Intellectual Intelligent Tutoring System: The ITS with Emotions

Dr. O.P. Rishi

Abstract— Emotional Intelligence (EI) is emerging as an important factor in high performance at work, at school, collage, or at home. Learner performances depend on the external conditions or circumstances that exist when learning occurs. Recent research results indicate that cognitive processes are related to emotions and it play a powerful role in cognitive processes. Since emotions are omnipresent in any kind of interaction it can be advantageous to take them into account, particularly in the context of an intelligent tutoring system (ITS). In traditional learning environments, the teacher attempts to ensure the best conditions for learning and especially the emotional conditions. For Example, 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 (ITS) 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 the present paper we propose a way to detect and manage learner's emotions in order to improve the learning process and the emotional conditions of learning that should exist in a learning activity according to the cognitive process activated. Also, we demonstrate that adding an emotional charge to a learning content additionally helps the learning process, in particular the memorization process, which is known to be of central importance in any form of learning. These mark a significant step towards Intellectual Intelligent Tutoring Systems that are emotionally intelligent and hence cope in a beneficiary w ay with a learner's emotions

Index Terms— **Emotional Intelligence, Intelligent Tutoring System, Emotional Conditions, Learning Process**.

I. INTRODUCTION

It was commonly assumed that learning implicated intellectual and cognitive processes, Emotional Intelligence (EI) is emerging as an important factor in high performance at work, at school, and at home. The impetus to engage in and persist with any learning activity is directly linked to the emotional state of the learner (how he feels about himself) and his motivation (how he feels about the subjects).

Hence those different emotions will incite different outcomes. Positive emotions, for example, allow for efficient acquisition and creation of knowledge, while negative emotions reduce and inhibit knowledge retrieval and memory [16]. E-learning environments need to consider all

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of these elements and particularly the emotional state of the learner. But how can we identify the emotional state of the learner? How do we generate the best possible learning conditions for each learner and most importantly, how do we create an E -Learning system capable of controlling and managing emotional learning conditions?

These questions remain essential to the understanding and enhancement of learning processes and mechanism. The Learning Process implies to fulfill a variety of tasks such as understanding, memorizing, analyzing, reasoning, or applying. Given the above mentioned relation between feeling and thinking, the student's performance in these different learning tasks will depend on his emotions.

With in this paper we proposed a system for modeling learners' emotions and their variation during a learning session with an Intelligent Tutoring System (ITS). For example, a computational matrix for computing and constantly up-dating learners' emotions has been developed in [1]. Moreover, other researchers have developed systems that are able to control and influence the learner's emotions. The "affective companion" adapts to the learner's emotions, by adjusting the difficulty of an exercise [11]; the "affective tutor", on the other hand, is itself affectively adaptive to the user's emotions [4]. Such an ITS is therefore able to influence, in a specific way, a learner's emotions

The purpose of Intelligent Tutoring Systems (ITS) in E -Learning context is to support and improve the process of learning for any field of knowledge [21]. 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.
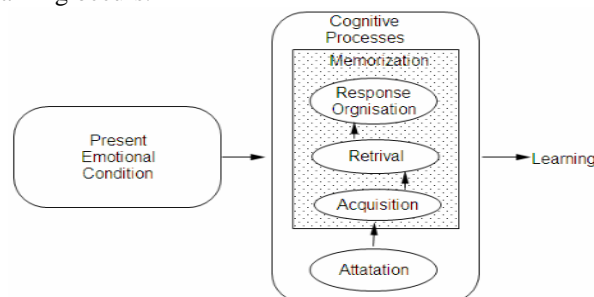

Figure 1: Cognitive Processes of Learning

Currently 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. [14][5]. In addition, they play an important role to

improve creativity and flexibility in problem solving and could enhance performance on the task at hand [13]. Moreover, in traditional learning environments, students who are bored, anxious, anger or depressed, could not learn and think efficiently [7]. Consequently, the conditions of learning should include the emotional factor. The emotional condition of learning can be defined as "the external circumstances that exist and could affect the emotional state of the learner at the first time and learning therefore" [9] If we follow this definition then, we address the following question: Which are the emotional conditions through which we can improve the learning in the context of an ITS? Through this paper we try to answer the above question.

