The Pleasure of Finding Things Out*

Amanda Beeson

What makes a good teacher into a great teacher? There is no simple answer, yet we all have standouts in our memories of teachers with this ineffable quality of greatness. Three great teachers I have had are Ms. Tamara Pomm, my eighth grade algebra teacher, Professor Michael Artin, my abstract algebra teacher, and Professor Glenn Stevens, whose lectures in elementary number theory at PROMYS are for me the benchmark of perfection. It is the respect and unwavering high standards, the impeccable clarity, and the continual curiosity and love of the subject that they bring to their classrooms that make them outstanding teachers. I endeavor always to incorporate those aspects of their teaching into my own.

1. **Respect and high standards.** I strive to create a learning environment where students ask questions without hesitation because they trust that I respect them. I actively solicit questions during class and in office hours and consider each one seriously. One salient memory of Professor Artin's class reveals him entreating a confused class to articulate their questions even when it was not easy to do so. Sometimes "are there any questions?" leads to a silent class, while "I know how hard it can be to formulate a question, but if you would like me to explain that again, please raise your hand" is met with eager arms. One student writes, about my current calculus class, "I really appreciate how willing you are to go back and explain things over again if we don't understand."

   The best way to show respect for students is to prove to them that you believe they can perform at a high level by pushing them: challenging homework to help them practice, fast-paced lectures to make them think on their feet, difficult exams to allow them to shine. Tailoring one's standards to be high for the particular class at hand is an art, but getting written feedback, encouraging participation in class, paying close attention in office hours, and holding frequent quizzes are several effective methods I use. I pepper my lectures with questions for the class: from the challenge problem on the board at the beginning of lecture, to definitions they should know, to conjectures they might have about upcoming topics. It is a great show of respect, a good didactic technique, and a downright challenge for the professor to ask a question of the class

*R. Feynman, *The Pleasure of Finding Things Out: The Best Short Works of Richard P. Feynman*, Basic Books, New York, 2000.

and stand at the front of the room waiting until someone answers. In the summer of 2008, I opted to let my linear algebra class come up with each of the many equivalent parts of the Invertible Matrix Theorem together, rather than just writing them out myself. I stood at the front of the room in silence for a full minute watching their brows furrow and their brains spin into action while they assimilated the observations we had been making for several days on their own. They could sense I trusted them to come up with the theorem. Slowly, they started piecing it together and when they successfully got the last condition correct celebratory hoorays and high-fives boiled over in the classroom.

2. **Clarity.** One cannot, however, have high standards without being clear about their expectations. I gave so hard a linear algebra midterm that my colleagues warned me it would be devastating. However, I informed my students a week in advance that "I may look like a softie, but I am going to give you a difficult exam so study hard." And study they did. Not only did I witness them glued to their books on campus over the weekend, but they out-performed even my best expectations on the exam.

   Clarity helps a class run smoothly and allows students to learn more efficiently. I present an organized website, complete with lesson plans, homework assignments, clearly stated grading policies, and timely updates about review sessions, practice exams, and extra office hours. I always show up a few minutes early to class to post a challenge problem, a list of topics covered the day before, the plan for the current day, the suggested reading in the text for the following lecture, and any pertinent announcements. I lecture in an organized fashion, with neat handwriting, and I motivate each topic by saying clearly what we have accomplished, where we are headed, and why we care. As Professor Stevens would say "You only really know something if you can see it at a glance!" What I admire about him is the depth, gusto, and lucidity of his explanations. He unveils the lessons in a perfectly crafted order, cuts through complicated territory to paint a crystal clear picture, and instills in the listener an appreciation for the beauty of the subject.

3. **Eternal curiosity.**

   The best way to illustrate the beauty of a subject is to live and breathe it. There are always choices about how to imbue each topic with one's own taste: I teach Calculus as a deep and lively subject that took mathematicians a long time to make precise, rather than a rote technical topic. "Alright, we understand the slope of a line. Now can you define the 'slope' of this quadratic curve?" I ask playfully pointing at a graph on the board. And I really let them try for a few minutes so they feel that in some sense we are developing the theory of calculus together. While teaching my students about the concept of a limit, I overheard one of my students repeat my words "subtle

and beautiful" under her breath; I think it was the first time that anyone in the room had ever heard a math professor use those words.

I foster my sense of wonder for mathematics by imagining I am relearning the subject with my students. I think of myself as working the problems *with* them. "How should *we* proceed now?" I ask during office hours. It requires a lot of integrity on the part of the instructor not to give away solutions even though students press for them. It immediately sets the tone of high standards and, if portrayed correctly, also makes the student keenly aware of the instructor's respect for them. Some of my fondest memories from high school involve Ms. Pomm inviting us to come to her room at lunch where she would crack her mysterious Russian problem book and feed us challenge problems as though they were jewels. If we could not solve one she would just smile smugly and encourage us to keep trying. The lesson she taught me has been echoed back to me time and time again in student reviews of my teaching: "She does not answer the questions, but makes you get the answers yourself. But in the end, I'm the one who grows from this the most."

Students find it refreshing when an instructor has an uncompromising criterion for excellence; is very clear in their expectations; and exudes a contagious love and enthusiasm for their subject. Even though I am tough, I was still able to win the UCSD Math Department Outstanding TA Award based largely on student evaluations. At least two students here at Williams College have recently told me they will take my Calculus II class even though they do not have to, simply because they enjoy my class and are able to learn from me so effectively. I work constantly to be the kind of professor who inspires the next generation of students and teachers with respect, standards for excellence, and uncontainable love of the subject.