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Statement of Teaching Philosophy

Learning is a complicated process. As it is currently understood, learning takes place when people are confronted with problems or ideas for which their conceptual frameworks and content knowledge fall short, and then are presented with authentic, engaging, and meaningful activities that guide them to new frameworks, deeper knowledge, solutions to problems, and new questions for further study. My job as an instructor is to provide all the ingredients for this process to take place, and then to see the process through. It is my responsibility to confront students with perplexing and difficult questions, to design experiences to guide student exploration, to make sure students are engaged and active in their work, to help students through their difficulties, and to assess to what extent my teaching has helped students learn. In the end, through my facilitation of their learning, my goal is for every student to become a confident, disciplined, and passionate learner ready to continue this process throughout his or her entire life.

Leading to this central goal are several subgoals that I set for all my students. One of those is **content mastery**; without a thorough and skillful command of the content in a particular class, students will not be able to do hard creative work with that content later. But learning does not consist in or end with content mastery, and so I set several other goals for students in their learning. First, students should **map specific content onto new and difficult problems** in a variety of different domains, particularly those which are of interest to students individually. Having "head knowledge" of a subject means little if students cannot apply it to authentic problems like those they are likely to encounter later in their lives. Second, students should **find and articulate the connections** between what they are studying in one course and what they have learned or are currently learning elsewhere in the course and among past courses and their everyday experiences. People learn most effectively when they fit new knowledge into a larger framework, and it is important that students in my course do this while they are mastering the content. Third, students should **employ effective problem-solving techniques and adopt good problem-solving attitudes**. Regardless of whether students continue to use calculus, for instance, after taking a course in it, they will most certainly be solving problems of one sort or another; therefore getting good at problem-solving in general is at least as important in a calculus class as is getting good at doing calculus. Fourth, students should **develop the characteristics of mind attendant with being educated people**: confidence, mental toughness, healthy skepticism, persistence, creativity, clarity, and discipline are a few of these. These are lofty goals for students, and my entire career is predicated on the idea that all students are capable of attaining them, given the right balance of challenge and support.

The precise ways in which I lead students toward these goals look different from class to class, but all my classes have a few methodological elements in common: **active learning, substantive and sensible infusions of technology, meaningful human interaction, and early and frequent exposure to work on authentic problems**. In my calculus courses, for example, I employ peer instruction techniques in which students are given difficult conceptual multiple-choice questions to think about and answer on their own; students then vote on their answers using classroom response systems (also known as "clickers") and see the class' results from the voting, then pair off and argue for their answer with peers. After voting again, the class usually coalesces around the right answer or one of two answers including the right one, and then I debrief the class by working out the answer with their help. Peer instruction combines active learning, technology, and human interaction to create a potent and inclusive learning environment for all students. In my computer science class "Computer Tools for Problem Solving", I use an inverted classroom model in which the class lectures are posted to YouTube as a series of 10-minute video podcasts for students to watch outside of class, and then the class time is spent entirely by students working in teams on realistic laboratory problems in data visualization, mathematical modeling, and programming. In the inverted classroom, students learn how to acquire basic content knowledge on their own, while getting guidance from me at the points where they need it the most. Other instances of my pedagogy are less sophisticated but equally effective; for example, punctuating my freshman-level course lectures with pop-culture references and bad jokes creates a sense of fun and community among students, and letting students in linear algebra have unlimited use of MATLAB and Wolfram|Alpha on tests allows me to introduce authentic problems that assess not only content mastery but also the ability to apply basic knowledge.

All of these pedagogical methods are just exercises unless I take care to assess carefully what effect they have on student learning. I take assessment very seriously and implement it in several different ways in each class. I include a balance of both formative and summative assessments in my classes. Formative assessments, intended to monitor

the development of student learning as it happens, are brief and frequent. For example, I use the online homework system WeBWorK to give short homework sets two or three times a week. Students get instant feedback on their work and are allowed as many re-attempts as they want prior to a deadline, and I can monitor student progress in real time and intervene with individual students or the entire class if there are problems. Summative assessments, intended to gauge student mastery of concepts and methods, are infrequent and substantive, usually including real-world problems requiring a sound grasp of both mechanics and concepts, and I usually allow students unlimited use of technology and print resources in order to let the problems be as authentic as possible. In my classes, usually about 50% of a student's grade comes from several different kinds of formative assessments and about 50% from summative assessments. Outside of grades, I give frequent student surveys about the course itself using online survey platforms on Moodle or at Surveymonkey.com, on issues ranging from when certain assignments should be due to overall student satisfaction in the course. For example, in calculus, I give three informal course evaluations per semester in addition to the college's official course evaluation, so that I can monitor student needs and feelings as closely as possible throughout the course. In some courses such as Computer Tools for Problem Solving in which the pedagogy I employ is particularly innovative, I collect as much qualitative and quantitative data as possible not only to analyze it for ways in which I can improve the course but also that I might use it for scholarly research on teaching and learning.

I have several goals for myself as a teacher as I move forward in my career. First, I want to continue to study and implement both peer instruction and the inverted classroom model of instruction in my classes. I am very enthusiastic about the results I have had with these two pedagogical models, and I want to understand their uses and nuances more. Second, I want to continue to stay abreast of the latest developments in instructional technology and to implement technology effectively in my classes. In particular, I am interested in ways to incorporate computing, especially computer programming, meaningfully into the mathematics curriculum and ways to develop the computing and programming skills of mathematics students within mathematics courses. Third, I want to branch out in terms of the subjects that I teach, particularly to courses in statistics and computational mathematics, to more courses in computer science, and to project-based teaching experiences including undergraduate research projects. Fourth, I want to expand upon my depth and breadth of knowledge in the scholarship of teaching and learning that I developed in graduate school as a Master Teaching Fellow at Vanderbilt University, to the point that I am doing scientific research in teaching and learning on a regular basis on questions of interest to me and importance to my students. In particular, I have become interested in engineering education and took a minicourse on "Getting Started in Engineering Education Research" through the American Society for Engineering Education; I have some questions I would like to investigate in engineering education and some contacts with established researchers within the engineering education community that could lead to the kind of fusion of teaching and scholarship I seek.

Both now and in the future, I want to make my teaching more like that of the teachers who influenced me the most: engaging, deeply personal, challenging, disciplined, and far more than just a classroom experience. Through continued infusions of new ideas from the research literature and from colleagues, a positive attitude and a spirit of innovation and experimentation, and a genuine care for the students themselves and their ideas and dreams, I hope to move closer to that ideal each day.