The goal of this paper is to identification of certain emotional conditions of learning which contribute to learning enhancement and learner performance and improve the effectiveness of such emotion-based Intelligent Tutoring Systems. This analysis allows us to define the different emotional states, emotional conditions, and how can we improve the performance of learner during negative emotions. More precisely, we aim at determining the emotional state of the learner which leads to the best performance, and how an ITS can directly use the influence of emotions connected to the learning content to improve learner's cognitive abilities.
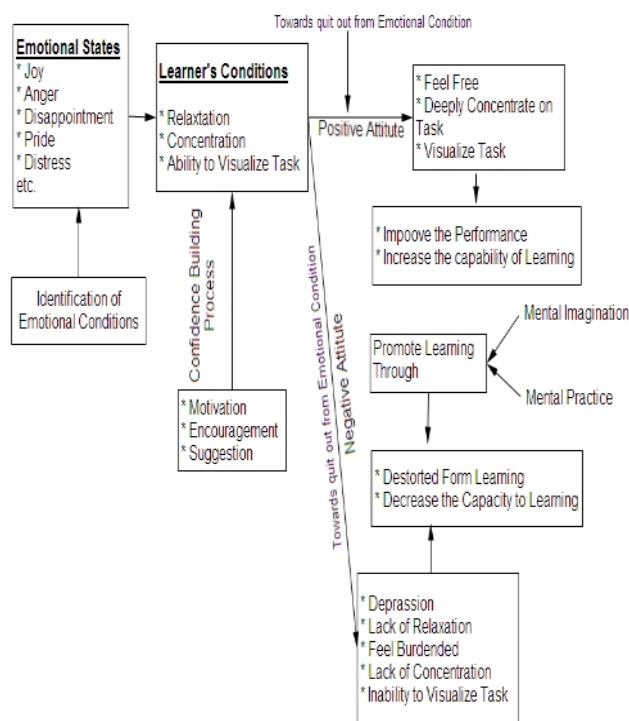

Figure 2: Retrieving and Measuring the Emotional State of Learning

In this paper we try to discuss the type of emotions, emotional condition of learning and its role in learning behaviors, how these can be used to improve learning, and how they can be controlled and how cognitive processes involved in learning and their what is the relation between learning & emotions. In the second section, we describe process of learning and approach to increase the attention of the learner. In the next section elaborate the ITS

and we also describe the concept of an Intellectual Intelligent Tutoring System (IITS) which uses emotions to improve learning efficiency. With in this section we also discuss the method of facilitate learning content memorization by emotionalizing in ITS. Finally, we describe a method based on a dynamic set of rules which allows an IITS to determine and generate the best emotional state for a learner and how can we improve of the performance of ITS through emotional intelligence.

II. TYPES OF EMOTIONS, AND ITS ROLE IN LEARNING BEHAVIOUR

Different emotions affect learning differently. Anger, Anxiety, or Distress provides a negative impact on learning and such conditions can be treated as Negative state of Emotions Similarly Success Joy & Pride has a positive impact on Learning where as fear of failure, a negative influence on achievement [17] and this can be considered as Positive state of Emotions. Negative Emotions destruct the concentration of learning and reduce the performance while positive emotions can improve creative, flexible and integrated thinking and learning processes [11].

The learner can encounter specific situations which can induce by themselves new emotions. It is exactly the same that, its effect on learning performance is opposed in the two cases due to the different origins. So we distinguish between two classes of emotions with respect to their origin:

Positive Emotions

Negative Emotions

In general, strong emotions, both positive and negative, can block parts of the brain involved in the thinking process and therefore prevent the learner from concentrating, memorizing, retrieving in memory, and reasoning [3]. Now, we analyze the impact of positive and negative emotions on performance whether they have been externally or internally generated.

Positive Emotions: If the origin of the emotion is directly linked to the learning process then the positive emotions have a strong positive effect on learning. It allow for a more creative and flexible thinking process and also increase motivation to maintain the good performance.

Negative Emotions: Negative emotions for example anxiety, anger, distress or stress reduce learner's concentration and turn his focus to different matters. In the context of learning, negative emotions like being jealous, envious, or resentful about someone else's these emotions act as a motivating factor for encouraging the learner to work harder and replace them by positive emotions and work as motivation factor.

