Teaching Statement

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For engineers and experimentalists, the most exciting moment is when we can prove theoretical conjectures through a series of well-designed experiments. However, this process forms one of the most challenging parts for the development of an effective teaching practice to bridge the classroom-based learning with hands-on research. My classroom goals for students are to (1) establish solid theoretical foundations, (2) develop hands-on skills and apply theories to practical applications, and (3) foster critical thinking and stimulate innovations. I have developed these goals through my prior teaching assistant experience in two courses at Rice University, Undergraduate Course: Quantum Mechanics for Engineers and Graduate Course: Optoelectronic Devices, and this experience frames my view of teaching.

Theoretical Foundations. Theories and concepts are at the highest level of the teaching hierarchy. These form the very first things I will teach students, since they are the foundations of understanding. The behavior of electrons, photons, and their interactions in solids governs the operation of modern optoelectronic devices. Despite the different nature of these two fundamental particles, an underlying link highlights the similarities. Moreover, wave-particle duality defines the length scale where quantum mechanics starts to play a role, and that is generally important on the nanoscale. However, the (semi-)classical description is typically more intuitive and instructive toward understanding and developing applications. Based on my past experience, learning by analogy between electrons and photons, and by the combination of classical and quantum mechanical treatments turns out to be a very effective way to understand fundamental concepts. Furthermore, focusing on the big picture can ensure a lasting impact on students, even if memory of quantitative formulas may fade away. When exploring the dark unknown territory of scientific mysteries, students are still well-equipped to light their way toward unconventional innovation.

Toward Applications. At the second level, examples of traditional devices can demonstrate how the theories and concepts are applied to concrete situations, and how the "learning by analogy and through different views" strategy is employed. For example, when I discussed integrated dielectric optical waveguides in my guest lectures, I introduced two different perspectives: classical Maxwell equations for waves and the analogy of the Schrödinger equation in quantum wells for electrons. This relieves students of memorizing complicated transcendental equations, and instead allows them to focus more on understanding the underlying physics. A generalization, such as coupled waveguides or a periodic array, can be included either in class discussions or through take-home assignments. Students can practice evaluating and critiquing current devices, finally designing optimized devices. I believe it can make students aware that the development of modern technology is deeply rooted in the fundamental principles they have learned.

The unique goal for experimental optoelectronics is to realize the innovative design, through a combination of state-of-the-art nanofabrication techniques and electrical/optical characterization. Several introductory lectures can help students understand the basics of those techniques, and more importantly, lab visits and hands-on experience can sharpen students' skills for future endeavors.

Beyond Imagination. At the third level, it is good timing to stimulate students' bold imagination by introducing cutting-edge research in my field. The topics are selected under the framework of taught concepts, and students are encouraged to form small groups (e.g. 3 persons) and choose one or two topics. I would like students to review literature critically to define the unresolved issues, and apply the theories, concepts, and techniques to propose solutions. Through final oral presentations and written reports, students can summarize their discoveries. I believe this comprehensive training is beneficial to students in a wide spectrum of their endeavors. This can help them foster critical thinking to identify real practical problems, learn how to work collaboratively to come up with solutions, polish their communication and presentation skills to express their ideas succinctly and clearly, and practice writing skills for a broader readership. I have successfully demonstrated the effectiveness of these guidelines when I mentored several undergraduates during my PhD and postdoc. Impressively, one of the undergraduates I supervised coauthored a high-impact publication with myself as the corresponding author. Another supervised student was admitted into a prestigious PhD program at Stanford University pursuing his continuing interest in optoelectronics. I am proud that my mentoring strategies have worked well for students' success, and I believe the transfer of such experience to the classroom can benefit more students and stimulate their interests to be self-motivated researchers throughout their learning process.

I am excited to implement these goals in a series of introductory and advanced courses on *modern optoelectronic devices*. The first part can focus on the in-class lectures, delivering fundamental concepts and typical applications. The second part can focus more on the hands-on experience in a real lab and advanced topics for group projects. I would also be very happy to teach related courses like *electricity and magnetism, optics, electromagnetic theory, solid state physics, semiconductor materials and processing, physics of semiconductors,* and *device physics.*

Inclusivity. My core teaching and mentoring philosophy can be summarized in one word – inclusivity. This is embedded in the strategies I use such as stimulating learning and active learning to create a dynamic classroom, and this also tailors my teaching to maximize student engagement. I believe it is vitally important to limit the amount of lectures, where the instructor is the only one talking, and rely more on interactive discussions to foster active participation. However, the most challenging aspect is to solve the pedagogical "one-size-does-not-fit-all" problem. I have experienced this challenge when I mentored a variety of students doing research. They have different backgrounds in physics, electrical and computer engineering, chemistry, and materials science. They have various levels of prior knowledge on the subject, ranging from undergraduate, master, and PhD students. They even come from different education systems, such as differences in teaching and learning style found in the East vs. the West.

We face a similar scenario in the modern diverse classroom. The first thing I would like to start my classes with is asking students to take a carefully-designed entrance survey, including several quick multiple-choice questions and short in-class discussions. This survey aims to learn about their prior experience, figure out their misconceptions and confusion, and discover their expectation for the syllabus. This also helps me to design the lecture materials to facilitate understanding by translating concepts across disciplines and different backgrounds. Moreover, it aids in creating a unique classroom chemistry to optimize the learning process for each individual student.

Assessment. Student feedback is one of the most valuable assessment tools for evaluating not only students but myself as a teacher or mentor. This can be implemented, for example, by a collection of surveys throughout the semester, in the form of quick quiz questions, votes, and peer discussions. And, it can build an effective communication channel with students so that I can help myself adaptively adjust my teaching strategies. Through this feedback loop, I can continually sharpen my teaching abilities and deliver a deeper understanding to my students.