977). Moreover, in traditional learning environments, students who are bored, anxious, anger or depressed, could not learn and think efficiently (Goleman 1995). Consequently, the conditions of learning should include the emotional factor.

We present a new definition for the emotional conditions of learning as "*the external circumstances that exist and could affect the emotional state of the learner at the first time and learning therefore*". Then, we address here the following challenging question: Which are the emotional conditions that could improve learning in the context of an ITS ?

To this end, based on the process of learning and memory presented by (Gagné 1977), we propose the emotional conditions that should exist when each phase of the process is activated. The process of learning and memory includes four phases or cognitive processes: the attention process, the acquisition process, the retrieval process and the response organization process (Gagné 1977). Sometimes, learning tasks require just two or three cognitive processes, mentioned above, that's why, we have chosen to reason by process and to present emotional conditions according to the process activated.

The organization of this paper is as follow: In the first section, we review some previous work realized in connection with emotion and e-learning environments. Then, in the section 2, we discuss different cognitive processes that exist in the learning and memory process. In the same section, we propose some emotional conditions of learning that should exist according to each cognitive process in order to improve learning. After that, in the section 3, we show how we obtained from experiments various elements to prove our proposition in the process of attention and that of acquisition. So, we present in particular these experiments and show the results obtained.

Previous Work

Before dealing with the emotional conditions of learning, it will be useful first to review some of the previous work that exists and tries to improve e-learning environments in considering and managing the current emotional state of the learner.

For instance, at MIT Media Lab, Kort et al. proposed a model, which describes the changing of the emotional state during model-based learning experiences, to aid efficient learning (Kort, Reilly, and Picard 2001).

Moreover, some researchers are interested in including the emotional state of the learner into the architecture of an ITS. So, they integrate learner's emotional state in the student model. For example, Conati used a probabilistic model based on Dynamic Decision Networks to assess the emotional state of the user with educational games (Conati 2002).

Some other researchers have implemented the animated pedagogical agents in order to motivate the learner. For instance, (Lester, Towns, and FitzGerald 1999) have created a pedagogical agent called COSMO, who exhibits emotive behaviors aiming to support learners in problem-solving activities. Besides, (Jaques et al. 2004) have developed the mediating agent which tried to infer the student's emotion and to present emotive behavior in the purpose to promote a positive mood in the student. Moreover, (Faivre, Nkambou, and Frasson 2003) have developed a multi-agent system for instruction; in which they integrate two agents. The first one exhibits the tutor's emotional expressions in a 3D dimensions and the second one tried to elicit and analyze the learner's emotional experiences during his interactions with the system.

Few works in computer science attempted to induce emotions. For instance, at affective Social Computing Laboratory, (Nasoz et al 2003) used results of (Gross and Levenson 1995) to induce sadness, anger, surprise, fear, frustration, and amusement. In addition, (Chaffar and Frasson 2004) have used a hybrid technique which combines guided imagery, music and images to induce three emotions, including: joy, pride and confident.

However In the best of our knowledge, none of the existing works tried to identify the emotional conditions of learning according to each cognitive process as given by the model of learning and memory (Gagné 1977). To this end, in the next section, we present the emotional conditions of learning depending on the cognitive process.

