Affective Computing

Scenario
Ty has been going to classes for just over a week, and his worries about attending college are beginning to surface in his mathematics lab. He has never been confident in math and was placed in a remedial course for first-year students who need support before taking college math. His mind wandered during class yesterday, and the first assignment question has him stumped:

*In the equation* \(2x + 4 = 3x - 1\), *what is the value of X?*

As part of a pilot program to help struggling math students, the math lab offers electronic tutors that employ affective computing, and as he stares at the question and considers the possible answers, a pleasant voice comments through his earphones: “You appear confused, Ty.”

Startled at first, Ty recalls that this electronic tutor interprets facial expressions, keystrokes, and stylus marks on his digital scratch pad.

“What would you like me to assist you with this problem?” Ty watches as the electronic tutor steps through the solution with him. Then he solves a similar problem, surprised he knows what to do. “You seem more confident solving for X now,” says the tutor.

The tutor provides help in a variety of forms: verbal explanations, animated arrows, comic drawings, or text comments. Based on Ty’s facial expressions and his habit of drawing on his electronic scratch pad, the program determines he learns best with illustrations, and shifts to presenting more information graphically.

Keisha, one of four TAs monitoring the class, checks the stats each week for Ty’s lab work and that of the other 39 students in her section. The analytics program she uses offers a graph showing how many students have participated and correlates that with their performance. Most are doing better than expected, but when a student struggles or otherwise shows signs of distress, the system flags the situation. Ty’s name has been flagged, but Keisha can see that he has learned how to do the work and—based on reports from the expression-recognition software—that his confidence is up. She sends a quick note saying that he appears to be making good progress but to contact her if he has any concerns. Ty is not alone. By semester’s end, confidence has grown across the class of 160 students and successful responses on the first attempt are up 17 percent.

1 What is it?
The term *affective computing* refers to IT systems and devices designed to discern human emotions, respond to the user on the basis of what they perceive, and, in some cases, represent human emotion to users. Unlike “conventional” computing, in which computers only “know what they are told,” affective computing strives to “infer” or “read” a user’s emotional state, adding a qualitative component to interactions between humans and computers. Computers that can perceive human emotion might, for instance, recognize when a student is frustrated with a particular learning activity and redirect that student to different kinds of resources that might be more helpful. Affective computing could lead to IT systems and devices that can respond appropriately to subtle or subconscious clues from users and, as a result, provide more appropriate and effective interactions for those users.

2 How does it work?
Affective computing captures signals from human users through cameras, microphones, skin sensors, or other means, collecting information about facial expression, voice tone, gestures, and other variables that can indicate emotional state. By evaluating those data points, the system interprets the user’s emotional state. That determination guides actions that the computing system takes, such as referring users to appropriate services or resources. An affective computing system might monitor an online learning environment, looking for signs of confusion or boredom among learners and providing different learning choices for those who are struggling. In a sophisticated model that uses avatars or computer-generated voices to communicate with users, affective computing might tailor those avatars or voices to match or complement the emotions of the users. Affective computing software might expand to include mechanisms to “learn” over time, improving its ability to accurately recognize various emotions.

3 Who’s doing it?
Although the field of affective computing in higher education is nascent, a number of institutions are sponsoring development. The MIT Media Lab hosts the Affective Computing Group. MIT’s Personal Robots Group has
developed a smartphone-based social robot named Tega that functions as a tutor for preschool students, interacting with the children in a manner that integrates play with learning. Tega interprets student emotional cues and responses, using those data to devise motivational strategies that help children learn. At the University of Sydney, researchers are investigating how emotions can factor into collaborative learning. To aid their research, developers have created Siento, a platform for recording human data gathered through webcams and sensors as humans interact with and respond to computer-based activities. Siento has allowed researchers to measure human interaction with computers in naturalistic scenarios in several experiments. Meanwhile, developers at Stanford University are working to address the problem of providing suitable support for the large numbers of students in MOOCs. Student requests that are posted on the class forum can be lost amid the crush of posts that contain content of all kinds. YouEDU is an instructional aid that can detect, map, and address student posts that suggest urgency or confusion. Initial tests suggest that YouEDU provides effective intervention in MOOC forums.

4 Why is it significant?

Because affective computing systems address the emotional domain, they can engage users at a deeper level, providing what feels more like a human relationship. For example, students who need extra help might soon turn to machine tutors that give colloquial feedback tailored to students’ emotional state, not just their content proficiency. Tools based on affective computing might provide more accurate diagnoses for learning problems or mental health concerns such as anxiety or depression. Analytics initiatives have successfully used quantitative methods to improve student outcomes, and affective computing systems add a qualitative element to those efforts by focusing on emotion. Information gleaned from affective computing systems can provide faculty with a more thorough view into students’ attitudes and reactions, possibly providing insights into curriculum redesign or the basis for individual interventions.

5 What are the downsides?

The physical, verbal, and other cues that affective computing uses to evaluate emotion may not be consistent among users from disparate nations and cultures, not to mention users with conditions such as autism spectrum disorder. This variability could make affective computing tools unreliable. Users might be apprehensive about the kinds and the amount of behavioral data that could be gathered about them, seeing the collection and use of those data as an invasion of their privacy. To the extent that people interact with affective computing personalities as if they were human, some may anthropomorphize those tools, seeing them as emotional entities. On the other hand, robots and machine-based personalities that act too much like humans can cross into the “uncanny valley,” feeding fears about the rise of machines. The proliferation of emotion-based support mechanisms in teaching could imply that learning is all about the affective rather than the cognitive domain, while relying too heavily on these systems could lead us to exclude other methods of understanding the people around us.

6 Where is it going?

Affective computing is becoming a major focus for artificial intelligence, particularly in robotics, feeding a growing awareness that machines can perform certain activities as well as or better than humans. Beginning in elementary school, each child might be assigned an affective tutor that evolves over the student’s educational career, providing learning support across courses and time. Such companions might access health information from wearable devices to help identify anxiety attacks in time to short-circuit them or to raise flags about depression before it becomes debilitating. Developers of such systems may need to unravel the impact—positive or negative—that they have on student agency and the acquisition of metacognitive learning skills. Affective computing might be used for informal learning, as in a “digital docent” at a museum.

7 What are the implications for teaching and learning?

For online instructors, who are generally isolated from the visual and auditory cues about the mood of a class or individual students, affective software could fill such a void, providing data on whether students are interested, bored, excited, confused, or curious. For students, a digital entity that offers authentic conversational interaction could become a personal academic assistant that might be able to read human behavior more accurately than most people. Affective computing is a natural complement to—or extension of—adaptive learning, which endeavors to modify learning content for individual student needs. The added dimension of student affect could make adaptive technology more successful at coaching students. Software could help students decide when they are emotionally overloaded, leading them to seek help. Perhaps the most important teaching value affective systems offer is the potential to help students better understand themselves and the emotional responses of other people.