J.T. Webster: Teaching Statement

I believe that the societal, technological, and intellectual value of applied mathematics is indisputable. But I also believe there is inherent value in learning mathematics. Mathematical learning strengthens the ability to think analytically and reason abstractly – making students better writers, problem solvers, and thinkers. Thus, I try to emphasize to my students that mathematics does not consist solely of the application of formulae for the purpose of mechanical computation. Moreover, beyond the teaching of concepts, beyond the imparting of technical knowledge, teaching is about helping students realize their own potential to think critically and to solve problems. I endeavor to facilitate original thought and give students the opportunity to form their own approach to problem solving and analysis.

The principal goal in my teaching is to make students first internalize fundamental mathematical ideas before integrating them into computation and application. I want students to understand what an integral is before trying to compute it. For this reason, in my lectures, I strive to be thorough and mathematically honest. Even at the most basic level, I emphasize justifications so that a student never entirely divorces a theorem or formula from why it holds. This approach helps to eliminate major conceptual gaps in students’ understanding and provide them (when possible) with a linear story. I have begun the practice of giving what I call ‘big picture’ lectures once or twice during a term. In these lectures I try to relate everything we have done up to a given point with the direction in which we are heading.

Ultimately, I have seen this conceptual approach lead to increased retention and foster enhanced computational skills, as students view computation as part of a whole that is mathematical understanding. Moreover, students themselves have been receptive to this approach. In each of the settings in which I have taught I have consistently received positive and high-ranking student evaluations from mathematics and physical science majors, as well as engineering students. As a graduate instructor, I received the annual teaching award in 2012. This award is given for overall excellence in teaching for graduate students, based upon evaluations, submitted materials, and an in-class observation, and was voted on by the entire mathematics faculty.

While at the University of Virginia and in one full year of postdoctoral work at Oregon State University I have taught the following courses: applied calculus for non-mathematics majors, calculus for engineering majors, calculus for mathematics and physical science majors, elementary ordinary differential equations, and matrix and power series methods. The classroom settings at Virginia were small, consisting of usually 30 students. At Oregon State, my lectures were generally sized at 100 students with recitations of 30, each with its own teaching assistant.

I believe my classroom approach and course policies are conducive to accomplishing the goal of conceptual comprehension, as laid out earlier in this statement. I meticulously choose lecture examples that highlight major concepts while simultaneously serving as good computational models for later student reference. I often motivate or reinforce fundamental mathematical concepts with content which may extend beyond the text. This typically manifests itself in small research or reading projects – past examples have included Gronwall’s inequality and applications, the Basel, brachistochrone, and isoperimetric problems, and the one dimensional wave equation. I feel that I must provide a context for the content I present. Painting a broader picture and embedding course material in outside topics allows students to make connections and form a broader perspective. I always try to highlight where course concepts are used in the physical sciences or higher mathematics (e.g., center of mass, Gaussian probability densities, or simple harmonic motion). I have taken to devoting at least one lecture in a course to a physical or engineering application, wherein I relate a real-world concept or investigation (e.g., the dynamics of a bridge) to a recent course concept (simple harmonic motion). As an example, in my ordinary differential equations course, I group students together and ask them to solve the spring-mass initial value problem with damping and forcing. I then ask them to describe the
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solution qualitatively; in the final step, I utilize an in-class computer/projector (and available JAVA applet) to generate a real time movie depicting the spring-mass system they have just solved. In general, I believe it is intellectually satisfying for students to see the content of a course woven into a broader fabric. Because memorization and computation are ultimately important in mathematics, I also assign carefully chosen computational homework sets, wherein students can work many simple problems in order to master mechanics and check their solutions for correctness; however, these sorts of problems are never the primary focus of my lectures, classroom activities, or written assignments. Overall, the focus is to build conceptual understanding, with reinforcement coming from applications to substantial problems in the physical sciences or more advanced mathematics.

Often to my students’ dismay I remind them of how important analysis and exposition are in STEM fields. I firmly believe that students should be expected to analyze what they have calculated (or proven) and explain their thinking. These skills will be expected of them outside of the classroom, and are beneficial in the greater academic and professional context. For these reasons I emphasize writing, justifying, interpreting, and explaining in my courses. I expect students to present their work neatly, explaining their steps clearly (in complete sentences), and often addressing whether or not they think their answer is reasonable. In this way, though their answer may be incorrect, I know they have given serious thought to what they have done and I understand precisely where an error has occurred.

