Can Affective Computing Lead to More Effective Use of ICT in Education?

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Abstract

Impact of technology on learning has not been answered clearly many years after the introduction of ICT into classrooms. Today there are optimist and pessimist views regarding the use of ICT in education. Academic research has a position between these two opposing views. Although promising results on benefits of ICT use in education, ICT is not used in teaching in such extend as it could be appropriate according the potentials in the literature. The expected impact of ICT has not been realized mainly because massive investments in equipment and training have not been accompanied by the necessary radical organizational restructuring. The integration of ICT is a complex and multidimensional process including many dynamics such as ICT tools, teachers, students, school administration, educational programs and school culture.

Another difficulty in front of this integration is the lack of interactivity and emotionality of currently used ICT. While using these devices students of today want active participation and emotionality instead of staying in a passive role. They are also looking for emotional satisfaction from using and interacting with the products. The main purpose of this article is to make an inquiry on affective computing with an educational viewpoint.

The literature review is showing that emotions may serve as a powerful vehicle for enhancing or inhibiting learning and there are optimistic expectations towards affective computing among researchers. Affective computing systems are expected to have positive impacts on learning. Many researchers now feel strongly that intelligent tutoring systems would be significantly enhanced if computers could adapt to the emotions of students. Affective computing and detection of human emotions are areas still maturing and there various are difficulties in front of implementing affective computing systems in real educational settings. New multidimensional studies must be conducted considering various related dimensions such as teachers, students, curricula, school culture, hardware, software, ergonomics, and costs.

Key words: ICT, affective computing, emotion, instructional technology.

Introduction

Many years after the introduction of ICT into educational systems we face two opposing rhetoric on the use of ICT. First is optimist rhetoric which supports the idea that ICT can raise standards if it is used in very carefully designed ways. Conversely on the other side the pessimist rhetoric argues that parents and teachers are distracted from the provision of children's basic needs by pressure to introduce them to technology. Academic research provides a third, floating position between optimistic and pessimistic views. Although many years of effort and vast investments the integration of ICT is still weak and there is so much to do. Because there are good reasons to suppose that ICT has powerful positive potential, and that the use of ICT can have meaningful beneficial effects on the users, schools do not have the option of ignoring it.

I see lack of interactivity and emotionality in current technologies as one of the difficulties in front of this integration. The present generation of students wants active participation and emotionality to manipulate presented objects and expect a degree of emotional and interactivity. Affective computing is a term that is referring to the development of computer systems enriched with affective understanding. Within the scope of this article related literature has been reviewed in order to investigate the term «affective computing» and seek an answer to the question: «Can affective computing lead to more effective use of ICT in education?»

ICT: Hopes and Reality

In the early days of ICT use in the school classroom, traditional computer assisted instruction, based on rigid and closed drill and practice, was the dominant ICT approach. With the raising questions about efficiency of drill and practice software, more flexible and open learning programs were developed (Katz, 2002). But many decades after the introduction of ICT into classrooms, there are still unanswered questions about the impact of technology in the long and short term on students' learning, and how it has affected simple and complex learning tasks. While a plethora of studies has been conducted on the effects of ICT in education, major policy and methodological problems have precluded an unambiguous answer to such questions as: «Does the way in which ICT is implemented have a major or minor impact on students' knowledge and understanding?» and «Does the impact affect the surface or deep structure of students' thinking and acting?» (Cox and Marshall, 2007).

A literature review of ICT and attainment by Cox and Abbott in 2004 showed that the most robust evidence of ICT use enhancing pupils' learning was from studies which focused on specific uses of ICT. Where the research aim has been to investigate the effects of ICT on attainment without clearly identifying the range and type of ICT use, then unclear results were obtained making it difficult to conclude any repeatable impact of a type of ICT use on pupils' learning. Also missing from many previous research publications are methodologically robust studies that might be based on large and varied samples, that are conducted over several years and that provide unambiguous answers to the question whether or not ICT has made significant impacts on a wide variety of student learning outcomes. (Cox and Marshall, 2007).

A paper of Reynolds, Treharne and Tripp (2003) relates to optimist and pessimist rhetoric on the use of ICT for educational purposes. They conclude that a large body of optimist rhetoric, couched as research, supports the idea that ICT raises standards of pupil achievement. The consensus among the optimists is that ICT can raise standards if it is used in very carefully designed ways. Teachers will need to ensure that different types of learning are clearly differentiated and carefully related to the proposed use of ICT. Only this fundamental change will ensure ICT can fulfill its potential as a resource to make learning more intrinsically satisfying and meaningful.

