Mathematical thinking is more than memorizing theorems and working problems. As mathematicians, we make conjectures and test them; we look for patterns; we connect new ideas to familiar ones; we generalize, abstract and describe. Yet all too often, I believe we short-change our students by simply presenting theorems and examples from a book instead of incorporating them in the world of mathematical thought. If the students are not engaged and thinking mathematically, I believe we miss the real goal of teaching mathematics. Not everyone will become a mathematician in the strictest sense, but everyone can benefit from learning to think mathematically.

I am in my third year as a visiting assistant professor at the University of California, Riverside (UCR). I also served as a primary instructor for 3 years as a graduate teaching assistant at the University of Illinois, where I was awarded the Brahana TA Instructional Award in 2009. My classes have ranged in size from 8 to 128 students. My methods and style depend on the size of the class and the content we are discussing. I always try to communicate that mathematics is more than a list of definitions and theorems, but a paradigm for solving problems. For instance, in my small linear algebra class we were about to discuss how elementary row operations affect the determinant of a square matrix. Rather than list the operations and the effect on the determinant, I asked each student to pick their favorite 3×3 matrix. I recorded the determinant of each matrix on the board. I then asked each student to swap the first two rows and calculate the new determinant. When I had recorded the new determinants, it became clear to the class what to expect in general: that the new determinant should be the negative of the original. What would have been a somewhat dry list of properties became a hands-on experiment. Perhaps more importantly, they were able to conjecture what the theorem should be before we tried to prove it in full generality. In other words, the students were thinking as mathematicians do.

In my Euclidean Geometry class I had my students create GeoGebra web-based computed demos for the major theorems and concepts from the class. Each student picked a topic, such as the Euler Line, and had to create a demo that would visually indicate or motivate the general statement. For the Euler Line, two of my students created a demo with a fully dragable triangle with dynamically updating orthocenter, circumcenter and centroid which, necessarily, are always collinear. (The full set of completed projects is posted on my webpage `http://www.math.ucr.edu/~jmccullo`.) The students reported learning a lot by creating their own demos and clearly enjoyed applying a bit of what they had learned.

Technology is a means to an end. The types of technology that most enhance the learning experience vary from GeoGebra demos for large lectures to Mathematica workbooks in lab experiments. I'm constantly looking for new ways to get my students thinking mathematically. Sometimes this includes talking to other professors, graduate students or former students. I have also taken education classes in pursuit of a Masters Degree in the Teaching of Mathematics, which I completed in December 2008. I hope to continue to improve my teaching so future students can appreciate and enjoy the utility of mathematical thought.