To unify the points included in the previous three paragraphs, I have developed a new practice while at OSU. I provide a supplement to the textbook at regular intervals during the term, which includes linear overview of content, with examples worked in detail and presented as I expect students to present their computations and proofs, and reflections or connections which may have been stated in lecture, but not necessarily written out. This information is entirely supplemental but I have found that students appreciate these packets and make good use of them. I have also seen an increased depth in student understanding and an improvement in the quality of their submitted materials.

Having discussed the specific points of my classroom policies, I should also assert that I believe teachers must always be open to assessment of methodology in the classroom and their policies. I want to adapt as the student populous and the technological setting change. I believe in taking and responding to feedback, and using each new course as an opportunity to improve pedagogically. In attempting to track students’ comprehension, retention, and intellectual growth, I have taken to giving my students the opportunity to provide me with feedback at ‘key’ points in the term. I ask students to report on mechanics of the course, whether or not they are connecting with and retaining material, and also to make suggestions about what types of review material they would like to see.

One area in which I am currently developing and fine-tuning my approach is assessment. I find that effectively incorporating assessment (graded homework, quizzes, and exams) into my courses can be challenging, especially when one does not have much assistance in grading. I must be careful to give myself adequate time to conduct my research and related functions (e.g., grant activities and conference participation). To date, I have made use of weekly quizzes, research assignments, and written and online homework each for a very specific reason. However, I am still searching for the best means of providing feedback to students and accurately making informative assessment in a prompt manner. There seems to be no correct approach in this regard, but I have noted certain tactics do have more success than others; for instance, I find that calculus students often neglect to read comments on graded homework. However, they carefully look at my marks on graded quizzes, owing to their brevity and higher point value. Hence, I make more detailed and specific commentary on these quizzes and provide students with comments about their overall status in my course on the weekly quiz.
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Continuing as an educator, I hope to find an efficient means of assessment that benefits students, while not becoming overwhelming in the requisite grading time.

As a final thought, I would like to mention interactions with upper-level courses and students. Although I have yet to be assigned a senior or graduate level course to teach, I am very excited about this prospect. To date, I have substituted in various graduate and upper-division undergraduate courses such as undergraduate and graduate real analysis, graduate partial and ordinary differential equations, functional analysis, and control theory. I have spent a great deal of time considering how I will structure and teach such courses. First, I believe clarity is the key at any level. The more advanced a course is, the more necessary careful planning is to keep things focused and moving along. I also believe homework is essential to comprehension (at any level), and also, perhaps even more essential at the graduate level, written commentary from the instructor. I believe that deeply thinking about challenging problems is where a bulk of true mathematical learning takes place. Finally, I am very excited about the possibility of working with undergraduates in research. Although my schedule ultimately did not permit it, I had begun preliminary planning an REU project while at Oregon State. In the field of applied PDE there are many opportunities to incorporate undergraduates into the modeling and numerical facets of a problem. Specifically, with regard to the models I work on (occurring in aeroelasticity), there are simplified problems (e.g., a two-dimensional potential flow coupled to a linear beam) that would provide a rich opportunity for numerical study in collaboration with advanced undergraduates. Such work would not only be beneficial for the student, but also provide meaningful results in mathematical aeroelasticity.

In conclusion, I would like to assert that I very much enjoy teaching mathematics, and ultimately, this helps me succeed in imparting knowledge. Students consistently comment on the energy and enthusiasm I bring to my teaching in their course evaluations. It is dangerously easy to disengage students by half-hearted, dry, or disinterested presentations. I do not believe enthusiasm or energy should be faked, but teachers can make a concerted effort to be mentally present, awake, and to show the affection that they have for their material. I think I have a unique and effective teaching style and approach, which encourages and provides for the success of my students. I believe my courses are memorable, and students leave with conceptual retention, computational skills, and having seen a plethora of applications. And lastly, since I attempt to challenge each one of my students at a conceptual and computational level, each leaves my course an improved problem solver. I hope to continue refining my approach in teaching mathematics, always improving my ability to communicate effectively and actively creating an environment where intellectual growth can take place.

\[1\] Selected student evaluations, statistics, and comments are available on my homepage: http://people.oregonstate.edu/~websteju/JustinsHomepageResources.html