Teaching Statement

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I feel that the greatest lesson that I can teach my students is an excitement for mathematics and its rigorous approach to discovery. Regardless of specialization, be it education, differential geometry or numerical analysis, we have chosen our path as mathematicians because at some point we discovered the excitement and power of mathematics. I found this fervor through seeing the utility of applied mathematics in modeling our natural world; I therefore try to incorporate these ideas in my teaching in the hopes that I can help students with similar inclinations to develop their enthusiasm as well.

Teaching Style

The best way to ensure that students get the most out of a course is through careful course design, lectures and assessment. My teaching style is composed primarily of outside reading, daily lectures, frequent homework/quizzes, long-term projects (if applicable), and two to three exams per semester.

Reading: Many of us wish that we could spend more class time in discussions with our students, answering their questions and working through the more difficult aspects of a given topic. These desires are often thwarted by the fact that we only have a finite amount of lecture time, with syllabi that promise to cover a vast array of topics. While I cannot offer a magic bullet to solve this problem, I have found that by forcing the students to read each section from the book prior to my lecture on that topic, I can spend less time on the introductory and/or trivial material and more time in discussion, or presenting the more interesting aspects of a topic. My technique for forcing the students to do this reading is to require that they turn in a short homework assignment at the beginning of class, prior to my lecture on the topic. Since students have different learning styles and some have more difficulty learning through reading, these assignments typically consist of only a problem or two that closely match worked examples in the reading, rendering the assignment simple so long as a student puts in the effort. While some students complain about this added responsibility, I have found that many more of my evaluations positively comment on this technique, with students appreciating that I spend more of our time together on the most difficult concepts.

Lectures: In my efforts to bring an applied component to my classes, I try to provide intuitive physical examples as motivation for the mathematical concepts under study. As discussed above, through requiring my students to have read each section prior to class, I can then spend time in class working through challenging example problems and on discussing the applications of each topic. For example, in a linear algebra class when discussing eigenvalues and eigenvectors, I spend a significant amount of the lecture discussing discrete dynamical systems, using a Matlab demo to show how an initial condition with even the slightest nonzero weight on an eigenvector with eigenvalue of magnitude greater than one will lead to a system that increases without bound.

Handouts: In some cases, a single textbook may not cover course material in the style or order that I would prefer. Moreover, many highly instructional textbooks do not provide discussion on the applications of the material. I believe that handouts may be used to fill in these missing components with such contextual information, and for example I have regularly used them in my course on introductory scientific computing to introduce basic iterative linear solvers (e.g. the Richardson, Jacobi and Gauss-Seidel iterations).

Homework: I believe that the most effective learning tool for mathematics is practice. I therefore assign weekly homework in addition to the short pre-lecture assignments. My homework assignments therefore begin with variations on examples seen in class to provide good practice for basic skills. However, every set of homework should also include problems that extend and build upon the ideas presented in class to attain new insight. Thus I assign some more challenging problems that require students to combine a variety of ideas and skills to achieve a more significant result than any of the individual parts. In some classes these longer assignments are not graded and only serve as a study guide for what students can expect on exams, though in courses with sufficient teaching assistant and/or grader support these will be graded as well. When homework assignments are not graded, I instead use short weekly quizzes to ensure that students keep up with the course material.

Exams: My goal on exams is to first establish a measure of the students' mastery over the basic concepts from the class – these questions are variations on the homework. As with homework assignments, the exams also incorporate a few problems that students have not seen before, and which require extrapolation of the basic concepts toward a more challenging situation. I often grade these exams on a curve, since the challenge problems sometimes prove too difficult for the time limit allotted for the exam (though with experience I have been getting better at this).

Technology: Many of my courses naturally lend themselves to the use of technology in the classroom (e.g. Linear Algebra, Scientific Computing, Numerical Solution of ODEs, Parallel Scientific Computing). For such courses, technology plays a key role in my teaching process. I therefore typically spend up to one third of our class time working with the students using in-class demonstrations. I then post all of the resulting scripts, functions, plots and outputs to a web page that I provide for the course. Moreover, I regularly incorporate computing into homework assignments to help exercise the key concepts in a hands-on fashion.

Projects: I am a staunch believer in using long-term projects to help students synthesize different lecture topics into a more ambitious goal. The size and duration of my projects increase proportionately with the level of the course: for undergraduate courses I will typically assign three to four one-month-long projects, and for graduate courses a project can last throughout an entire semester. Of course, projects lend themselves more easily to some topics than others, and I have not yet come up with projects for some of my courses (e.g. multivariable Calculus).

Nowhere is my belief in the power of projects more clearly evidenced than in my graduate course on Numerical Methods for Ordinary Differential Equations. At the beginning of the semester, I typically provide a list of three or four possible project topics for the students to choose from (or they can propose their own). I always choose these topics from current research articles (e.g. projective integrators, symplectic methods, novel IMEX methods). These projects always require extensive outside reading to understand the current state-of-the-art, and as I lecture throughout the semester I strive to point out the topics that will prove useful in completing the various projects. While multiple students may choose the same project topic, at the end of the semester I "race" their resulting solvers on a variety of difficult test problems. As a result, students typically begin by reading journal articles together and end by doing all work on their own. During the final exam period, all students give presentations on their projects and any creative techniques they invented. At the end of these presentations I show the competition results, giving prizes for the best project on each topic (e.g. coffee mug or bookstore gift certificate). In the end, not only do I find that this extensive outside work reinforces the related course topics, so that students excel on those portions of qualifying exams (even over a year later), but I also find that multiple students each semester wish to continue their project as an independent study course, involving students in research from early on in their graduate careers.

Teaching Goals

In addition to fostering an enthusiasm toward mathematics, my primary goal when teaching undergraduate courses is for the students to gain a solid mastery of the core concepts and skills, including the mathematical vocabulary and methods of calculation. My secondary goal is for students to understand these concepts thoroughly enough to make generalizations and connections between the mathematical concepts they learn and their studies in other disciplines. My goals in graduate courses differ only slightly, in that I also strive to involve students in research as early as possible, whether they plan to work with me for their Ph.D. research or not.

Although my teaching style is still, and always will be, in development, it has proven successful in the courses that I have taught so far, resulting in excellent teaching evaluations at SMU, UCSD and even as a teaching assistant at Rice. I that hope as my career continues I will find colleagues who will add new and innovative strategies to my repertoire, and who will provide me with critical feedback so that I can grow to become a more effective instructor.