Conversely on the other side we have pessimist rhetoric, produced from a different perspective. One sector of pessimist rhetoric is opposed in principle to the use of any form of computer technology in schools. The pessimists link this to their perceptions of how society should develop, what should be its goals, its purpose, and its ethical underpinnings (Reynolds, Treharne and Tripp, 2003). A report by the Alliance for Childhood in the USA (Cordes and Miller, 2000) argues that parents and teachers are distracted from the provision of children's basic needs such as contact with other human beings and the natural world around them by pressure to introduce them to technology. They impose the adult mode of seated, intellectually orientated approaches, such as Internet research. It suggests that forcing this type of «sedentary» learning could be responsible for obesity, and that the solitary style of working with a computer will deprive children of the emotional contact they need with other people.

Academic research provides a third, floating position between optimistic and pessimistic on the spectrum of approaches (Khan, 2003). For example in Reynolds, Treharne and Tripp's (2003) study, 83% of teachers interviewed in schools stated that they believe ICT can raise standards. This may be accepted as a supporting result for the optimist rhetoric. Yet, it should be questioned that, why is this a belief instead of a reality after the investment of so much in terms of both money, time, commitment and energy in ICT over the past twenty years? In another study Goktas, Yildirim and Yildirim (2008) found that only one-fourth of the K-12 teachers in Turkey used computer laboratories and integrated ICT with their courses. The remaining teachers either do not integrate ICT or they lack of sufficient ICT facilities. In a study on Scottish schools Conlon and Simpson (2003), found while home computers appear to be frequently used, classroom computers are seldom used and the use of computers in the classroom is often peripheral to the learning process, such as word processing of essays. After a literature research Juutti, Lavonen, Aksela, and Meisalo (2009), has resulted that although promising results on benefits of ICT use in education (support on student collaboration and knowledge building), ICT is not used in teaching in such extend as it could be appropriate according the potentials in the literature.

Aviram (2000), summarizes the general answers given to the questions such as «Why has ICT had such little impact on teaching and learning?», «Why has ICT not been fully integrated into schools?» and «Why haven't student learning outcomes improved as a result of ICT?» in six answers. These are:

- This is a radical process of adaptation and schools need time to make such radical adaptations.
- Teachers, being adults who grew up in ICT-poor environments, have natural emotional and cognitive difficulties in adapting to the new culture and need more time and training.
- The technology is still immature, hence difficult to use and often unreliable, therefore schools' adaptation is very difficult and slow.
- There have been changes but they are of a new kind not captured by prevailing evaluation tools.
- Education is by its very nature conservative and always responds slowly to external changes.
- Serious structural obstacles built into the organization of current forms of schooling prevent real change in learning/teaching methods necessary to take advantage of new ICT.

But except the last one, Aviram finds these answers unsatisfactory. He argues that many organizations have undergone quickly through a radical change motivated by ICT. He adds large part of their personnel of these organizations grew up in ICT-poor environments. He then questions if education is essentially a preserving force that prevents or slows down change. He says «no» to that question. He gives such examples as formation of the modern standardized, mass-oriented, state-governed educational system out of the pre-modern pluralistic, heterogeneous, elite oriented educational system that existed in the West for many centuries until the end of the nineteenth century.

Although many years of effort and vast investments the integration of ICT is still weak and there is so much to do. That is what we can infer from research. Maybe like Aviram (2000) thinking in a different way would help better: «ICT is being introduced to education not because it does a better job; it is being introduced because it does the job differently». Teachers in the past days were preparing educational materials, arranging instructional activities, evaluating students, and calculating marks just like teachers are doing these days. A paper based educational material of course can be prepared without using a word processor and a printer. But if the user has enough computer usage skills, technology can add ease for correction and more reusability to the same task. A video may be played to schoolchildren using a video tape, a TV, and a video tape player. The same video may be played also using a computer and a projector. But when you think about frame freezing, replaying, rewinding or forwarding the video it is obvious which technology can do these tasks more easily. The picture changes dramatically when a teacher needs a video editing task such as adding text on it, reversing it, or changing play speed. Which technology enables us to

do these? These examples can be extended with various applications and technologies. Because there are good reasons to suppose that ICT has powerful positive potential, and that the use of ICT can have meaningful beneficial effects on the users and because this different way of doing things is now rapidly conquering the world, schools do not have the option of ignoring it.