Positive and negative emotions can go as far as affecting the way the brain processes and retrieves information. The involvement of the emotional-right brain with the cognitive left - brain can dramatically improve learning. It is suggested that a synergistic principle operates between the hemispheres; hence, a functioning whole becomes significantly greater than the sum of its parts. For example if you are Reading a story book or listening to a song, the left brain would be processing the words and

the right brain would be processing content of the story or the music as it is (Colin Rose: interview in Aston Clinton, Bucks, England, 1990). So it's no accident that we learn the words of story or any popular songs very easily
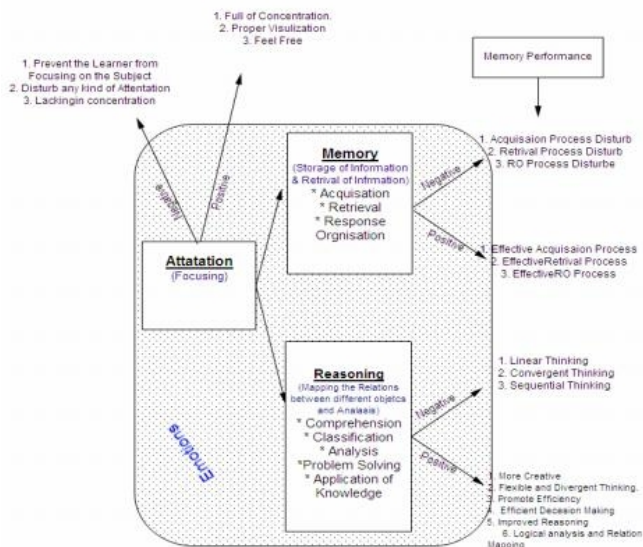

Figure 3: Effect of Positive and Negative Emotions in Learning

Learners are highly complex beings and as such, learning involves both a cognitive and emotional process. In fact, emotional intelligence is recognized as an essential component to the success of human learning processes. The learning process involves in particular three cognitive processes, namely attention, memorization, and reasoning, with respect to each of which the learner's cognitive ability depends on his emotions. Positive emotions promote efficiency and thoroughness in decision making and problem solving [12].

A. The Attention Process

The attention process 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 [21]. 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.

Attention means focusing. Learning can take place only if the student listens. A necessary condition for successful learning is hence to gain the attention of the student [8]. Depending on the learner's emotions the emotional state plays a pivotal role in attention. The learner's emotional state affects the performance on tasks requiring attention In fact, strong emotions, in particular if they are negative, disturb any kind of attention and concentration and prevent the learner from focusing on a subject [7]. Moreover, negative emotions lead to difficulties in switching the attention to a new focus [4].
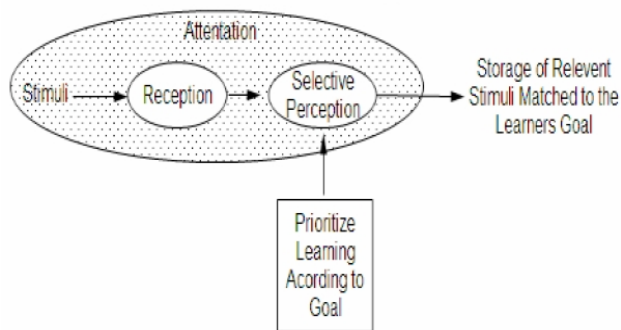

Figure 4: Attention Process of Learning

B. The Memorization & Reasoning Process

The Memorization Process involves in particular three processes, namely Knowledge Acquisition, Knowledge Retrieval and response organizations. Memory is one of the most important concepts in learning. Knowledge memorization represents a principal objective of instruction and is necessary for the major complex cognitive tasks of learning process [2]. Memorizing is a process which involves the Acquisition of information, storage of information as well as the retrieval of knowledge (reasoning) and the following properties [3]:

2.2.1 Acquisition Process

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 so that to facilitate the process of acquisition, we should ensure some emotional conditions. Consequently, we ensure to conceive the content of the material according to the emotional state of the learner, by adding some emoticons in the material, and we induce the emotion corresponding to the affective tone of the material by designing several interfaces that could affect the current emotion of the learner.

2.2.2 Retrieval Process

Emotions affect the attention process, the acquisition process and also the retrieval process. The process of retrieval consists in remembering and fetching the information in the long -term memory and retrieval from memory in formation which is coherent to their current emotional states. This process is important because it's the bases of many learning tasks like the problem solving etc.

2.2.3 Response Organization Process

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 [14].

