Teaching Statement

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I met recruiters from Samsung electronics company during my college and graduate school. The recruiters consistently told me that Samsung likes to hire people with physics major because their employees with physics major tend to perform better in multiple technical positions than those with engineering degrees put in a position different from their specific majors. They think physics graduates have a better problem-solving ability. I think that the problem-solving techniques are the result of a logical thinking process that physics education promotes. My teaching philosophy centers on fostering the logical thinking process. My role as a teacher is to guide students through challenging physics concepts and problems using a variety of methods to become an independent scientist and thinker.

I believe that physics is rooted in questioning and explaining what is happening around us, and we use mathematics as a tool for describing what we understand. If Galileo did not question the validity of Aristotle's theory of falling objects and/or if he watched a hailstorm without his question in mind, he would have not unveiled the true theory of falling objects. Later, Newton wrote it elaborately using mathematics. This represents what physics is about: questioning, explaining, and describing. I want to introduce such stories in class so that students naturally learn what physics is about and how the thinking process flows in great-minds like Galileo and find a connection to real-life. They can even enjoy the small stories and may become more interested in physics.

I want to foster students' questioning and explaining attitude. Instead of insisting that students ask questions or explaining things voluntarily, I ask them questions that they should spontaneously express their thoughts. During my teaching assistant at Iowa State University, when students ask me to help them get right answers, instead of simply giving answers I guide them with questions, such as "why do you use this equation here?" or "why did you put this apparatus at this position?" This gives students time to think about what they did and why they did it, and they explain their reasoning in their own words. This is a good practice of the questioning and explaining attitude. After a series of questioning and explaining, students start to ask my help by *explaining* their reasoning, which means that they *question* themselves. Students often find errors in their reasoning and learn by themselves while they speak.

Yet, students also need a step-by-step guide. I realized from students' evaluations that my method was lacking this approach. When I mentored a graduate student at the University of California at Berkeley, I practiced more of a step-by-step teaching. The graduate student was writing a journal paper, a big part of his Ph. D. thesis. When he was finally able to answer all my questions and explain his understanding of physics, he still had difficulties in expressing them consistently and articulately. He needed a step-by-step learning of how to organize his thoughts and write a scientific report. I sat down with him and went through his paper together from one figure, one equation, and one sentence to the whole paper. We did this for a couple of hours a day for 2 weeks in total. His paper was published in Physical Review B with editor's suggestion. I believe that he took a step forward to be an independent scientist through this experience.

I have used various teaching methods that are suitable for individuals as well as groups of students. I prepare problems which are more conceptual and whose solutions are simple, ask students to come up to a blackboard, and solve it while explaining to their peers. At the end of every week, I prepare quizzes to test their understanding using problems that are similar to those they already practiced in class. To encourage a group work, I give students a big blank paper or a large portable whiteboard during a recitation class, and 3~4 students make a group and work together on the same paper/whiteboard. At the end of the semester, laboratory class students are asked to present one of their group results in front of the class.

Students come to a class with different educational backgrounds so that everybody learns differently from different methods. The key for students' better learning is understanding that they have different ways of learning. Students nowadays are much more visual that they grow up with videos. I plan to use more visual aids such as computer simulations (e.g. Wolfram Demonstration Project) and video clips of experiments (for instance, "Brian Cox visits the world's biggest vacuum chamber" on YouTube demonstrates the free fall experiment beautifully.) I also want to provide a laboratory course, if applicable, that provides only the objectives of experiments. Students themselves design and perform the experiments with minimal help from instructors then write a scientific report that is similar to a journal publication. If time and fund allow, I want to organize a field trip to a large-scale facility such as Argonne National Laboratory. Alan Goldman at Iowa State University, who became my Ph. D. advisor after a field trip, brought me to the advanced photon source at the beginning of my second year in the graduate school. The trip truly encouraged me to be a scientist and work in the x-ray and neutron scattering field. I am certain that seeing and being in such scientific facilities will promote students becoming a scientist.

I understand that there are many more effective teaching methods that I have not yet encountered. I will keep interacting with students, learning their needs, developing new teaching methods, learning different teaching approaches from fellow teachers, and incorporating them in my teaching to provide a better learning environment to students. I want to help students to understand physics concepts, improve their problem-solving techniques, and develop a logical thinking process. I want to make physics more relevant to their everyday life.