Over a period of twenty years, it has become clear that change only occurs if it meets perceived needs and when the barriers to innovation are dismantled. Such barriers range from the technical through to the social and curricular (Khan, 2003). Aviram (2000), offers a starting point which is to recognize the impact of ICT have not been realized mainly because massive investments in equipment and training have not been accompanied by the necessary radical organizational restructuring. The integration of ICT into teaching-learning process is a complex and multidimensional process including many dynamics such as ICT tools, teachers, students, school administration, educational programs and school culture (Demiraslan and Usluel, 2006). As ICT enters the socio-cultural setting of the school, it may trigger changes in the activities, curriculum and interpersonal relationships in the learning environment, and is reciprocally affected by the very changes it causes (Demiraslan and Usluel, 2008). Therefore, research studies in ICT need to shift their attention towards the whole configuration of events, activities, contents, and interpersonal processes taking place in the context that ICT is used (Lim, 2002).

Bax (2002) prefers the term «normalization» to define the integration goal. The term normalization is relevant to any kind of technological innovation and refers to the stage when the technology becomes invisible, embedded in everyday practice and hence «normalized». Normalization is therefore the stage when a technology is invisible, hardly even recognized as a technology, taken for granted in everyday life. Bax gives the examples of pen assisted learning and book assisted learning relating them to language learning. We do not speak of PAL (pen assisted learning) or of BAL (book assisted learning) because those two technologies are completely integrated into education, but computer assisted learning has not yet reached that normalized stage. Bax thinks that computer assisted learning will reach this state when computers (probably very different in shape and size from their current manifestations) are used every day by students and were certainly becoming more humanistic but mostly owing to technological limitations related to hardware and software.

As Bax (2002) states, normalization will occur when ICT becomes more humanistic and overcome technological limitations related to hardware and software. In fact, current ICT have strict limitations in terms of interactivity and emotionality. I see these limitations as another barrier in front of the ICT integration. Prensky (2001), states that the present generation of students – the games generation – are quite different from older generations. They do not want to stay in a passive role with different media, instead they want active participation and emotionality to manipulate presented objects and expect a degree of emotional and interactivity. As technology evolves rapidly, users of technology products and interactive computing systems are no longer only satisfied with the levels of product efficiency and effectiveness. Users are also looking for emotional satisfaction from using and interacting with the products (Shih and Liu, 2007). It can be proposed that the traditional way of thinking and learning has been shifted from deploying established media to a considerably more interactive media such as virtual realities and interactive digital video and audio (Page and Thorsteinsson, 2002).

Emotions and Learning

User emotions are within the research area of affective computing. Affective computing is exploration techniques that may lead in the future to the development of computer systems enriched with affective understanding (Picard, 1997). At this point an important question arises to be answered: Can affective computing lead to more effective use of ICT in education? In the rest of this paper I will discuss issues

about use of affective computing for educational purposes, but before, the importance of emotions for learning and education should be touched.

It is well known that emotions have effects on learning (Bruton, 2003). Learning is associated not only with our cognitive abilities, but also with our emotions, expectations, prejudices, self efficacy and our social needs. Emotion serves as a powerful vehicle for enhancing or inhibiting learning (Greenleaf, 2003). Emotions may initiate, terminate, or disrupt information processing and result in selective information processing, or they may organize recall. Different emotions can influence these mechanisms in different ways (Pekrun, Goetz and Titz, 2002). Emotions also have an effect on learning and achievement, mediated by attention, self-regulation, and motivation. They direct the person toward or away from learning matters in learning situations (Ellis and Ashbrook, 1988).

Positive emotions are usually considered as «pleasant» states of emotions that are distinguished from negative emotions regarded as «unpleasant» states of emotions (Gadanho and Hallam, 2001). Positive emotions facilitate self-regulated learning (Boekaerts, Pintrich, and Zeidner, 2000). In addition research findings also indicate that positive emotion makes things better in people's everyday life. For example, researchers in organizational behavior, marketing, and management asserted that positive emotion can lead to better job satisfaction, decision-making, and consumer purchasing behavior (Shih and Liu, 2007). Positive emotions have great impact on learning, curiosity, and creative thought (Norman, 2004). In fact, positive emotion is said to have positive impact on patients' or normal people's health (Picard and Klein, 2002). Students' perceived self-regulation correlates positively with positive emotions, whereas perceived external regulation correlates with negative emotions (Pekrun, Goetz and Titz, 2002). However on the other side, negative emotions, even mild stressors lead to initiation of the stress response, which negatively affects the student's ability to perform. Emotion is therefore a double-edged sword, with the ability to enhance learning or impede it. Educators need to understand the biological underpinnings of emotion in order to foster an emotionally healthy and exciting learning environment that promotes optimal learning (Wolfe, 2006).