Therefore the effectiveness of the memorization process is narrowly linked to someone's emotions: Whereas positive emotions enhance the memory performance in general, unrelated and negative emotions disturb in particular the retrieval process. On the other hand, emotions which are related to the content to be memorized help storing it. The retrieving process is improved when the

emotional state is close to the one at the time when this information was memorized.
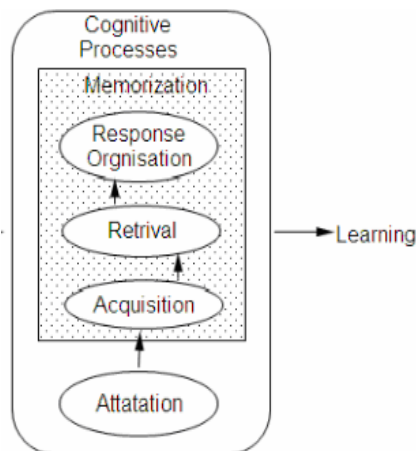

Figure 5: Cognitive Process & Memorization Process of learning

2.2.4 Reasoning Process

Reasoning is the subsequent task attached to memory in which the learner is supposed to reason with the acquired knowledge. The process of reasoning enables a learner to perform more complex cognitive tasks – such as comprehension, classification, application of knowledge, analysis, and problem solving – which represent the ultimate goal of the learning process [2]. The Positive emotions improve any kind of reasoning since relations can be made more easily between objects or ideas [12]. In general, such emotions lead to a more creative, flexible, and divergent thinking process, whereas negative emotions cause a more linear, convergent, and sequential thinking [15].

Therefore Emotions can be used in the learning content to, in particular, increase the attention of the learner and improve his memory capacity. In the following section we discuss how emotional charges can contribute to the learning content and how it influences the learner's performance.

III. THE INTELLECTUAL INTELLIGENT TUTORING SYSTEM (IITS)

The traditional ITS model contains four components: the domain model, the student model, the teaching model, and a learning environment or user interface. ITS projects can vary tremendously according to the relative level of intelligence of the components. For example, a project focusing on intelligence in the domain model may generate solutions to complex and novel problems so that students can always have new problems to practice on, but it might only have simple methods for teaching those problems, while a system that concentrates on multiple or novel ways to teach a particular topic might find a less sophisticated representation of that content sufficient. When multiple components contain intelligence, homogeneous or heterogeneous representations can be used. ITS can also be classified by their fundamental algorithm. One well - known category is the model tracing tutor, which tracks students' progress and keeps them within a specified tolerance of an acceptable solution path.

A. Emotionalizing Learning in IITS

Teaching and learning are emotional processes: a teacher who communicates the content in an emotional way will be more successful than another who behaves and communicates unemotionally. The main reason for the power of affective learning is the emotional charge which is attached to the learning content. In fact, situations, objects, or data with emotional charge are better memorized [3].

An ITS should be able, like a successful human teacher, to emotionalize the learning content by giving it an emotional connotation. This connotation can be naturally linked to the learning content: for instance, events in history can naturally generate certain emotions. However, emotions can also be artificially added to a learning content which is a priori unemotional, for example by associating images with emotional charge to random words or numbers. It has been shown that people in a given emotional state will attribute more attention to stimulus events, objects, or situations that are affectively congruent with their emotional state [3]. An ITS can use this fact for gaining more attention from the learner by emotionalizing the learning content.

Two approaches can be used: In fact, it can adaptively add an emotional charge to the learning content which is similar or related to the present emotional state of the learner, who will then pay more attention to the material presented to him. On the other hand, an ITS can as well change the emotional state of the learner such as to make it more similar to the emotional charge of the content to be learned. This second approach will be used in particular for learning contents which have a certain emotional charge a priori.

The first approach will be used for learning contents to which the ITS artificially adds an emotional charge.

When a large quantity of data lacking any emotional content has to be memorized and later retrieved, i.e., distinguished, and then adding emotional charges with respect to very different emotions

  – Saddening, comforting, disturbing, disgusting, arousing
  – Can help the memorization process. If, during the step of memorization, an ITS associates the learning content with an emotional charge, the learner will be conditioned such as to establish a connection between the subject matter and his specific emotional reaction. Then, so conditioned on having certain emotional reactions to different matters, the learner will be able to recall and distinguish the (non emotional) learning contents as easily as his emotional reactions to them. An ITS therefore pushes the learner to structure and memorize the knowledge in categories of emotion, which is in fact precisely the natural organization of memory [3]. Moreover, this process of creating a relation between content and emotion allows an ITS to quickly and easily help the learner to remember a specific content in presenting him the emotional charge related, such as an image.

We can hence conclude that an ITS should include the possibility to emotionalize the learning content in different ways to improve the learner's cognitive abilities. Moreover, an ITS can improve the learning capacity of a learner by

influencing, in a specific way, his emotions, i.e., acting with emotional intelligence.

