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Statement of Teaching Philosophy

My vocation to education has two inextricably linked parts: to *learn*, with increasing depth in my subject area and with increasing breadth across the whole spectrum of intellectual life; and to *teach*, leading students into a life in which they think and learn on their own with disciplined creativity and with a taste for the pleasure of asking and answering important questions about the world. Mirroring this dual nature, my philosophy of *teaching* is rooted in my conceptions about how people *learn*. Through a diverse collection of teaching experiences throughout my life -- not only as a professor but also as a tutor to middle school kids with ADD/ADHD, a literacy tutor to adults recovering from brain injuries, and as a dad to my preschool-aged daughters -- I can point to six basic observations about how people learn which shape my teaching today.

1. People learn because they have questions. Real learning of a subject does not begin until the student has taken enough interest in the subject to form an honest, significant question which renders the subject worthy of attention. Sometimes these questions are practical, sometimes purely aesthetic or asked out of mere curiosity. But learning does not begin unless, and until, those questions are formed in the minds of the student.

How does this translate into teaching? My classes ground themselves in reasonable, interesting questions for which we need the mathematics under study to answer. For example, on the first day of a calculus class, I give an example of two related quantities, such as the price of oil and the price of a gallon of gas. Then I ask: How can we make this relationship precise? How fast is the price of gas changing? By how much can I expect the price of gas to change over a given period? These are questions of interest to the everyday consumer, but they are also questions which motivate the main ideas of calculus (the function, derivative, and integral), and students see why we need these topics.

2. People learn by interacting with the world around them. No learning takes place by mere observation. Learning takes place when students work out the particulars of the concepts they are seeing. This is true no less in mathematics than it is in the humanities, the arts, or athletics. Each concept must be made concrete through individual effort in order to internalize it and ask the right questions about it.

How does this conception translate into teaching? Active learning, especially involving computer technology, is a core element of my teaching. For example, students in my Quantitative Reasoning course go house-shopping online using a real estate web site to gather data which they then use to calculate mortgage payments. Students in my Topics in Geometry course use dynamic geometry software to investigate constructions and formulate conjectures which they then prove. Students in my Differential Equations class use computer algebra systems and spreadsheets to find analytic, numerical, and graphical solutions to dynamical systems in finance and biology.

3. People learn best when they are taught how to learn. If a student is taught only content, learning takes place no faster than the rate at which the professor teaches. But if a student is taught not only content but *process* -- the methodology by which new knowledge is generated in a subject -- then the student can learn on his or her own; and the more he or she knows, the faster he or she will add to the knowledge base. Lifelong learning begins with learning how to learn on one's own in this way.

How does this conception translate into teaching? Effective problem-solving a central goal of each of my courses. I designed and teach a course for sophomore mathematics students called Methods of Problem Solving in which Georg Polya's four-stage problem-solving heuristic is employed in a variety of settings. I include a "mini-Polya" course in other courses, especially at and below the level of calculus, where students often struggle with solving problems. Assignments in these courses include problem sets which require structured problem-solving and clear exposition of reasoning.

4. People learn best when they are challenged. The goal of an education is not merely the accumulation of content knowledge but the creation of a lifelong learner. A student cannot become a such a learner if his or her academic work is unchallenging and the expectations are low. All students deserve to be given work that "stretches" them and to have high standards set for them. Otherwise there is no learning and no growth taking place, only a gradual settling into a lifelong, suboptimal level of skill.

How does this conception translate into teaching? I model the assessments in my courses using Bloom's Taxonomy, a standard six-tiered framework of cognitive tasks. Some assessments focus on tasks in the lower three tiers (*understand*, *remember*, and *apply*). Others focus on the upper three tiers (*analyze*, *evaluate*, and *create*). For example, calculus students are given problem sets which require not just calculating derivatives but calculating the same derivative in multiple ways using a model that they have created with a spreadsheet, comparing the results, interpreting the meaning of the results in context, and deciding which derivative calculation is the most realistic. Also, each of my upper-level courses has a significant creative project built in; for example, Modern Algebra students created an online solutions wiki which contained the proofs for their exercises, and Cryptology students created a web site on cryptography during World War II.

5. People learn as much outside the classroom as they do inside. The life of learning truly takes hold in a person's life when learning becomes de-institutionalized and seen as part of the fabric of everyday life. The learning experience for students should include numerous, inviting venues for learning outside the classroom. Every moment and location should be seen as a time and a place for learning.

How does this conception translate into teaching? I am almost constantly thinking about mathematics, teaching, and learning. Through my blog Casting Out Nines (http://castingoutnines.wordpress.com) and through microblogging platforms such as Twitter (http://twitter.com/roberttalbert), I carry on "back-channel" discussions on a broad range of subjects which include not only students but also professionals and interested readers from all over the world. I have helped develop numerous off-campus and after-hours opportunities for students to interact with mathematics and technical professionals, for example through shadowing programs with professionals in jobs that use mathematics. On a different level, I like to let my personal life be visible and accessible to students -- through sharing stories about my kids or making food for evening classes -- to let students know that becoming a lifelong learner and mathematician need not come at the expense of a fruitful personal life.

6. People enjoy learning things. When a person sets out to answer a question he or she believes is difficult and important, and when through hard work and perseverance that person arrives at an answer and a host of related questions, it feels good. When we learn, we have accessed that which makes us truly human: the ability to combine our thoughts and memories together with what we learn from the world around us to create something new.

How does this conception translate into teaching? In the end, my level of enthusiasm makes or breaks the learning experience for students. I am genuinely enthusiastic about learning and about mathematics, and I believe I have a responsibility to model a life of the mind that takes genuine pleasure in learning things and shares that pleasure shamelessly with my students. I try to transmit that pleasure and enthusiasm in each class meeting.

Since teaching and learning are inseparable, another key element in my teaching is my scholarship, which has lines of activity in mathematics and in teaching. I have included my scholarship about cryptography, for example, in my Modern Algebra course and the interdisciplinary course on "Cryptography, Privacy, and Leadership" which I designed. I have shared my work in Web 2.0 technology with pre-service mathematics teachers and used it to develop online group course projects. Making my scholarship accessible to students is another instance of de-institutionalizing learning in order to enflame the students' curiosity. (More details about my scholarship can be found in my Statement of Scholarship.)