# Chapter XXXIV
# The Role of Affect in an Agent-Based Collaborative E-Learning System Used for Engineering Education

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## ABSTRACT

*Affective computing is a new artificial intelligence area that deals with the possibility of making computers able to recognize human emotions in different ways. This chapter represents an implemented framework, which integrates this new area with an intelligent tutoring system. The authors argue that tutor agents providing socially appropriate affective behaviors would provide a new dimension for collaborative learning systems. The main goal is to analyse learner facial expressions and show how affective computing could contribute to learning interactions, both by recognizing learner emotions during learning sessions and by responding appropriately.*

*The question is not whether intelligent machines can have emotions, but whether machines can be intelligent without any emotions.*

—Minsky

## RESEARCH BACKGROUND AND MOTIVATION

On the one hand, with the focus on innovative and user centered interaction technologies, the interplay between emotions and computers, widely known as affective computing, "computing that relates to, arises from, or deliberately influences emotions" (Picard, 1995), plays an important role in human computer interaction (HCI). Research findings suggest that emotions play an essential role in decision-making, perception, learning and in general influence the mechanisms of rational thinking. According to Rosalind Picard: "*If we want computers to be genuinely intelligent and to interact naturally with us, we must give computers the ability to recognize, understand, and even to have and express emotions*" (Picard, 1997). On the other hand, it is often understood that the eventual objective of communication within virtual environments (VEs) is to model communication between humans in the physical world. In order to achieve this objective, communication capabilities within the virtual world must not be limited to the simple exchange of information. Everyday human communication involves a level of affective communication (communication involving emotional states) that is absent from many VEs. Many researchers now believe that *affective tutoring systems*[1] would be significantly enhanced if computers could adapt according to the emotions of learners (Alexander et al., 2004). If human emotions are essential for human thinking and learning processes, virtual learning environments must recognize this to be successful.

If VEs are to truly represent real world interactions they must both:

1. Facilitate the communication of affect, and
2. Make the agents situated in the environment react in a way that respects the affective context.

An agent that ignores these aspects of the environment will jar with the realism of the communication as much as a mechanical system that ignores the laws of physics.

Our objective in this chapter is to show that the use of affective systems is pat of an interaction problem that concerns the whole interaction cycle, where emotions arise from an active act of interpretation and participation on the end-user side. We introduce a model of interaction between users and animated agents as well as inter-agents interaction that supports the basic features of affective communication in VEs, given that detecting a learner's emotional reaction to a given situation is a fundamental element of any distant learning environment. This chapter presents an affective e-learning framework based on emotional agents that can partially replace and support human-teachers, by assisting and motivating learners in distributed learning environments (Ammar et al., 2005). We outline an approach to constructing an emotion-recognizing computer system, and present real-time results of the recognition of basic emotional expressions from the video. The system automatically detects frontal faces in the video stream and recognizes the emotion with respect to six basic facial expressions (anger, disgust, fear, joy, sadness, and surprise), as suggested by Ekman (Ekman et al., 1975).

This chapter is organized as follows: Section 2 introduces related work, Section 3 describes affective communication, Section 4 explains the proposed EMASPEL framework, Section 5 gives the application results, and finally Section 6 finishes with conclusions.

## RELATED WORK

Psychologists have pointed out the way that emotions affect learning. According to (Piaget, 1989) affect has an accelerating or perturbing role in learning. Coles (Coles, 2004) suggests that negative emotions can impair learning; and positive emotions can contribute to learning achievement, e.g. learners can be weak in mathematics due to an affective blockage. Some educational systems have given attention to generation of emotion in pedagogical environments