The Emotional Conditions of Learning

(Gagné 1977) identifies varieties of capabilities or performances that have been learned by human beings since their birth. The first one is the intellectual skill which is the ability to interact with the environment by using symbols. For example, to constitute a sentence, we have to make a correspondence between the verb and the subject, if the verb is in the singular form, then the subject must be also in a singular form and so on. The second capability is the verbal information which consists in expressing or telling some information or ideas by using different forms such as oral speech, writing or drawing, etc. The third capability called the cognitive strategies which could be: techniques of thinking, methodologies of analyzing problems or approaches to solve problems. The fourth one is the motor skill which consists in executing movements in a number of ordered motor actions such as driving a car. The last capability called attitudes; it is represented by mental states which influence the learner's choices of personal actions, for example, preferring to study mathematics rather than economics during the time of study (Gagné 1977). To enhance these capabilities, we have to understand the process of learning and to determine the emotional conditions that an ITS should provide in each phase of the process. As shown in Figure 1, the process of learning and memory involves varieties of cognitive processes. Figure 1 is based on the information-processing model represented in (Gagné 1977).
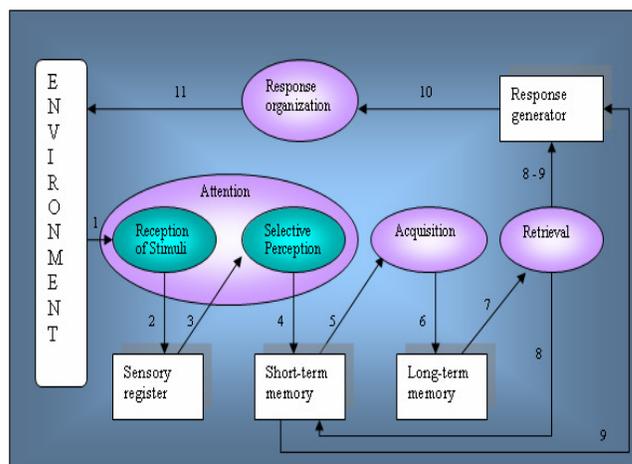
Figure 1. The Process of Learning and Memory

After the interaction of the learner with the environment, the process of learning and memory starts according to the following sequences:

(1) attention is the initial phase of learning; in the first stage, the learner detects the relevant stimuli,

(2) after receiving the stimulation, it will be registered in the sensory register,

(3) after that, the selective perception will be activated for storing the relevant features of the stimulus in the short-term memory,

(4) then, the information will be stored into the short-term memory as auditory, articulatory or visual images which are subject to repetition or rehearsal,

(5) in the acquisition phase, the information will be encoded into a meaningful form,

(6) after transforming the information into a semantic or meaningful form, it will be stored in the long-term memory,

(7) then, the retrieval phase consists in searching and recalling information in the long-term memory,

(8) the information retrieved may be returned to the short-term memory or passed directly to the response generator,

(9) the response generator receives the information either from the short-term memory or from the retrieval phase,

(10) after receiving the information, the response generator structure tries to generate a desirable response organization,

(11) finally, the response will be returned to the environment.

After having described the process of learning and memory, we detail, next, the role of each phase of the process and elicit the emotional conditions of learning that should exist in each phase.

The Emotional Conditions in Attention Process

The attention phase includes the reception of the stimuli and the selective perception. In fact, attention underlies the detection and the storage of stimuli that are relevant to the learner's goals (Mogg and Bradeley 1999). According to these goals some stimuli will be prioritized in attention than others. After receiving the stimulus, selective perception stores the relevant characteristics of the stimulus detected in the short term memory.

The emotional state plays a pivotal role in attention. The learner's emotional state affects the performance on tasks requiring attention. In fact, negative emotions have two types of effects: impairment effect related to reduced performance (Hartlage et al. 1993) (Eysenck 1992) and bias effect related to prioritization of treating stimuli which have negative impact or valence (Matthews and Wells 1999). Besides, emotions such as joy or sadness generally show down the process of attention (Mogg and Bradeley 1999). The learner who is submerged by these emotions has difficulties to alter the attention to the new learning activity and he is involved in processing either impertinent features of the task or information which is not related to the task. So to attract the focus of the learner, it should be better to change his current emotional sate to the curious state, by changing suddenly in stimulation up or down (Gagné 1977), for example brightening a word in a text, changing the color of a concept in the interface or making a sound suddenly.

The Emotional Conditions in Acquisition Process

As mentioned before, after detecting the stimulus, this information must be encoded or transformed into a semantic form to facilitate the storage in the long-term memory. At this stage, the information is modified into learned capabilities.

Emotions affect not only attention but, also the acquisition process. Some studies have found that human beings tend to code more information if the tone of the material corresponds to their emotional states (Mayer and Salovey 1988). For example if the current emotion of the learner is happy, he would encode more information if the material was also emotionally positive than if the material was depressing or emotionally negative. So, to facilitate the process of acquisition, we should ensure some emotional conditions. Consequently, in the acquisition phase, we propose two alternatives: the first one is to conceive the content of the material according to the emotional state of the learner, by adding some emoticons in the material, for example. The second one is to induce the emotion corresponding to the affective tone of the material by designing several interfaces that could affect the current emotion of the learner.