In their qualitative study where they investigated 5 cases, Pekrun, Goetz and Titz (2002) found that students experience a rich diversity of emotions in academic settings. Anxiety was reported most often, but overall, positive emotions were described no less frequently than negative emotions. They concluded that emotions seem to be closely intertwined with essential components of students' self-regulated learning such as interest, motivation, strategies of learning, and internal versus external control of regulation. Gaining a realistic account of students' competences for self-regulation and academic performance may require taking their emotions into account. In so doing, simplistic conceptions of negative emotions as bad and positive emotions as being good should be avoided because positive emotions are sometimes detrimental and negative emotions such as anxiety and shame beneficial.

In 2002 Meyer and Turner made a series of observations in classrooms and coded classroom discourse. They analyzed when emotions are displayed and interpret the meaning of a teacher–student interaction, in part, based on whether the emotion supported or detracted from the learning activity. They found that instruction associated with positive student motivation is often intertwined with explicit displays of emotion, such as laughter at a teacher's joke about his mistake on the board or a student's expression of pride at understanding a difficult problem. Also instruction that students report as more motivational correlates with teacher support, including positive emotional support and statements of caring, as well as other characteristics of a positive classroom climate. At the same time, they discovered that students with mastery goals either did not interpret mistakes negatively or somehow successfully regulated their negative affect, and so they did not report that negative emotions interfered with their beliefs and behaviors. The lack of a relationship between mastery goals and negative affect is an interesting finding of the study, suggesting that students who can more effectively regulate their emotion may be the ones more likely to report a mastery goal perspective. Teachers' demonstrations of positive emotions and intrinsic motivation appear to be critical features of instructional interactions that correlate with student reports of positive emotions and motivation to learn. They concluded that emotions to be ubiquitous in classrooms and important for understanding instructional interactions.

To reduce conceptual complexity, experimental mood research on performance effects of emotions has traditionally focused on differences related to the valence dimension of emotions, positive vs. negative mood. Positive emotions are considered as «pleasant» states of emotions while negative emotions as «unpleasant» states of emotions. In their model, Pekrun, Goetz and Titz (2002) added a second dimension, activity, to that representation. Using these two dimensions they grouped emotions, particularly academic ones, as positive activating emotions (such as enjoyment of learning, hope for success, or pride); positive deactivating emotions (e.g., relief, relaxation after success, contentment); negative activating emotions (such as anger, anxiety, and shame); and negative deactivating emotions (e.g., boredom, hopelessness). They also explained how mediating mechanisms and resulting academic achievement are influenced by these four categories of emotions as follows:

