

A Framework for Designing Computer Supported Learning Systems with Sensibility

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ABSTRACT

In the current paper, the authors propose a new conceptual framework in Computer Supported Learning System-CSCL design that takes emotion into account. They conduct their analysis through five layers: physiological, emotional, sociological, technological, and educational, in relation to learning. This study reviews the literature in emotional learning and emotion assessment and proposes a model for the design of a social-emotional computer supported learning system.

Keywords: Affect Recognition, Affective Computing, Computer Supported Collaborative Learning (CSCL), Education, Emotion, Emotion Assessment, Social-Emotional Learning

INTRODUCTION

The advancements of educational technology (Virtual Learning Environments-VLEs, Computer Supported Collaborative Learning-CSCL, Intelligent Tutoring Systems-ITSS) endue students with the opportunity to select their own teacher (school teacher, another peer, another system etc.), their own curriculum, their own assessors (Laurillard, 2009). However, most of the existing e-learning systems still have limitations when used by students in real set-

tings or have difficulties in connecting with the teacher's needs (Daradoumis, Martinez-Mones, & Xhafa, 2006; Kort, & Reilly, 2002).

One major pitfall is that the innovative Human Computer Interactions-HCI models "tend to focus exclusively on cognitive factors, and are often unable to adapt to real-world situations in which affective factors play a significant role" (Kort & Reilly, 2002, p. 1). While CSCL researchers evaluate activities and systems that describe impact on the cognitive aspects there has been minimum experimental research

performed to evaluate the affective aspects of these group activities (Calvo, 2009). Emotions, however, are present in any form of education and together with cognition and motivation are the key components of learning (D’Mello et al., 2008).

The enrichment of ITS and CSCL systems with emotion awareness (detect and respond) capabilities has become an increasingly prominent theme in recent years and, so far, the automated detection of student’s emotions has shown promising results, though it is still in its infancy (Arroyo et al., 2010; Calvo, 2009; D’Mello et al., 2008; Marsella & Gratch, 2009). In parallel, although numerous studies are struggling to reliably collect information about students’ emotions, the empirical evidence resulting from school-based research about the role of emotions in learning is still limited (Picard et al. 2004).

The design of a system that shows respect to students’ emotions is a complicated process because of the nature of emotions. Research convergence from different research domains (Neuroscience, Artificial Intelligence, Sociology etc.) and “in vivo” study of the subject, can reveal a path (Davou, 2000; Picard, 2010). In the current paper, we propose a framework, in which the study of emotions in computer supported learning system design, is conducted through five layers: In layer 1 (*Neuro-physiological Structures*) we examine recent neurological findings considering the roots of emotion in the brain. In layer 2 (*Emotion/Affect Considerations*) we define emotion, affect, feeling and mood. In layer 3 (*Sociological Aspects*) we view emotions from a social point of view. In layer 4 (*Technological Applications*), we review methods and tools to assess student’s affective state and finally in Layer 5 (*Educational Perspectives*), we attempt to link our framework to the educational reality by providing recent educational models and theories with respect to emotion. In the last section, we propose a conceptual model based on the above analysis, providing a start-up on building new or enhancing existing learning systems with emotion awareness.

A FIVE-LAYER FRAMEWORK IN SYSTEM DESIGN APPROACH WITH RESPECT TO EMOTION

The deep understanding of emotions and their impact in learning entails the examination of different biological, psychological and social functions and their interplay. In her book, Davou (2000) resembles the study of emotions with a chain that consists of six interdependent rings namely *neuro-bio-cognitive* (brain functioning as studied in cognitive neuroscience), *emotional* (the study of emotions in clinical psychology) and *socio-cultural* (current social and cultural factors that affect human behaviour). Influenced by her approach and in analogy to the hierarchical, layer model of network communications, we describe a five-layer approach in designing collaborative learning systems with respect to emotion.

Layer 1: Neuro-Physiological Structures

When an axon of cell A is near enough to excite cell B and repeatedly or persistently takes part in firing it, some growth process or metabolic change takes place in one or both cells such that A's efficiency, as one of the cells firing B, is increased. (Hebb, 1949)

This is often paraphrased as “neurons that fire together, wire together” and is often described as the basis of neural networks. As it is cited in Davou (2000), every new piece of information is imprinted through neurosynaptic changes in the form of:

- Morphological transformations in neurons’ structure and synapses via the creation of dendritic spikes.
- Biochemical cellular processes that also elaborate the composition of new proteins.

The above is ascribing the neuropsychological basis of learning. We learn, because of an electromagnetic to biochemical transformation

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