Emotional intelligence is the ability to recognize, interpret, and influence someone's emotions. When the effect of feeling on thinking is known, this can be used in order to improve someone's cognitive abilities [7], [22]. It is hence natural to include emotional intelligence into the learning process. A human tutor is in fact an emotional practitioner in the sense that he can influence learner's emotions with the objective of improving his learning efficiency [10]. Since interaction with a computer triggers similar responses as if it was with another person [20] (see also [19]), a new generation of ITS should be able to influence learner's emotions in a same way as a human tutor.

Motivated by this principle we have introduced the concept of an Intellectual Intelligent Tutoring System (IITS) in [18]. An

IITS is an ITS which includes functional capabilities able to

(1) know learner's emot ions and,

(2) induce emotions to the learner in order to improve his performance.

More precisely, an IITS needs to achieve the following conditions: know the current emotional state of learner determine the impact of an action on learner' emotional state select the most advantageous emotional state of a learner to enhance his performance.

We have tested the two conditions. The first condition was achieved using nine emotional scales allowing the user to indicate his current emotional state. To model t he impact of these actions on learner's emotion we have used a graph technique, where the vertices are emotional states and the connecting edges the possible actions which can occur in a learning session (for instance criticism, encouragement, congratulation…). This representation allows assessing the emotional state resulting from an action on an initial emotional state.

B. Handling Emotions to Improve the Performance of an ITS

From the previous section, we can conclude the following facts:

– Positive emotion s are better for learning than negative emotions and positive emotions can strongly improve the learning process
– Negative emotions like being jealous, envious, or resentful about someone else's these emotions act as a motivating factor & have a positive effect on learning performance based on these facts the IITS can generate optimal emotional conditions in the learner.

The optimal emotional state to be generated is dynamically determined for any specific learner since there does not necessarily exist a particular emotional state that is optimal for a certain learner at any time. This dynamic determination of the optimal state can be based, for a certain learner, on a set of rules which is, initially, a generic set of rules identical for every learner, but then updated during the learning session depending on the observed emotions and performances of the learner. Examples of such rules can be as follows.

3.2.1 Rules for the learning Session

Rules for the beginning of the learning session depending on the initial emotional state of the learner (externally generated):

If the learner has externally generated negative emotions, generate positive emotions in the learner.

If the learner has externally generated positive emotions with strong intensity, then generate negative emotions.

If the learner externally generated positive emotions with moderate intensity, then generate positive emotions.

Rules applied during the learning session depending on the internally generated emotions:

If the learner has positive emotions and good performance (compared to his average performance), generate positive emotions.

If the learner has positive emotions but poor performance, generate negative emotions.

If the learner has negative emotions and poor performance, then generate positive emotions

If the learner has negative emotions and good performance, then generate negative emotions.

If the learner has strong emotions of any valence then emotions of the opposite valence are generated.

These are examples of rules which belong to a generic initial set of rules universally applied for every learner. If, however, some of these rules turn out during the learning not be appropriate for a learner, then they are changed or replaced by other rules designed for this learner. Mo re precisely, this adaptation of the rules will be a quantification thereof: the choice of emotions to generate are taken depending on the exact intensities of emotions and the exact performance as measured during the learning session. For instance, if a l earner has good performance with positive emotions exceeding a certain threshold, and the generation of additional positive emotions has a negative effect, then the corresponding rule will be changed, and negative emotions, or no emotions at all, are generated in this situation, i.e., if the positive emotions exceed the determined threshold. Therefore, the changing of certain rules is in fact a quantification of the rule, by introducing a certain threshold separating emotion intensities for which an action is taken or not.

In conclusion, we have proposed a dynamic method, based on a set of rules which are changed and thus tailored to a particular learner during a learning session, which allows an IITS to generate the best emotional conditions for learning f or each learner at any time.

3.2.2 Learning Scenario for IITS

Let us consider a learner interacting with an IITS. If a person X is anxious because of some external situation or event − say because his father is not having good health (so the emotion is externally generated) − he will be less able to focus and hence will obtain weaker learning performance. If, on the other hand, the anxiety stems from the urge to perform well on a test proposed by the IITS, then it can increase learner's motivation and hence performance. Although it is exactly the same emotion, its

effect on learning performance is opposed in the two cases due to the different origins.

IV. CONCLUSION

That emotions are essential to the success of the human learning process is a well established idea substantiated by cognitive science. Our aim is to create an emotion -based ITS (intellectual ITS capable of integrating all of the key elements emanating from accelerated learning techniques in order to provide learners with the best possible eLearning environments.

In the present paper w e 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.

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