Working between disciplines

A common criticism of science and engineering PhD programs is that they train students in one narrow field. The engineering physics program at the University of Virginia, where I am a student, defies this criticism. Instead of a fixed curriculum, students take four physics, four engineering, and two mathematics courses—the exact topics are up to them—and choose an advisor in any science or engineering department. As a result, each student has a unique combination of coursework and research training. Interdisciplinary programs, such as engineering physics, create opportunities and challenges, technically and interpersonally.

Although interdisciplinary work might seem like a new concept, many programs are surprisingly long established. University of Virginia founded its first PhD-granting engineering program in 1952 with the establishment of engineering physics. Notably, Willard Gibbs earned his doctorate in applied science and engineering, the first engineering PhD degree in the United States, in 1863. The undeveloped state of science and engineering research at that time necessitated early interdisciplinary programs. Now, they are needed to bridge highly developed individual disciplines that each require extensive experience.

Interdisciplinary students face challenges communicating across disciplines and departments. In my experience, these challenges begin on the first day of class. Almost all of my classmates belong to more traditional programs. Because they already knew each other, they shared several core classes and quickly formed study groups. Interdisciplinary students must either work to connect with their classmates or quickly develop good personal study skills.

Communication challenges also appear during research. Students in my program often work on research projects that are outside the core competency of their group. For example, I work in the materials science and engineering department, but perform fluid dynamics simulations to optimize vapor deposition performance. Although deposition conditions significantly influence the coatings, our group members typically focus on the resulting material properties and behaviors. This creates a communication gap that both sides must work to overcome. Interdisciplinary students must understand subjects beyond their immediate discipline and be able to communicate results to experts and nonexperts alike.

Interdisciplinary students also face difficulty “talking shop” with members of their research group because of the diverse nature of studies. For example, my most similar colleague studies Pluto’s atmosphere! Therefore, students often must look beyond their research group to find useful technical advice. This requires additional networking, but it also can help connect students to the greater technical community of an institution. These connections can help when a problem occurs, because interdisciplinary group members have diverse expertise and additional connections.

But you don’t have to be in an interdisciplinary program to incorporate knowledge from other fields into your work. For example, all engineering graduate students, regardless of discipline, should acquire some level of programming skills. Graduate students are widely expected to interact with and write code, whether for lab equipment controllers or data analysis. University of Virginia now offers a “Computation as a Research Tool” graduate course with several emphases, depending on the skills needed by each student. These types of courses can give students a huge jump-start in programming, where new graduate students sometimes struggle.

One inevitable trade-off of interdisciplinary education is the reduced experience students gain in their core fields. However, students learn how to quickly come up to speed with a new topic while doing useful work. Interdisciplinary programs give students confidence that they will be able to work through challenges, a skill that is especially useful postgraduation. Although interdisciplinary programs may create short-term challenges, they ultimately provide long-term benefits for students and the technical community as a whole.

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