> Motivation: Emotions may trigger, sustain, or reduce academic motivation. Positive activating emotions such as enjoyment of learning may generally enhance academic motivation, whereas negative deactivating emotions may just be detrimental. The other two categories of emotions, however, may show more complex effects. Positive emotions such as relief or relaxation can deactivate any immediate motivation to continue academic work, thus facilitating disengagement. However, being positive emotions, they can also serve as reinforcers strengthening motivation for the next stage of learning. The effects of negative activating emotions may be even more ambivalent. Anger, anxiety, and shame can be assumed to reduce intrinsic motivation, because negative emotions tend to be incompatible with enjoyment as implied by interest and intrinsic motivation. On the other hand, it follows from their activating nature that these emotions can induce strong motivation to cope with the negative events that caused them, thus strengthening specific kinds of extrinsic motivation.
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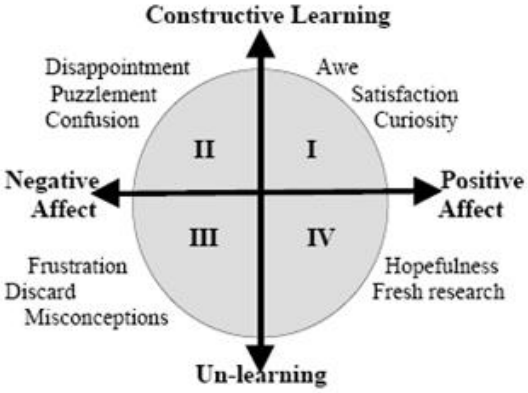
> Strategies for learning: Positive academic emotions facilitate the use of flexible, creative learning strategies such as elaboration, organization, critical evaluation, and metacognitive monitoring. Negative emotions, on the other hand, may trigger the use of more rigid strategies, such as simple rehearsal and reliance on algorithmic procedures. These effects should be stronger in activating than in deactivating emotions. Emotions such as relaxation or boredom imply physiological as well as cognitive deactivation, thus leading to reduced attention and shallower, superficial processing of information.
>
> Cognitive resources: Emotions serve functions of directing attention toward the object of emotion, implying that they use cognitive resources and can distract attention away from tasks. Emotions such as enjoyment, pride, admiration, anxiety, anger, or envy can relate to the setting, other persons, or the self, thus producing task-irrelevant thinking, reducing cognitive resources available for task purposes, and impairing academic achievement. However in emotions directly relating to the process of learning and task performance, the situation may be different. Specifically, enjoyment of dealing with learning material and related experiences of flow may direct attention toward the task at hand, thus allowing for the full use of cognitive resources instead of reducing them. The terms intrinsic and extrinsic can be borrowed from motivation research to characterize the implied distinction. Seen from a task perspective, emotions relating to the setting, other persons, or the self can be considered extrinsic emotions. Emotions such as task-related enjoyment, on the other hand, are intrinsic emotions to the extent that they relate to inherent properties of task material or the process of dealing with such material. Positive intrinsic emotions may

be assumed to direct attention toward the task, thus directly facilitating learning and performance.

Self-regulation versus external regulation of learning: Because self-regulated learning presupposes cognitive flexibility, it may be speculated that it is facilitated by positive emotions. Negative emotions, on the other hand, may be assumed to motivate students to rely on external guidance.

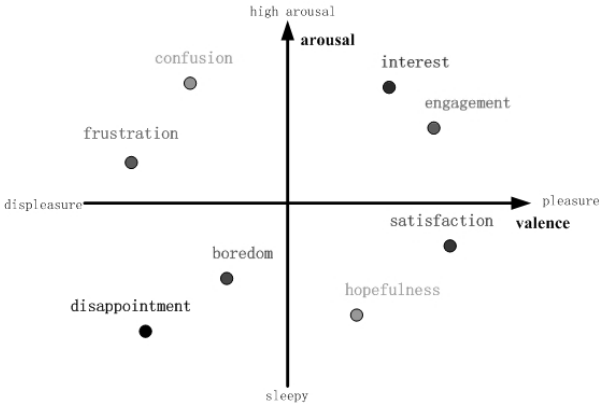
Kort, Reilly and Picard (2001) proposed a four quadrant learning spiral model in which emotions change when the learner moves through the quadrants and up the spiral. They also proposed five sets of emotions that may be relevant to learning. However, empirical evidence is needed to validate the learning spiral model and to confirm the effects that these emotions might have on learning.

FIGURE I. Four quadrant learning spiral model



One well-established dimensional model is psychologist Russell's circumflex model of affect. In Russel's model emotions are seen as combinations of arousal and valence, they are distributed in a system of coordinates where the y-axis indicates the degree of arousal and the x-axis measures the valence, from negative to positive emotions. The Russell's model is widely used in recent researches and most of these just explored from three to eight basic emotions. (Shen, Wang, and Shen 2009).

FIGURE II. Russell's circumflex model of affect



The extension of cognitive theory to explain and exploit the role of affect in learning is still in its infancy (Picard et al., 2004). In the last decade, a number of scholars have focused on understanding the

role of affect or moods and emotions, in education for an overview of recent work. Yet, we still have much to learn about the affective experiences of students and teachers in academic contexts and how to integrate affect into existing models of motivation and learning. In her study where she investigated five articles related with emotions, Linnenbrink (2006), concludes it is clear from these manuscripts that affect is critical to understanding students' and teachers' educational experiences, and that it is has been ignored for far too long. Except test anxiety that has been researched extensively since the beginning of the 1950s, students' academic emotions, other than anxiety, have been largely neglected (Pekrun, Goetz, Titz, and Perry, 2002).

