Stefano Profumo (Physics)- Statement of Teaching Philosophy

I was very intimidated when I started teaching at the beginning of my faculty appointment at UCSC. I came from a college and graduate school experience, in Italy, where one would never question, or often even approach, the Instructor; no feedback was asked or given; no homework, no midterms: the interaction was limited to an hour-long oral final exam. The different teaching philosophy and style I immediately encountered here presented me with quite a cultural shock, and I soon realized that I had to learn a whole new skill-set.

With the challenge, slowly but surely, also came the rewards. I resonated with the different approach to teaching. I realized that I was truly passionate about sharing with my students both my knowledge of physics and mathematics as well as the enthusiasm I feel about these topics. I strived to listen to and to understand my students' issues and concerns, and to learn from their feedback. I started to develop an approach to teaching, described in what follows, that students seemed to increasingly appreciate and value: the appraisal for my Mathematical Methods for Physics (116A-B) course as "*overall learning experience*" went from about 45% of "*Excellent*" in Winter '08, to 65% in Winter '10, to 85% in Winter '12.

A key aspect of my teaching style is to deliver engaging, high-quality lectures. I have never received any formal training in teaching, but I have always been curious as to why certain seminar and colloquium speakers are so much better, more exciting and engrossing than others. I decided that, just like learning to ride a bike, it was a matter of understanding key points in the "art of presentation", and of a lot of trail-and-error. I started studying how successful presentations are prepared and delivered. I eagerly read books like "When the Scientist presents", but also like "The Presentation Secrets of Steve Jobs", and pondered over how that *excellence* could be transferred and add value to my lectures.

I believe a well-organized, engaging lecture is one that possesses a *core topic*, clearly outlined at the beginning of class, together with a motivation as to why we care about it and how it is relevant. I try to put the core topic's relevance in perspective at various levels: for the course itself, for physics more broadly intended, and, crucially, for current research. This is accomplished with examples during the course of the lecture, when possible at all three levels, to reinforce the notion that we are learning something of value. The lecture is concluded circularly, reiterating the key take-home aspects of the core topic. I consider reaffirming important concepts multiple times one of the most effective approaches to transfering knowledge.

Each course I teach presents unique challenges: striving to draw connections from Newton's mechanics to cutting-edge particle physics research; engaging students in a course on Mathematical Methods, that many students assume is full of "dull topics", through a diverse set of exciting physics examples; helping our first-year graduate students through the delicate transition into graduate school (this includes an yearly workshop on successful graduate fellowship application preparation); finding the optimal balance between individualized attention and collaborative learning during office hours, especially for courses with large enrollments.

Experience, time spent in the classroom, and the feedback from my students keep helping me to improve my teaching skills, and have prompted me to test sometimes innovative practices, at both the undergraduate and the graduate level. Every time I start a new class I like to think that I will both deliver a better set of lectures and that I will be experimenting with something new in how I organize my classes. Talking with colleagues about their teaching strategies and eagerly attending the many campus events and colloquia on teaching techniques and skills are key resources in this challenging, yet stimulating endeavor.

In my undergraduate instruction, I have often experimented with my own versions of "Collaborative Learning", a practice I had first heard of at a Physics Colloquium: for example, the weekly discussion sections, ordinarily consisting of the TA solving problems at the blackboard, were turned into group meetings where students got together in groups of 2-3 and solved exercises assigned by the Instructor. Both the TA and myself were typically present at the Collaborative Learning sessions, moving from one group to another, and giving feedback and help to the students as they worked on the assigned problems. In some courses, attending Collaborative Learning was awarded a few points in the final class score, a practice that made session attendance close to 90%. Other examples of practices I have been experimenting with are "Weekly Quizzes" in discussion sections in the undergraduate classes, "Reward Points" for interactive participation in discussions during sections, and, at the graduate level, promoting oral presentation skills by asking students to present their weekly homework at the blackboard in front of the class.

The style of my graduate teaching is guided by three criteria:

a. Stimulating the curiosity and interest of students for current research topics, and trying to spark new research out of the material being discussed;

b. Striving to illustrate the theoretical concepts presented in class with applications to issues of cutting-edge relevance or of significant historical interest;

c. Trying to introduce the students to the practice of doing scientific research.

One of the practical ways in which I implement (a.) and (c.) is to ask students to present their weekly homework assignments to their peers in the form of an oral, blackboard-style presentation: I believe that orally explaining science to others is a skill that can and should be learnt by anyone interested in successfully pursuing scientific research. Students particularly appreciated my emphasis on (b.) in both my Quantum Field Theory and Classical Mechanics courses, where often the intricacy of the theoretical setup fogs up the physical meaning and the implications of the matter under discussion.

An important aspect of my teaching philosophy is the notion that at UCSC the faculty are doing cutting-edge research. We are not telling a story that others are writing. We are co-authors (sometimes first authors!) of that story. And although we are not re-discovering matrices, complex numbers and classical mechanics, we know first-hand why all those things are important – crucial! – to tackle questions in contemporary research. Fourier transforms are what we use to calculate how much dark energy and dark matter contribute to the energy budget of the Universe; the Lagrangian function we write down for a simple harmonic oscillator is the same we use to quantize particles in quantum field theory, and to understand how electrons and protons (and particles yet to be discovered, like the one making up the dark matter) behave at the most fundamental level.

The first thing I do in class at the beginning of the quarter is to present in quite some detail my research and the work of my close collaborators, especially my graduate students; I then always ask my TAs to talk about their own research. Every week I introduce the topics of the weekly Physics and Astronomy/Astrophysics colloquia. It is my strong believe that much of the value added of getting an education at UCSC comes from having such a formidable research environment.

My constant efforts to bring research in the classroom have many benefits, including for my own scholarly activities. For example, I recruited many excellent undergraduate and graduate students out of my classes, all genuinely curious about my work and eager to start doing research with me. It is perhaps the best possible compliment when students ask me to join my group and to get involved in the very research I tell them about in class.

My experience as a teacher at UCSC is unfolding as a truly fascinating journey. One that started with some trepidation and which has now turned into one of the main reasons why I am so excited and professionally fulfilled by being a faculty member at UCSC.