Integrating Domain-Independent Strategies into an Emotionally Sound Affective Framework for An Intelligent Learning Environment

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Abstract

This paper presents a framework that integrates domain-independent strategies into an emotionally sound affective (ESA) framework for an intelligent learning environment. The integration is an extension to current affective learning frameworks that consider only domain-dependent strategies to help student manage their emotional or affective states. It is hypothesised by helping students to manage their emotional or affective states, and hence, improve their performance in learning will improve.

Keywords: Domain-independent strategies, emotionally sound affective framework

1. Introduction

Despite the fact that emotions play an important role in learning, few attempts have been made to study emotions in Intelligent Tutoring Systems (ITS) though it is an area gaining increasing attention (e.g. Conati, 2002; del Soldato & du Boulay, 1995; Kort & Reilly, 2001; Lester et al., 1999a). Traditionally, affective learning frameworks use only domain-dependent strategies to help students manage their negative emotional or affective states. (e.g Conati, 2002; del Soldato & du Boulay,1995; Kort & Reilly, 2001; Lester et al., 1999a; Jaquas et al., 2002), for example by making the lesson easier if it is believed that the student needs some experience of success. However, emotion regulation theories have suggested that there are two strategies used to manage individual emotional or affective states: emotion-focused strategies, which are domain-independent and problem-focused strategies that are domain-dependent (Lazarus, 1991; Gross, 1999).

In this paper, we propose an emotionally sound affective (ESA) framework that integrates both domain-dependent and domain independent strategies. The ESA framework consists of two phases: 1) the appraisal phase, which attempts to appraise students' emotional state and 2) the reaction phase, which proposes to use adaptive strategies and activities, in order to help students manage their emotions (Yusoff, 2004).

The first phase of the ESA framework which appraises students' emotional states is introduced at two learning stages. The primary appraisal, which uses the PANAS questionnaire (Watson, Clerk & Tellegen, 1988) appraises students' emotional states at the beginning of a lesson. The primary appraisal establishes students' emotional states with regard to their personal beliefs and goal commitments. The secondary appraisal of this framework, on the other hand, appraises students' emotional states during the lesson. It uses students' reactions to two eliciting factors to appraise students' emotion. These eliciting factors are: the difficulty level of the lesson which is based on the nature of the lesson and the students' control over the lesson.

The students' Control over the lesson is modelled using student-computer interactions that are based on three methods: 1) by on-line communication with students during the interaction, 2) by monitoring students' request for help to complete a lesson and 3) students' self-reporting. In the ESA framework, asking for help, completing a lesson and, giving up are examples of the student-computer interactions. The intensity of the Control eliciting factor is determined by its three eliciting variables: Independence, Effort and Competence, that are derived from students' motivation modelling techniques in learning (e.g

del Soldato & du Boulay, 1995; De Vincente & Pain, 1999).

Independence is defined as the degree that students prefer to work without asking others for help. It has been widely used as an important parameter to detect students' affective states in affective learning environments (del Soldato & du Boulay, 1995; De Vincente & Pain, (1999); Jaques et al., 2003). In the ESA framework, Independence is modelled by the frequency of requests. A low request frequency corresponds to a high level of independence and high request frequency means a low level of independence.

Effort is another popular parameter used to detect students' affective states in an affective learning environment (e.g del Soldato & du Boulay, 1995; De Vincente & Pain, 1999). Effort is defined as the degree of engagement that students display to accomplish a task. In this framework, Effort is represented by the frequency of interactions between a student and the system, such as clicking on a mouse or pressing a key. A high number of interactions indicates a high level of effort, and a low number of interactions indicates otherwise.

Competence is the third variable that can influence the Control eliciting factor. It is a measure of the students' knowledge and skills to perform a lesson task proficiently. The framework represents Competence by a ratio of the number of errors to the number of attempts made to solve a problem. A low ratio corresponds to a high level of competence, and a high ratio implies otherwise.

Just as for the appraisal phase, the ESA framework implements the reaction phase at two learning stages: 1) at the beginning of a lesson and 2) during the lesson. Its main objective is to help students manage their emotions, especially after experiencing negative emotions, by using two underpinning strategies: domain independent or emotion-focused strategies and domain-dependent or problem-focused strategies.