Affective Computing

Affective computing is a term that is referring to the development of computer systems enriched with affective understanding. In a study which is on human-computer interaction Mishra (2006), concluded that users accept affective feedback from the computer but do not necessarily respond to it the same way as they do if they receive the same feedback from humans. Users accept feedback from the computer at face value. In the case of receiving feedback from humans, people are more interpretive (e.g. is he making a joke or is he trying to mention something else), and seek to understand the context of the feedback and this is not something they do when working with computers. The results of this study are interesting primarily because they indicate that the psychological aspects of human computer interaction are complex and are hard to explain using simplistic frameworks such as «computers are neutral tools» or «interacting with computers is just the same as interacting with humans.

Although affective computing is a promising area, so far little attention has been paid to the affective causes and consequences of the users' behavior in computer based or assisted environments. Although there is an increasing interest in inquiry on emotions in education (Schutz and Decuir, 2002), affective computing and learner emotions have not become a serious research interest among educational technologists. One of the reasons of this lack of interest may be that instructional designers have been too busy with cognitive and motivational objectives. Another reason may be the research difficulties in front of researches. Emotions are not a comfortable topic to investigate. Conducting research on emotions in education presents a number of potential challenges. For example, emotions are very fluid. They can be quick to occur and quick to change. Traditional research methods in educational psychology are not suited to capturing the fluid and changing nature of emotions and affective states (Ainley, 2006). In addition, within the educational context, for ethical reasons, they do not lend themselves to some traditional research methods. For example, what principal or parent would agree to allow a researcher to create a situation in which students could become angry so that researchers could study the experience of anger in education? Thus, the study of emotions, maybe even more so than other areas, has many potential inquiry challenges (Schutz and Decuir, 2002). New studies are needed to be designed and implemented keeping in mind these challenges.

Unfortunately we have rarely incorporated emotions comfortably into the curriculum (Sylvester, 1994) although there are instructional models developed to produce an emotionally sound instructional design. Emotionally sound instruction consists of instructional strategies to increase positive emotions and decrease negative emotions when using instructional technology (Astleitner, 2000). One of these models is ECOLE (emotional and cognitive aspects of learning). ECOLE aims the improvement of instruction by enhancing positive emotions and achievement. ECOLE uses some teaching strategies to enhance well being, enhance interest, reduce anxiety and boredom and enhance achievement. The ECOLE strategies may be summarized as student centered instruction, differentiation and transparency of demands, individual feedback,

cooperative activities, play-like activities, clearly structured instruction and materials, authentic tasks, transfer to everyday life (Zikuda, et. al., 2005).

Another example to emotionally sound models is FEASP (fear, envy, anger, sympathy, pleasure), which was offered by Astleitner (2000). According to this model the instructor must analyze emotional problems before and during the instruction. There are 5 basic emotions to be considered in this model. While fear, envy, and anger should be reduced during the instruction sympathy and pleasure should be increased. Based on observations during the instructions emotional strategies must be designed, implemented, and evaluated. An overview of the model is given below.

TABLE I. FEASP Model

	Emotional Strategies	Instructional Technology Features
Fear reduction	Ensure success in learning Accept mistakes as opportunities for learning Create relaxed situation Be critical, but sustain a positive perspective	Cognitive learning design Q&A, success statistics Training delivered through multimedia Cognitive tools
Envy reduction	Encourage comparisons with autobiographical and criterion reference standards instead of social standards Use consistent and transparent methods for evaluating and grading Inspire a sense of authenticity and openness Avoid unequal distribution of privileges among students	Students progress tracking using target lists Programmed fact based evaluation and feedback Personal information board Rule based granting of privileges
Anger reduction	Stimulate the control of anger Show flexible views of things Let anger be expressed constructively Do not show or accept any form of violence	Anger buttons Linked information Anger help option Nonviolent actions: motivational design
Sympathy increase	Intensify relationships Install sensitive interactions Establish cooperative learning structures Implement peer helping programs	Synchronous and asynchronous communication tools On/offline trainings for empathic communication Collaborative learning tools Social networks on the web
Pleasure increase	Enhance well being Establish open learning opportunities Use humor Install play-like activities	User friendly interface design Virtual classrooms Story/comic/cartoon production systems Instructional computer games

