Inducing positive emotional state in Intelligent Tutoring Systems

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Abstract. The emotional factor has been never taken into account in Intelligent Tutoring Systems (ITS) until recently. However, emotions play a crucial role in cognitive processes particularly in learning tasks [4]. Thus, our purpose in this research study was to analyse the effect of some tutoring actions on the learner’s emotional state in order to ascertain the feasibility of positive emotions inducing in ITSs. To achieve this aim, we developed a data structure web course and a virtual tutor using different pedagogical actions to induce positive emotions in the learner. We have conducted an experiment to collect participants’ physiological responses after the tutoring actions. The results of this experimental study showed that certain actions have significant positive effects on the learner’s emotional state.

Keywords. Positive emotions, Tutoring actions, Intelligent Tutoring Systems, physiological signals

Introduction

Recent educational researches have shown that cognition and emotions processes are closely linked [5]. Emotions are clearly present in learning tasks. Studies attempt to understand and measure the effect of emotion felt by the learner on his performance during learning tasks. The results of these studies showed that emotions play a significant role in cognitive learning tasks.

In Intelligent Tutoring Systems (ITS), tutor must take into account the learner's emotional state. The type of emotions which the learners feel in the learning activity seems very significant: the negative emotions decrease their performances, whereas the positive ones ensure cognitive engagement, support the performance and the successful [4]. Thus, the tutor must have capabilities to regulate the learner's emotional state. Recently, the issue of emotion regulation drew interests from several fields including neuroscience, psychology, education, computer science, etc. Indeed, emotion regulation concerns the ability to reduce high levels of emotion arousal and the capacity to change our feelings [3]. Nonetheless, emotion coping differs from emotion regulation by its focus on reducing negative emotion experience [2]. Researchers distinguish in general between two types of emotion coping strategies. The first strategy is the problem-focused coping strategy which is intended to solve the problem that causes the emotional situation. The second strategy is the emotion-focused coping

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strategy which is intended to regulate the negative emotion aroused. In this research work, we present emotion coping in intelligent tutoring systems. We study the effect of the tutor’s actions on the learner’s emotion regulation.

1. Methodology and experimental study

Aiming to study the effect of some tutoring actions on the learner’s emotional state, we developed an experiment in which we tried to detect the participants’ emotional responses after some tutoring actions in a data structure web course. For this purpose, the electromyography signal (EMG) was used because it is the most studied and validated physiological measure for indicating the valence (more details are in [1]).

1.1. First situation

In this situation, the tutor used two kinds of actions trying to mitigate the effect of any negative emotion produced in this situation:

- The first kind named the problem-focused actions. These actions attempt to act on the problem that is causing the emotional situation. In this case, the tutor tried to change the situation that is causing the emotion by using an example or a definition to help participants for understanding the course.
- The second kind named the emotion-focused actions. These actions attempt to regulate the learner’s emotions generated by the situation. In this case, the tutor acts in order to allow participants to change its way of perceiving the situation - without changing the reality itself - by encouraging them to make an effort to understand the course alone for example.

1.2. Second situation

When the participants obtain their mark after the evaluation test, the tutor uses three emotion-focused actions: the first action (encouragement) is to encourage participants to make more efforts to improve their knowledge in sorting algorithms, the second action (recommendation) consists in providing recommendations to participants in order to improve their mark and the third action (congratulation) concerns only the participants who had excellent marks (a mark than greater than eight on ten).

2. Data analysis and discussion

For each tutor's action, we compared the recorded signal before the action with the one recorded during and after 5 seconds of this action (Table 1). This allowed us to verify if the tutor's action explained significantly a part the EMG physiological signal changes.

In the first situation, the results of the ANOVA test showed that learner needs element of understanding rather than encouragement when he did not understand the course. During the comprehension activity, we can conclude that it is recommended to use a problem-focused action in order to induce positive emotions in the learner. These actions attempt to change the problem that is causing the emotional reaction by
explaining the course using an example or a definition for instance in order to change
the learner's misunderstanding state and improve his emotional state.

In the second situation, the results of the ANOVA test showed that
Recommendation and Encouragement actions have positive effects on the learners'
emotional states (learners who have middle and low marks) while the Congratulation
action does not affect the emotions of good learners.

These results can be explained by the fact that the learner requires actions
attempting to help him for improving his skills and achieving his learning objectives.
We believe that this is the reason why the participants expressed positive emotions
after certain actions.

| Table 1. Descriptive data and results of the ANOVA for tutor’s actions |
|------------------------|--------|--------|--------|
| Action                 | N     | Average | F      | p     |
| Definition             | Before| 16     | 1.83   | 10.10 | 0.00  |
|                        | During and after | 16     | 15.51  |        |       |
| Example                | Before| 21     | 1.544  | 29.174| 0.00  |
|                        | During and after | 21     | 7.986  |        |       |
| Encouragement_Comprehension | Before| 9     | 2.045  | 3.289 | 0.088 |
|                        | During and after | 9     | 7.375  |        |       |
| Recommendation         | Before| 9     | 2.046  | 6.036 | 0.025 |
|                        | During and after | 9     | 12.516 |        |       |
| Encouragement_Note     | Before| 14     | 1.763  | 20.359| 0.00  |
|                        | During and after | 14     | 6.673  |        |       |
| Congratulation         | Before| 2     | 0.948  | 4.681 | 0.162 |
|                        | During and after | 2     | 15.432 |        |       |

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