

Mentoring philosophy

The opportunity to mentor PhD students is truly one of the powerful motivations for being a faculty member at a research university. For me, it was one of the important factors in choosing to join the Pitt faculty over thirty years ago. The satisfaction of seeing a student transform from a good classroom student into a world-class researcher is hard to express.

My overall goal in mentoring goes beyond the completion of the degree. My goal is to help students develop the curiosity that will motivate them for their career. Long-term success in research is driven as much by being able to ask interesting and important questions as it is in developing answers to them. Thus, my mentoring includes both how to discover questions and how to find answers to those questions. As a result, my mentoring activities extend well into the student's post graduate careers.

Students usually enter a doctoral program with only a vague idea of what it means to be an impactful and accomplished researcher. Thus, my mentorship often begins before students have decided to join the PhD program. I have had innumerable conversations with people who think they might want to seek a PhD to make sure they understand what the experience is, what the goals are and whether this is right for them. The main point I wish them to understand is that PhD study is fundamentally unlike any other that they have done in their lives to this point, and that it involves changing how one thinks in addition to learning new or enriched content.

The students that I accept are ones that have an interest in interdisciplinary research, especially topics that span regulation, economics and technology. In the Dept of Informatics and Networked Systems (DINS), students are only admitted if an advisor agrees to work with them. Thus, my work with students begins before they are admitted because I must evaluate whether they have the interest, background and mindset for interdisciplinary work. I discover this through the evaluation of application materials as well as pre-admission interviews.

This kind of research requires a program of study that is carefully tailored to each student's interests, strengths, goals and background. Thus, my mentoring process begins with a discussion of the student's career goals as well as general aspects of the topics that they might be interested in pursuing. The outcome of these early sessions is a highly personalized plan for courses to take and research to pursue in support of their Preliminary exam. (The Preliminary exam in DINS requires, in part, that the students submit and defend a research paper.) Consequently, it frames the first joint effort that we engage in.

My research life has been motivated by an understanding that interesting questions are often more valuable to a researcher than interesting answers. As an interdisciplinary researcher, I

have been well served by using lateral thinking (i.e., thinking across disciplines) to develop research questions. Since lateral thinking is not something that you learn in a course, I have used the Preliminary exam paper process as my first opportunity to model this. I provide readings outside as well as inside the telecommunications area to help concretely demonstrate how lateral thinking can work for a topic they are interested in.

The next milestone of the PhD process is the comprehensive exam. In DINS, students must prepare and defend a tutorial paper that is exclusively their work. The beginning part of this paper must situate the topic of the tutorial, which is an opportunity for the student to demonstrate these lateral thinking skills. The remainder of the paper describes the topic of the paper in depth and, finally, connects it to possible research topics. Since this must be the student's own work, it is a good opportunity for me to assess their progress in thinking across disciplines. Consequently, the analysis of this paper contributes to the agenda for students going forward.

The completion of the comprehensive exam marks an important transition. At this point, the student begins to sharpen their focus on their particular research questions and topic. It is at this point that we can iterate on developing observable interdisciplinary research skills. To promote that, we read broadly in related literatures. I then ask the student to develop mini-research proposals (about 1 page in length) in which they briefly describe a question, explain why it is important and what literatures it contributes to and draws from, describe one or two possible research methodologies they could use to study the question, describe what data (if applicable) they would need, and then briefly describe what they would expect to learn. We then discuss their strengths and weaknesses. By keeping these short, the student can iterate through many of these and develop the skills needed to ask and evaluate research questions of an interdisciplinary nature. I use this process regardless of whether a student is supported by a research grant that has expected outcomes.

The ultimate outcome of these mini-proposals is that the student begins to focus in on a research topic that has an appropriate depth and breadth and that can be completed in a reasonable amount of time. As the student formulates their dissertation proposal, I encourage them first to produce a broad set of related research questions related to their topic; they will select a small number of these for their dissertation, and the remainder may prove useful for their research career beyond their PhD. From their research questions, the students then develop a set of hypotheses that they will evaluate in their dissertations. These hypotheses drive the research methodology, analyses and data that will be used in the dissertation.

Diversity has been an important aspect of my PhD mentoring goals. Work in policy and economics benefits substantially from diverse viewpoints and backgrounds. Thus, I have had students from many countries (US, China, Colombia, Ecuador, Korea, Thailand, Taiwan and Saudi

Arabia). I have actively sought out women who were interested in this field, and was successful in attracting and mentoring four. I was successful in recruiting one black student and three Latinx students.

I remain in touch with many of my PhD students and, often, continue to work with them as they progress in their careers. By way of example, just last year I co-authored a paper with two of my former students, one who completed his studies in 2001 and the other in 2009. I continue to pursue joint projects with Junseok Hwang; together, we have been seeking to establish research relationships with his university in Korea.

Mentoring has changed me as well. I have learned much from my students; for example, my student Arnon Tonmukayakul introduced me to agent based modelling, an approach that I employed with other students for many years afterwards. Another student, Amer Malki, prompted me to study Blockchain systems from one of his mini-proposals. Still another, Marcela Gomez, introduced me to the theory of matching markets that has transformed my understanding of market theory.