The first strategies employed in the ESA framework in this reaction phase are the domain-dependent strategies. They help students by providing suitable suggestions and strategies that are adapted to the students' elicited emotional state and are based on the premise that students in a positive emotional state are more capable of mastering their lesson (Fredrickson, 1998).

In addition to the domain-dependent strategies, the domain independent or emotion-focused strategies are implemented to help student manage their emotions. Coping statements and relaxation exercises are examples of domain independent strategies. Statements such as "I can make things happen" are used to maintain students' happiness while statements like "I can see this problem from another perspective to make it seem more bearable" are used to reduce students' nervousness. Apart from coping statements, relaxation activities such as muscle and head exercises are employed to help students manage their emotions.

The focus of this paper is on the use of domain-independent strategies in the reaction phase of the ESA framework as a way to help students manage their negative emotional or affective states. Domain-independent strategies refer to strategies and techniques that are unrelated to the lesson domain. Coping statements and relaxation exercises are examples of domain-independent strategies. In contrast, traditional affective frameworks help students by adapting domain-dependent strategies to their emotional or affective states (e.g Conati, 2002; del Soldato & du Boulay,1995; Kort & Reilly, 2001; Lester et al., 1999a; Jaquas et al., 2003).

We postulate that the integration of domain-independent strategies into the ESA framework helps students to manage their emotional states better and hence improves their performance in learning. The complete flowchart the integration of both domain-independent and domain-dependent strategies is given in Figure 1.
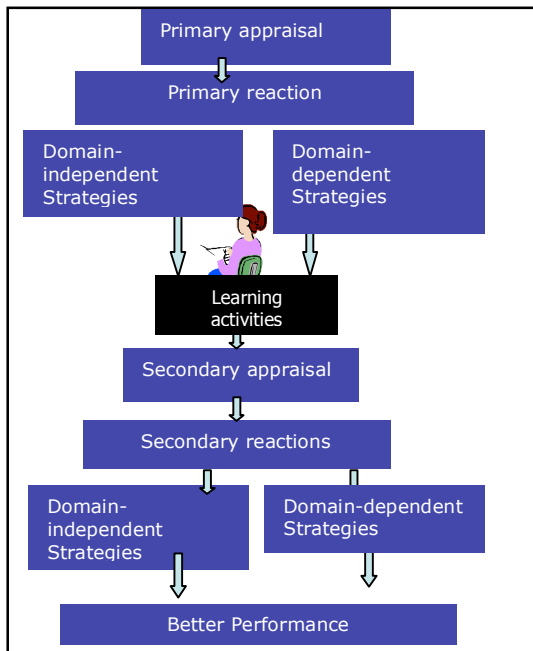
Figure 1: The flowchart of an emotionally sound affective (ESA) framework

2. Domain-independent strategies

To model the domain-independent strategies in the ESA framework, we refer to emotion regulation theories that are used to help individuals manage their emotional states (e.g Gross, 1999; Lazarus, 1991). Gross (1999) defines emotion regulation as a process by which individuals influence which emotions they have, when they have them, and how they experience and express these emotions. From Lazarus' (1991) viewpoint, emotion regulation consists of behaviour or cognitive responses or strategies that are designed to reduce, overcome, or tolerate the demands placed on the individual. These strategies are classified into two major categories: emotion-focused strategies and problem- focused strategies.

Emotion-focused strategies refer to thought or actions whose goal is to relieve the emotional impact of stress. There are apt to be mainly palliative in the sense that such strategies for coping do not actually alter the threatening or damaging conditions but make the person feel better. Examples are avoiding thinking about trouble, denying that anything is wrong, distancing or detaching oneself as in joking about what makes one feel distressed, or attempting to relax.

Problem-focused strategies, on the other hand, refer to efforts to improve the troubled person-environment relationship by changing things, for example, by seeking information about what to do, by holding back from impulsive and premature actions, and by confronting the person or persons responsible for one's difficulty

Therefore, we postulate that an emotionally sound affective framework must employ both domain-dependent and domain-independent in order to help students manage their negative emotional or affective states in learning.