The Emotional Conditions in Retrieval Process

The process of retrieval consists in remembering and fetching the information in the long-term memory. This process is important because it's the base of many learning tasks like the problem solving task.

As mentioned previously Emotions affect the attention process, the acquisition process and also the retrieval process, it has been demonstrated under various circumstances that human beings have a tendency to retrieve from memory information which is coherent to their current emotional states (Blaney 1986). So, to remember pleasant or unpleasant material in memory, depends on the emotional state of the learner, if he is happy he would recall more easily happy material. Besides, Hertel and Rude have found that depression is related to a deficit in retrieval strategies (Hertel and Rude 1991). Thus, the emotional condition in retrieval process is to induce an emotion according to the tone of the material to be recalled exceptionally depression, and if the content of the material is neutral, it would be better to induce the neutral state in order to improve the retrieval process. To induce emotion, we propose to design interfaces using a hybrid technique which combines guided imagery, music and images for example.

The Emotional Conditions in Response Organization Process

Response organization represents the basic form of the learner responding. In the context of an ITS, it should be writing some thing, demonstrating how to do something, or originating a solution to a novel problem, etc. The Response organization phase is also very important like the previous phases because the performance of the learner will be evaluated according to his response. Although, he could achieve the attention phase successfully, the acquisition phase successfully and the retrieval phase successfully, but he obtain a bad result because he failed in his response organization.

In the response organization process, emotions play also a crucial role. In fact, positive emotions are fundamental in cognitive organization, and make problem solving and decision making more original and flexible (Isen 1999). So, we have to take care to the emotional conditions that exist, when this phase is activated. In this case inducing a positive emotion like joy for example will improve response organization. To induce positive emotions, we use the hybrid technique mentioned previously, to design interfaces in order to affect the emotional state of the learner, so as to be in the best conditions for learning.

In the table 1, we summarize the emotional conditions of learning which could affect the internal processes. So we present according to the process, the emotional conditions that should exist.

Cognitive Process	Emotional conditions
Attention	- avoid negative emotions, - avoid emotions like joy or sadness that are not related to the learning activity, - induce the emotion of curiosity by highlighting an element in the interface suddenly for example.
Acquisition	- conceive the content of the material according to the current emotion of the learner or induce the emotion corresponding to the affective tone of the material.
Retrieval	- induce the emotion which matches with the affective tone of the material exceptionally the depression state. If the content of the material is neutral, then induce the neutral state.
Response organization	- induce a positive emotion such as Joy.

Table 1. The Emotional Conditions according to Cognitive Process

Experiments and Results

In the purpose to validate the emotional conditions of learning proposed previously that should exist according to the cognitive process activated, we are in the process of performing empirical studies. At the present time, we are conducting two experiments in parallel to validate the emotional conditions related to the process of attention and those related to acquisition phase, mentioned in the table above. At this moment, 26 participants from different genders and ages have done the experiments. In the first experiment, a series of 10 word pairs is presented to the participants, the word pairs are organized as one above the other, and one member of the word pair is high-lightened suddenly. Each word pair of the series presented briefly to the participants, after that it disappears and a dot is presented in the position occupied by one of the words. In this case, participants have to enter the word appropriate to the dot as soon as possible. The results obtained until now show that participants are faster to respond to the high-lightened word than the other member of the pair. From the 26 participants, we have just 4 persons that respond, firstly, to the non high-lightened word as shown in the figure 2.
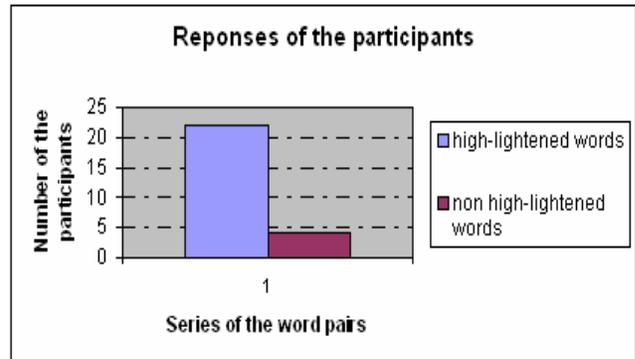
Figure 2. Result of the Experiment 1

