Mentor the Researcher, Not the Research: An Essay on PhD Mentoring

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During my Penn career, I have mentored more than 30 students and postdocs and almost all of them have become professors, matching their professional aspirations before joining Penn. While there are many approaches to PhD mentoring, I would like to offer three fundamental aspects of my mentoring philosophy.

Student-Centric Mentoring

There are two primary models of PhD student mentoring: project-centric mentoring and student-centric mentoring. In project-centric mentoring, the professor has a research project from a sponsor and then recruits graduate students specifically for that project. The project is well defined, has clear scientific objectives and deliverables (depending on sponsor), and the PhD student performs research toward realizing the goals of the project. This model serves many PhD students and their mentors extremely well and may be ideal for mentoring undergraduate research.

For my PhD students, however, I have always chosen student-centric mentoring, where the primary mentoring emphasis moves from the research project to the doctoral student, from the research to the researcher. While the project-centric approach emphasizes the research project and meeting deliverables and deadlines, which are critical to the sponsor and research supervisor, the student-centric approach focuses on reaching the maximum potential of every individual PhD student.

I have adopted a student-centric mentoring philosophy for two reasons. First, every doctoral student is different. Some are more theoretical, some more experimental, some more creative, some more organized and some more collaborative. Hence, getting the most out of every PhD student requires finding the right project for the student, not the right student for the project. This approach has worked particularly well for my group, which has about 15 members and is well funded from various agencies. Having a variety of qualitatively different projects is perfect for student-centric mentoring as I can focus on which research area (or combination of areas) can best develop the unique strengths of every student.

Second, while project-based mentoring focuses on producing great research, student-based mentoring focuses on educating great researchers, with great research being almost a byproduct. This approach ensures that the student will be producing great research after their doctoral thesis. Student-centric PhD mentoring is the ideal integration of education and research, which should be our focus in premier research universities.

Of course, it is entirely appropriate to consider more hybrid models in which a mentor begins with a more project-centric approach before transitioning to a more student-centric approach as the mentor comes to know more about the student's technical strengths and intellectual interests.

Promote Research Independence

Promoting research independence for PhD students is related to the previous point but it deserves to be explicitly discussed. It is possible for mentors to present their student with a research problem and allow the student to work toward a solution and present that solution to their mentor who can then set new goals for the student until enough progress results in a doctoral dissertation.

While this process may result in great research, the student has not learned to set their own research goals or to choose or formulate novel problems on their own. This inability may prevent students from becoming future research leaders. In my view, PhD students should graduate not when they can solve their mentors' research problems but when they can define (and solve) their own novel research problems.

Independence is a critical aspect of my mentoring philosophy because many members of my group want to pursue an academic career. Therefore my mentoring objective is to prepare them to think like leading academics after they graduate. To take on the role of research leader, they must learn to define their own research problems and chart their own research agenda.

Problem formulation is a difficult skill. Younger PhD students tend to quickly skip problem formulation so that they can proudly present their latest brilliant solution. Students are surprised to find out that most of my questions focus on problem formulation, model justification, relationship to existing literature, changing assumptions, or connections to more distant fields. Then I frequently ask, "Who cares?" so that students develop a sense of how to choose a direction that will have impact. Once I am convinced about problem formulation, novelty and importance, then I am more than happy to discuss technical approach and results. Over time this style results in the student inheriting a taste for research problems from their advisor. This is one of the finest and most gratifying moments of PhD mentoring.

Faculty are not just mentors of doctoral students, they are also researchers themselves. Frequently, these two sides of every faculty member can be in conflict. In many meetings with doctoral students, faculty discuss a research problem and, because they are experienced researchers, already have a good idea of how to proceed. While giving students a research problem and roadmap will be great for the research to progress, it would not be the best mentoring strategy for the students' career. Allowing PhD students to find their own answers can be frustrating for faculty if the research is time-critical, or needs to meet tight conference deadlines or program deliverables, or if the idea is so exciting that the faculty is personally eager to complete the research. In this conflict, I have always chosen in favor of the doctoral student and being patient, even if this means missing a conference deadline. I have always mentored the researcher, not the research.

Create an Intellectual Environment

While one-on-one meetings between the doctoral student and the faculty advisor are important, they should not be the only source of mentoring. Mentoring also happens when the advisor creates a vibrant intellectual environment. Doctoral students learn a lot from senior PhD students, postdocs, peers, collaborators, program managers, and visitors. Hence, frequent group meetings, seminars, social gatherings, conferences, collaborations with other faculty and students, and discussions with industry and government leaders all shape the research personality of every PhD student.

My group is predominantly theoretical but we collaborate closely with experimentalists, industrial researchers and other theorists. Given the nature of our research, I am a strong believer in research centers with shared space where many students across many groups constantly collaborate. I have been very fortunate that the GRASP (General Robotics, Automation, Sensing & Perception) lab, one of the premier robotics labs in the world, has provided such an intellectually nurturing environment for my research group.

Many great research ideas have originated in the GRASP lab corridors where students and faculty meet face-to-face for intellectual exchange. The best part of my day is when, after a corridor discussion, two or three group members have a fantastic idea and demand to see me immediately and discuss it. All my former students are now trying to recreate the magic of such space in their institutions.

It is important to acknowledge that there is no single mentoring philosophy that is ideal across different research areas, group sizes, funding profiles, or academic age. What I have described has worked very well for me, and more importantly, for my students. What pleases me most is when I see my former students approaching PhD mentoring in a similar manner as academics themselves. This is, after all, the biggest influence my PhD advisor had on me.

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This essay continues the series that began in the fall of 1994 as the joint creation of the College of Arts and Sciences, the Center for Teaching and Learning and the Lindback Society for Distinguished Teaching. See www.upenn.edu/almanac/teach/teachall.html *for the previous essays.*