Statement of Teaching Philosophy—Jiahao Chen

Good teaching means three things to me: being prepared, going the extra mile when necessary, and motivating students to care. I am lucky to have had many superb teachers over the years, both in university and before. They have shaped how I teach, both in informal mentoring of junior graduate students, and also in formal classroom settings.

One highlight of my time at MIT was watching Walter Lewin record his legendary physics lectures, replete with demos, for television. He later explained his teaching philosophy to me. It was simple, he said: no amount of ideology can substitute for being well-prepared for the classroom, and that meant knowing exactly what to cover in each lecture, and rehearsing the lecture at least twice before delivering it to students. This neatly encapsulates MIT’s signature style of learning by doing: Mens et Manus. He showed by example how the lecture format was far from obsolete for teaching introductory courses—what was often missing was expository clarity and student engagement.

I have also witnessed many excellent examples of lectures at the advanced level. Mehran Kardar’s one year course on graduate statistical mechanics is a masterful example of the art: he answered students’ questions not as interruptions of the didactic flow, but instead as if they were extensions of his originally planned lecture. In graduate school at Illinois, I was shown further examples of how to deliver elegant lectures on complicated subjects: Nancy Makri’s immaculate chalkboard derivations of path integral theories and Nigel Goldenfeld’s elegant presentations of phase transition theory, to name just two. I was also inspired by the dedication of others like Thom Dunning to modernize chemical curricula with the latest insights from physical and theoretical chemistry. These professors are first-rate, living examples of good teachers and good researchers.

My earlier teaching experiences have led me to appreciate how good teaching, at its core, about caring for students as people, and how such empathy helps teachers understand how students learn. Sometimes, empathizing with students means going the extra mile. As a middle school teacher, I found myself going outside the classroom walls to help students succeed whilst coping with personal challenges like parental divorces, gang violence or first breakups. It can also mean helping students achieve their goals, even if we wished for better. As an undergraduate tutor in my dorm, I was thanked by a student for helping him get a C instead of the F he was expecting. It was a sobering experience for me to work with students whose notions of accomplishment were to scrape through with passes.

In graduate school, by contrast, I was fortunate to work with many excellent students when I was a teaching assistant for the physical chemistry sequence at Illinois. In my last years as a graduate student, and also as a postdoc, I have had the pleasure of working with many graduate students in an informal mentoring capacity. I am also part of the K-12 videos project, which funds students to make science videos. I have helped to vet the technical correctness of these videos before public release. From discussing scientific details with student teams, I have also learned firsthand how misconceptions can survive formal schooling. This has made me pay special attention to how these misconceptions can be addressed in coursework or related activities.

As someone with interdisciplinary interests, I value the efforts taken by instructors to set the context of the course, especially in other departments. This helped me stay motivated to understand the material, particularly when faced with unfamiliar jargon.

Numeracy for everyday life  The typical person on the street views mathematics as hard and incomprehensible. Yet mathematics and statistics are integral to modern life, being responsible for formulating such aspects of everyday life as lotteries, elections, traffic networks, and markets. This has led me to think about how, as scientists and educators, we can promote numeracy and scientific literacy and awareness in all students, majors and non-majors alike, and in particular their ubiquity in modern life.

I have been inspired by a new and immensely popular Harvard course entitled “Science and Cooking: From Haute Cuisine to Soft Matter Science”. Not only does this course cover many topics in physical chemistry, but it also exposes students to the scientific hypothetico–deductive method and the essential rôle mathematics plays in the formulation of models in the physical sciences, and the utility of statistics in analyzing experimental data and testing hypotheses. The possibilities for contextualizing mathematics and statistics, of course, extend far beyond the kitchen and into the modern world at large. Real–world examples include:

- dynamical singularities and positive feedback in asset bubbles, as famously illustrated by the Dutch tulip craze and the $23 million book on Amazon [1],
- Bayesian models for predicting the outcomes of elections, [2]

• the geometry of orbifolds and their applications in explaining chordal progressions in classical music, [3] and
• the universality of the statistics of bus arrival times. [4]

Including timely material of this nature will form an important part of the coursework that I plan to teach to students specializing in mathematics and statistics. These examples can also serve as motivating context for courses for nonspecialist students in other disciplines such as science, engineering and business fields.

Computer-aided learning for advanced courses  Mathematics education faces a unique challenge in bridging the gap between the vocational application of mathematics for calculations and the rigor of mathematical abstractions and the logic of formal proofs. Much of the divide can be bridged with using computer algebra software to sidestep tedious algebra in favor of direct numerical calculations. Such approaches have long been used in the computational sciences, and has also been used in such mathematical proofs as the four–color theorem. Computational projects could be assigned as homework in a graduate course, or as multiweek computer lab projects at the upperclassman level. These help students to tackle problems that are not manifestly contrived to have easy solutions, and hence to have a more realistic experience of working on scientific problems. They can do calculations sophisticated enough to revisit theoretical concepts from earlier courses to integrate learning across the entire curriculum. Such experiences pave the way toward further advanced electives that I could teach: electronic structure theory, classical molecular dynamics and quantum dynamics, and random matrix theory. Lastly, familiarity with numerical computations is an increasingly valuable skill within academia and also in industrial settings.

Coursework I can teach  My interdisciplinary background in chemistry, physics and applied mathematics has exposed me to a wide variety of scientific and mathematical training, which I expect will allow me to develop unique course offerings. In addition to standard mathematics courses in the calculus sequence, I would also be capable of teaching courses in numerical analysis, mathematical methods in physics, scientific computing and programming. I am also interested in offering graduate coursework in specialized topics such as electronic structure theory, quantum dynamics, and random matrix theory.

References