For the second experiment, we use two different interfaces, one conceived to induce sadness, and the other one is for inducing joy. In the first time, we induce sadness, then, we evaluate the acquisition of the participant, knowing that the tone of the material is emotionally positive. After that, we induce joy; we evaluate for another time his acquisition process. To induce sadness or joy, we used a hybrid technique which combines guided imagery, music and images (Chaffar and Frasson 2004).
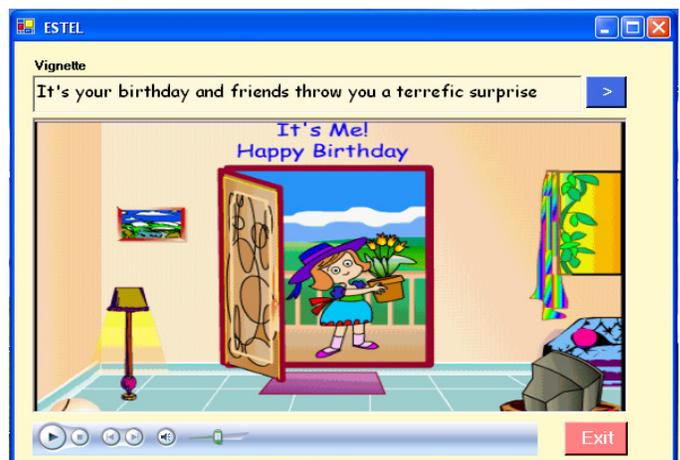
Figure 3. Example of interface inducing joy

Figure 3 shows an interface for inducing joy that uses the hybrid technique. So, we integrate in the interface a guided imagery vignette to engage the foreground attention and in the background we set an image that expresses what was said by the vignette in order to help in the guided imagery, we also put music to improve the background. For example, in this interface, we say to the learner imagine that "It's your birthday and friends throw you a terrific surprise party" (Mayer, Allen and Beauregard 1995), we show him an image that reflects this situation to help him in his imagination, in the background we put to him a music expressing joy such as Brandenburg Concerto #2 composed by (Bach 1721). We use the same principle to induce distress.
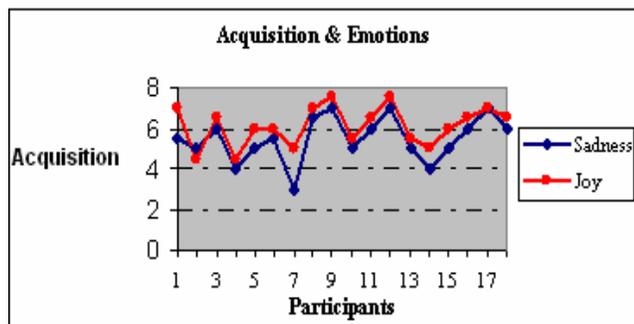

Figure 4. Result of the Experiment 2

As shown in the figure 4, the process of acquisition is improved after inducing joy in the participants, knowing that the content of the material is emotionally positive.

Conclusion and Future Research

In this paper, we have presented the process of learning and memory and described the emotional conditions of learning that should exist when a cognitive process is activated. In the context of an ITS, the emotional conditions for learning could be an interaction with the learner that affects his emotional state or the tone of the material that could enhance the learner's performance. So to improve learning, we have to reason by cognitive process. If the learner is in process of the attention phase, we have to induce curiosity, else if the acquisition phase is activated, we have to try to correspond the tone of the material with the emotion of the learner either by changing the material tone or changing the emotional state, else if the learner tried to retrieve some information, it's better for this process to induce the emotion related to the tone of the information, else if he is in the process of the response organization phase, we have to induce a positive emotion like joy for example. We are also aware of the fact that inducing emotions in humans is not easy. That is why we have used the hybrid technique which combines guided imagery, music and images in order to change the learner's current emotion.

For future research, we have to do more empirical studies to find the relationship between specific emotions with a specific cognitive process. It means to find according to each cognitive process, the set of emotions that could improve it.

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