FEASP model provides instructional technology features for developers to design affective-educational software. In fact educators and developers should benefit from the power of emotions in computer based or computer assisted environments. For example simulations, role plays, and other experiential activities can be highly engaging. By intensifying the student's emotional state, they may enhance both meaning and memory. Tackling real-life problems is another way to raise the emotional and motivational states (Wolfe, 2006). Collaboration in computer based learning environments should also be considered. Research shows that students not actively participating in the collaborative activities have more negative emotional experiences during web based the courses than other students (Nummenmaa and Nummenmaa, 2008). Videos, short stories, relaxation exercises, suggestions, and music may also be used. Akbiyik (2009), designed two learning environments (computer and classroom) for primary school students and compared these learning environments with expository (traditional) teaching. He grounded his study on

the principles of accelerated learning model which was formulated by Georgi Lazonov in late 60s. Although this model has principles referring to subconscious, positive emotions have a key role in it. In his study Akbiyik used motivating short stories, relaxation exercises, suggestions, video and music to intensify positive emotions and to create a stress-free, relaxing learning environment. According to the results, both accelerated learning groups (computer environment and classroom environment) achieved better than expository teaching (traditional) group. No significance difference was measured between accelerated learning groups. Akbiyik concluded accelerated learning principles can be used successfully in computer based or assisted learning environments.

On the other side the issue of which features can be used to intensify emotions is still ambitious. For example Park and Lim (2007), used 3 different delivery styles (cognitive interest illustrations, emotional interest illustrations, and text) in a computer based environment. Results revealed that the both cognitive and emotional interest illustrations had positive effects on post interest and motivation. But the types of visual illustration, however, did not have an effect on motivation, post interest, recall or comprehension. Although researchers interpreted this result as learners are aroused to be in a positive emotion and interest toward instructional materials when any types of illustrations are given to them, this result may be a result of emotionally defectiveness of the illustrations.

Another appealing issue related with affective computing is emotion recognition which is one of the key steps towards affective computing. Many efforts have been taken to recognize emotions using facial expressions, speech and physiological signals (Shen, Wang, and Shen 2009). Measuring emotions using physiological signal sources, like automatic arousal, heart rate, blood pressure, skin resistance and some facial electromyography activities, is the attractive prospect that, physiological measurement might offer a way to accessing a person's emotional state (Sarrafzadeh et. al., 2008).

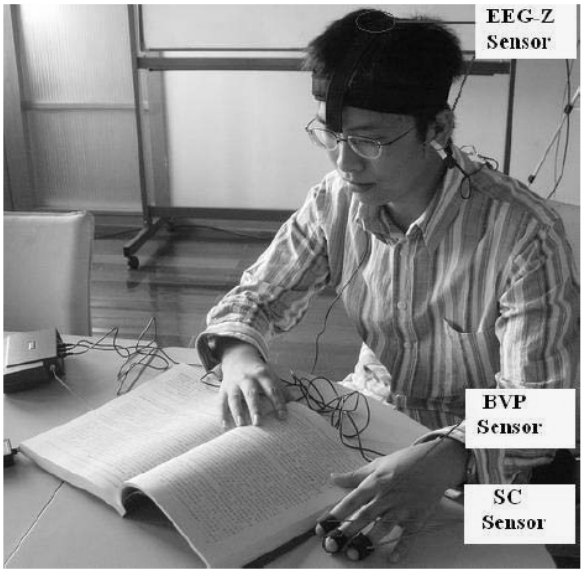
In fact many software systems would significantly improve performance if they could adapt to the emotional state of the user, for example if intelligent tutoring systems, ATMs, or ticketing machines could recognize when users were confused, frustrated or angry they could guide the user back to remedial help systems so improving the service. A human teacher may change his/her teaching according to emotional atmosphere of the class, puzzled or bored faces might mean that there is no sense in continuing with the current teaching strategy. A similar approach may be transferred to computer based or computer assisted learning environments. Such system may direct the courseware according to user's emotions.

Recognition precision of emotions varies with the technology used. Identification and classification of emotional changes has achieved results ranging from 70-98% on facial expressions and 50-87.5% for speech recognition. The successes in physiological emotion detection vary from 80% to 90%. It is suggested however that, because physiological measures are more difficult to conceal or manipulate than facial expressions and vocal utterances, and potentially less intrusive to detect and measure, they are a more reliable representation of inner feelings and remain the most promising way for detecting emotions in computer science (Shen, Wang, and Shen 2009). In a study in 1998, Huang, Chen, and Tao investigated the performance of machine based emotion employing both video and audio information. It was indicated that including both the video information (as extracted facial expressions) and the audio information (as prosodic features) improves the performance significantly. Huang, Chen and Tao's research indicated that the machine performance was on average better than human performance with 75% accuracy (Sarrafzadeh et. al., 2008).

