Why emotions are integral to learning

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Teachers intuitively know that neither their nor their students' learning is steady and constant, the same day in and day out and moment to moment, consistent from topic to topic. Rather, we all have good and bad days; moments of excitement, engagement and inspiration and moments of disappointment, disengagement and frustration; afternoons just before vacation and mornings just after; some skills and topics that we find interesting and some that we don't. These differences influence how children learn and how teachers teach; they even affect what students know at a given time. In short, learning is dynamic, social and context-dependent because *emotions* are, and emotions form a critical piece of how, what, when and why people think, remember and learn.

The fundamental role of emotions in academic learning first became apparent to me during my first professional position after college, as a junior high school science teacher in a highly diverse, urban public school near Boston. The community I lived and worked in had many first-generation Americans, 81 languages total spoken in our school of 1800, and many students living in underprivileged circumstances. Although I was teaching integrated science, a technical academic subject, I was intrigued that my students' questions and

explanations seemed connected to their friendships, home situations, aesthetic tastes and cultural values. I was fascinated but unprepared, for example, when the race relations among my 7th graders changed (and improved) dramatically after I taught a unit on hominid evolution that I designed with my former undergraduate professor. The students' new scientific understanding of natural selection for adaptive traits like dark or light skin seemed to powerfully influence their peer relationships and their own ethnic identities. Why had the students interpreted the science in such a personal, emotional way? And why, after the classroom turbulence had settled, did so many of my students suddenly seem to take a new interest in science? I brought these questions with me to graduate school, and through my research I still seek satisfying and complete answers to them.

Scientific understanding of the influence of emotions on thinking and learning has undergone a major transformation in recent years. In particular, a revolution in neuroscience over the past two decades has overturned early notions that emotions interfere with learning, revealing instead that emotion and cognition are supported by interdependent neural processes. It is literally neurobiologically impossible to build memories, engage complex thoughts, or make meaningful decisions without emotion. And after all, this makes sense. The brain is highly metabolically expensive tissue, and evolution would not support wasting energy and oxygen thinking about things that don't matter to us. Put succinctly, we only think about things we care about. No wonder my 7th graders had taken that science lesson so personally and so seriously. They had found that science could help them make personally relevant meaning of the racial and ethnic diversity and identity issues they encountered in their daily lives.

This insight—that we only think deeply about things we care about—has important implications for education and pedagogy. It opens questions about how, when and why students learn meaningfully (or just regurgitate facts and deploy procedures and algorithms, or possibly don't manage even those). It also raises issues about how technology, culture and social relationships shape learning, and how teachers can understand

and leverage emotions more productively in the classroom. It suggests that for school-based learning to have a hope of motivating students, of producing deep understanding, or of transferring into real-world skills—all hallmarks of meaningful learning, and all essential to producing informed, skilled, ethical and reflective adults— we need to find ways to leverage the emotional aspects of learning in education.

As my students show, understanding the role of emotions in learning goes far beyond recognizing the emotion a student is having *in reaction to* a situation in order to design learning environments that strategically manipulate students' behavior. For instance, giving out candy in science class may make students want to come to class, and sit quietly when they are asked. But, it will not help them feel the satisfaction of applying scientific thinking to pertinent real-world issues like, in this case, race relations.

Instead of focusing on managing behavior, it is critical to understand that the real reason emotions matter is that they influence the *meaning* students make of what they are learning—the connections they forge between a pressing question they care about and a new piece of information. That is, emotions steer students' (and teachers') thoughts and color the *experience* or *feeling* of engaging with information. By doing so, emotions determine whether academic information will be processed deeply and remembered, and whether it will influence students' thinking in the future, inside and outside of school. Educators have long known that personal relevance is important for durable learning, and promotes motivation and persistence. Now we are learning more about the emotional and social (and neurobiological) reasons why.