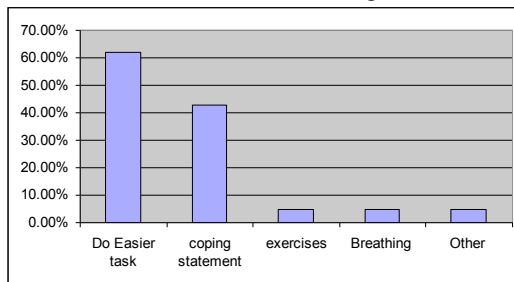## 3. Implementation of domain-independent strategies in ESA framework

The emphasis of this framework is not to regulate student emotions completely, but more appropriately, to help students manage their emotions. Domain-independent strategies involve applying several strategies and techniques that are unrelated to lesson activities. Coping statements and relaxation exercises are examples of domain independent strategies. For example, for a nervous student, who has given up on a difficult lesson task, this framework suggests that he takes a deep breath several times, imagines a pleasurable and relaxing scene, and reads an effective coping statement such as "I won't let my sadness affect my performance" to reduce his nervousness. Apart from coping statements, relaxation activities such as muscle and head exercises are used to help students manage their emotions. As a result, students will feel better and, consequently help the student to learn better.

To implement the domain-independent efficiently in this framework, a general algorithm is being designed that combines several domain-independent strategies and is summarised as follows:

1. Getting loose (comfortable position)
2. Breathing exercises.
3. Doing muscles (head and eyes) relaxation exercises.
4. Reading coping statements.

An initial survey among 21 Sussex University students has indicated that besides domain dependent strategies, domain independent strategies are seen to be equally important in order to help them manage their negative emotions as shown in Table 1.

Table 1: The strategies preferred by Sussex University students in managing their negative emotion in learning.

4. Discussion

This paper emphasises more on the integration of domain-independent strategies into an affective learning framework which are derived from emotions regulations theories (Gross, 1999; Lazarus, 1991). Our initial finding, working with UK and Malaysian students, suggested that these domain independent strategies are helping them to manage their emotional states. By contrast, current affective learning frameworks use only domain-dependent strategies to help students manage their negative affective state. (e.g Conati, 2002; del Soldato & du Boulay,1995; Kort & Reilly, 2001; Lester et al., 1999a; Jaquas et al., 2002).

An empirical study to find more evidence of the efficiency of domain-independent strategies in laboratory environments without affecting their learning focus will be conducted as future work. Apart from finding empirical evidence of the domain-independent strategies efficiency in laboratory environments, cultural differences among students is another important issue to be explored in future. Initial work with UK and Malaysian students has shown that domain-independent strategies such as the use of coping statements are cultural dependent, and thus, indicated that it is important to establish which strategies are best suited in multi culture learning environments.

References

Conati, C. (2002). Probabilistic assessment of user's emotions in education games. Journal of Applied Artificial Intelligence, 16(Special Issue on managing cognition an Affect in HCI), 555-575.

De Vincente, A., & Pain, H. (1999). Motivation self-report in ITS. [*Proceeding of the Ninth World Conference on Artificial Intelligence in Education*]S. P. Lajoie & M. Vivet (Eds.), (pp. 651-653). Amsterdam: IOS Press.

del Soldato, T., & du Boulay, B. (1995). Implementation of motivational tactics in tutoring systems. *Journal of Artificial Intelligence in Education*, 4(6), 337-378.

Gross, J. J. (1999). Emotion and emotions regulation. In L. A. Pervin & O. P. John (Eds.), Handbook of Personality: Theory and Research (2nd Edition) (pp. 525-552). Guildford, New York.

Jaques, P., Andrade, A., Jung, J., Bordini, R., & Vicari, R. (20032). Towards user's emotion recognition: A case in an educational system. 2nd *International conference on Computational Intelligence, Robotics and Autonomous Systems (CIRAS),* December 15-18, 2003, Singapore

Kort, B., & Reilly, R. (2001). An affective model of interplay between emotions and learning: reengineering educational pedagogy- building a learning companion . *In proceeding of IEEE International Conference on Advance Learning Technology.*

Lazarus, S. R. (1991). Emotion and Adaptation. Oxford U. Press.

Lester, J. C., Voerman, J. L., Towns, S. G., & Callaway, C. B. (1999a). Deictic believability: coordinating gesture locomotion and speech in lifelike pedagogical agents. *Applied Artificial Intelligence,* 13, 383-414.

Watson, D., Cleark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative Affect: The PANAS scales. *Journal of Personality & Social Psychology , 54*(6), 1063-1070.

Yusoff, M.Z (2004). An emotionally sound affective framework for Intelligent Tutoring System (ITS), The 17th White House Papers Graduate Research In Informatics at Sussex, University of Sussex, June 2004.