Although there are related studies conducted, within the content of this study I could not find any studies which was tested in real educational settings such as classrooms, schools, and courses. For example Shen, Wang, and Shen (2009), integrated biofeedback devices to an college e-learning platform and collected bio-physiological data such as heart rate, skin conductance, blood volume pressure and brainwaves. The study was conducted with one college student. Four types of emotions (engagement, confusion, boredom, hopefulness) that are associated with learning were included in the study. Video, music and jokes were used to overcome boredom and an intelligent recommendation agent which guided learners during their study, to the system were used. Frequently the user was asked to define and mark his emotion. In this study researchers could be able to determine user emotions with a precision up to 61.8%.

When they included brainwave data to the system precision increased to 86.3%. Shen, Wang, and Shen concluded that integrating biofeedback devices to a college e-learning system and measuring emotional data improved user performance by 91%. But it should be noted that this was a time series study which was conducted with only one student. Below is a picture taken during the study of Shen, Wang and Shen.

PICTURE I. Shen, Wang, and Shen's Study



In fact the task of predicting user emotions at a specific stage of a computer based learning system does not necessarily require biofeedback capability. Questionnaires and self-rating scales administered before a learning task can measure expectancies and anticipatory affective reactions. Similarly, questionnaires and rating scales administered after the task provide a retrospective on the event (Ainley, 2006). Also observation data may be used to determine user emotions during a specific part of the software. These data may increase quality and enhance the task of developing emotionally sound learning environments.

Conclusion

From related literature, we can infer that emotions have various effects on learning. Learning is associated not only with our cognitive abilities, but also with our emotions, expectations, prejudices, self efficacy and our social needs. Emotions may serve as a powerful vehicle for enhancing or inhibiting learning. Different emotions can influence learning mechanisms in different ways.

Although in the last decade, a number of scholars have focused on understanding the role of emotions in education, we still have much to learn about the affective experiences of students and teachers in academic contexts and how to integrate affect into existing models of motivation and learning. Except test anxiety that has been researched extensively since the beginning of the 1950s, academic emotions have been largely neglected. A similar situation may be observed in computer based or computer assisted learning environments. So far little attention has been paid to the affective causes and consequences of the users' behavior in computer based or assisted environments. Although there is an increasing interest in inquiry on emotions in education, affective computing and learner emotions have not become a serious research interest among educational technologists.

Here I suggest using the power of emotions in computer based or computer assisted learning environments. Certain features and technologies may be used to create an emotionally sound learning environment. Simulations, role plays, and other experiential activities can be highly engaging. Real-life problems and collaboration are other ways to raise the emotional and motivational states. Videos, short stories, relaxation exercises, suggestions, and music may also be used for this purpose in computer based or computer assisted learning environments.

Another issue related with affective computing is emotion recognition. Many efforts have been taken to recognize emotions using facial expressions, speech and physiological signals. Measuring emotions using physiological signal sources, like heart rate, blood pressure, skin resistance and some facial electromyography activities is an attractive prospect of the topic.

The task of predicting user emotions does not necessarily require biofeedback capability. Questionnaires and self-rating scales, and observations may also be used to determine user emotions during a specific part of the software.

Among researchers there are an optimistic expectations concerning affective computing and biofeedback. Affective computing systems are expected to have positive impacts on learning. Many researchers now strongly feel that intelligent tutoring systems would be significantly enhanced if computers could adapt to the emotions of students (Sarrafzadeh, at. al., 2008). Here I invite future researches to study on affective computing.

Of course there are some difficulties in front of implementing affective computing systems in real educational settings such as schools or courses. Most biofeedback devices seem to be far away from feasible and comfortable use. Besides, although there are commercially available biofeedback devices the reliability and accuracy of these devices should be tested. It is clear that more studies and developments are needed in this area. Affective computing and detection of human emotions are areas still maturing and researchers in various disciplines are still making progress. Because integration of ICT is a complex and multidimensional process, many dynamics such as teachers, students, school administration, educational programs, and school culture should be considered in future studies as well as hardware, software, and ergonomics. Especially psychological concerns may arise with the implementation of affective computing systems. Research shows humans accept affective feedback from the computer but they do not respond to it the same way as they do when they receive the same feedback from humans. A system sensitive to emotions may make users feel themselves as they have being watched by the big brother. Intelligent tutoring components should be carefully developed in an affective system. And of course costs of affective systems is a huge issue. During a time when ICT investment costs are questioned it may not be the best idea to demand more resources and ask for more investments.

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