Teaching Statement

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"The movement of the swimmer does not resemble that of the wave; in particular, the movements of the swimming instructor which we reproduce on the sand bear no relation to the movements of the wave, which we learn to deal with only by grasping the former in practice. We learn nothing from those who say: 'Do as I do.' Our only teachers are those who tell us to 'do with me,' and are able to emit signs to be developed rather than propose gestures to reproduce." — Gilles Deleuze

1. My Teaching Philosophy

As a student, I did not understand the method of images. In office hours, my professor kept telling me it was trivial. I felt so frustrated that I asked, "Have you forgotten what it feels like to learn?" Years later, having written papers applying the method of images to problems in quantum gravity, I keep a promise to myself that I will never forget what it feels like. In my teaching, I strive to make difficult, abstract concepts intuitive and concrete, strip away unnecessary jargon, think from the beginner's perspective, and always do the physics with my students. I see physics as an expression of the human spirit, and I re-experience the joy of discovery every time I teach. I believe that by doing physics we learn not only about the world, but also about ourselves.

At the same time, I am acutely aware of the potentially alienating dynamic that can exist between a professor and their class. To the extent that my station allows, I try to create a more equitable model of learning that empowers the student. I hold that the teacher's role is to act as a guide and maintain conditions that are favorable for learning. I aim, therefore, to blur the boundaries between teaching and learning, and encourage active engagement from my class.

My teaching philosophy rests on several principles. (1) Foster an inclusive, friendly community and a collaborative spirit. (2) Support cooperative, active learning: emphasize questions, dialogue, and students' agency. (3) Treat the classroom as the site of apprenticeship, rather than discipline, and a space where knowledge is generated rather than transmitted. (4) Exhibit generosity and compassion, and strive to be approachable and accessible, while pushing students to hold themselves to high standards of rigor and depth. (5) Uphold students' sense of confidence and tenacity. Repeated failure is necessary and should not be discouraged. (6) Approach teaching multimodally, integrating equations, verbal arguments, visual aids, and experimental demonstrations.

2. Experience as a Teaching Assistant

Over the past five years, I have taken an energetic approach to these ideas in TAing nearly two dozen courses across all required subjects in UCSB's physics major. By leading discussion sections in lecture-style (review), recitation-style (problem solving), open floor (Q&A), pair share, small group work, and student presentation formats, I have gained experience with many styles of teaching. I have also taken an active role in course administration, including by writing and grading homework

and exams, moderating online discussion channels, communicating students' concerns to professors, and writing syllabi. When students struggled during the pandemic, contending with unfavorable time zones and learning environments, I accommodated their circumstances by holding extra office hours at night and ensuring that classes were administrated equitably. My teaching evaluations, which are available upon request, have consistently received top ratings and glowing praise from students, and I have been nominated for and won several teaching awards at UCSB.

More recently, I served as the teaching assistant for a 20-student, two-year-long introductory sequence at UCSB's College of Creative Studies (CCS). In CCS, students submit homework in two passes, using feedback from the first pass to fix their mistakes in the second. In discussion sections, students volunteer to present their solutions to the homework problems at the board. Everyone engages in discussion, and I guide the conversation by asking questions meant to challenge the presenter. There are no letter grades and no exams, except for an "oral review" conducted with each student individually. The course emphasizes assessments that encourage exploration, clearly indicates what students need to do to succeed, provides constructive feedback on their work, hones their presentation and communication skills, and treats them as motivated and responsible adults. These ideas made a deep impression on me, and will guide my future course design.

3. Experience as an Instructor

In the spring of 2022, I took a graduate course on teaching and pedagogy. I wanted to improve my teaching, learn about best practices from education research, and prepare for an advanced course on classical mechanics and special relativity that I had asked to teach as the instructor. The pedagogy course is also part of my portfolio for UCSB's Certificate in College and University Teaching, which I expect to complete in the spring. During the class, I studied aspects of course design and evidence-based strategies to put pedagogical principles into practice. By the end, I understood how to make classroom choices that facilitate learning and make physics enjoyable.

I taught the mechanics course that summer following Taylor's *Classical Mechanics*, although I wrote the course materials from scratch and tailored them to my class as the course progressed. Initially, I struggled with the wide variability in the class's preparation. To make sure no one started off too far behind, I spent the first few lectures laying a common conceptual and mathematical foundation. I also developed an informal lecture style, inviting many questions and often asking them myself, ensuring that no one dominated the room or felt left out. Since students tend to ask questions in bursts, emboldened by their peers, my lectures naturally flowed in cycles of "dry" lecture followed by Q&A and broader discussion. This pacing helped to reduce cognitive load, and when I asked for feedback, many students said that being able to interrogate the material made them feel personally invested. I also administered a two-stage midterm, where the class worked on the exam first individually, and then in small groups. Students overwhelmingly found it helpful to get immediate feedback on their work and see alternative approaches to the problems.

4. Mentorship and Advising

Outside of the classroom, I have also worked closely with undergraduates in an advising role, for example through the Undergraduate Diversity and Inclusion in Physics club's mentorship program. I also regularly speak at panels for undergraduates dedicated to issues ranging from impostor syndrome to grad school applications and career advice. But it was only during a research project with Frazier, an undergraduate in my advisor's group, that I realized the unity of mentorship, teaching, and research. Frazier and I met every week and worked together closely on every aspect of our project, from grueling calculations to drafts of the paper we eventually published. I also advised Frazier as he applied to graduate schools; he is now studying high-energy theory at UC Davis, and we still regularly talk about physics. I hope to uphold this unified vision of mentorship and keep up the same level of zeal in my future roles as a mentor and advisor.

5. Principles and Practices in My Classroom

General principles. I believe that concepts take precedence over equations, and while deriving key results I emphasize why each step is taken. My task, beyond the delivery of content, is to teach students to think critically about *doing* physics. To keep up with the pace of modern physics, we must prepare our students to deal with change and to respond creatively to new situations where old paradigms fail. To reinforce this skill, I write homework problems that ask students to re-derive modified versions of results from lectures. I also offer open-ended, and sometimes ill-posed, challenge problems designed to stimulate critical thinking rather than elicit a correct response. (For example: why are q and $\dot{q}$ treated as independent variables in Lagrangian mechanics?) Of course, "think like a physicist" can sound vague and intimidating to some students, but like all practicing physicists, they learn to do so by allowing themselves to be challenged. It is my job to cultivate academic tenacity in my students and provide a safe environment where they feel included and comfortable with confronting the challenges necessary for them to grow.

Classroom innovations. In terms of course design, I plan to synthesize a traditional format of lectures and small-group discussion sections with some of the strategies I have seen at UCSB and described above. I plan to implement two-stage exams and a two-pass homework system, and I hope to use some of the discussion section time for student-led problem solving at the board. For more advanced topics courses, I may assign final projects instead of giving an exam, especially given the importance of writing proposals and scientific reports. Finally, I aim to introduce a feature of the courses I TA'd that saw great success during the pandemic—an online forum where students could freely discuss the course material. This Discord-style channel acted as a class group chat: it provided a natural mode of communication for students of a chronically online generation, and also served an important social role in bringing the class together.