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BOARD #150: WIP More than its parts: Insights from cultivating a multidisciplinary network for entrepreneurship and communication

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WIP More than its parts: Integrating a science communicator into an engineering program with an innovation and entrepreneurship focus

This **work in progress** describes how the Department of Bioengineering at the University of Oregon has reached beyond faculty in engineering and related sciences to incorporate expertise and coursework from a broader set of disciplines with a direct impact on student success. Those interdisciplinary networks internal to our institution – particularly from outside STEM fields – are central to our strategy for enhancing innovation and entrepreneurship education and the future flexibility in our graduate engineering programs.[1] [2] Interdisciplinary Engineering Education has been identified as a valuable approach in many programs because the professional landscape for engineers relies on a diverse set of technical competencies and an essential set of non-technical skills. [3]In the literature, authors have explored the landscape of interdisciplinarity and the role of colleges and universities in promoting it.[4] Other authors have explored the prioritization of content from technical, domain specific concepts to non-technical but critical knowledge and practice.[5] This paper seeks to extend that knowledge by identifying the rewards and challenges for practitioners of interdisciplinary work, particularly from the perspective of an outsider to engineering contributing to the strategy and content of graduate curricula in a department of bioengineering. In the end, the experts from communication, performing arts, entrepreneurship, and library sciences shared their knowledge with trainees. If built in systemically to the curriculum, that teaching community demonstrates the broader value of interdisciplinary work and problem solving through shared experiences, coaching, and mentoring.

Engineering education faces a broad problem of minimal formal training in essential non-technical areas such as communication, often leaving instruction in best practices in communicating science to informal networks and near peers who may have hard-won experience but little grounding in best practices.[6] [7]The result is a learning-through-hard-knocks ad hoc approach for many students rather than programmatically defined and implemented best practices, which promote earlier application in a scientist or engineer's training. By connecting early with trusted practitioners from non-STEM fields whose work is grounded in best practices, trainees can reduce time and energy in the early stages of their doctoral journey spent seeking knowledge and feedback about key non-technical skills, particularly communication. Additionally, it saves time among peers and supervisors who, rather than engaging in systemically remedial practices, can get more quickly to the big ideas of the research aims. When those non-technical practitioners have a role in developing the framework of curriculum in STEM, the potential for buy-in to and understanding of the shared mission increases, and the result, in our experience, is a more wholistic approach to training non-technical content and practice, infusing it across a range of training activities over time. This approach comes, however, with a challenge for maintaining those roles over the long term, particularly as personnel change and institutional priorities shift.

Buy it, build it

We present this from the perspective of a key representative of one of the non-engineering partner institutions at the University of Oregon, with a hope to provide insight for engineering program decisionmakers at the Phil and Penny Knight Campus for Accelerating Scientific Impact

at the University of Oregon. Early in the process of building our startup engineering graduate program, administrators faced an internal challenge of staffing from within our institution to form the teaching core with a few targeted outside hires. This resulted in a creative approach to delivering technical content as well as an opportunity to bring in essential non-technical content as part of the core curriculum for our doctoral students — and having those voices at the table from the outset. As one administrator put it in an early meeting in particular reference to communication training, the institution could either buy the training or build it from within, and it depended a lot on an initial vision for what our commitments were for the long term. Seeing that the need for communication training was unevenly addressed and that having freedom to incorporate it broadly with an in-house designed program, leaders of the new initiative chose to build in non-technical training alongside the traditional technical content.

Coincidental to the funding of the engineering program and research institution, a donor-funded center to focus on science communication was based in the School of Journalism and Communication on our campus. The principals hired to run the Center for Science Communication Research and staff its programs had a skills and interest overlap with the training needs of the engineering startup, so the timing of their needs and the alignment of their missions was fortunate. The science communication focus of the center was well positioned to have a voice in curriculum development and broader institutional strategy for the engineering program over the long term, so the ultimate response to that administrator's buy-it-or-build-it challenge was to build it. Now, six years later we have just graduated our first few doctoral students, with one notably joining a spin out startup from the institution. As a program that was established with innovation and impact as a strategic pillar, this student's choice at the start of her career was nicely symbolic of what the institution had worked toward – she graduated as an excellent engineer who was also academically prepared in entrepreneurship with strong communication practice.

The build-it balance required aligning institutional interests with individual interests in a small team charged with developing the curriculum. Administratively, the various institutions came to an agreement about workload and splitting time for faculty involved in the partnership, and this essentially made the space for the collaboration to develop over time. Previously, aligned individual interests in the different institutions had resulted in a more informal collaboration typical of how many academic relationships work. But as the program needed to launch, and the complexities of teaching responsibilities needed to be addressed, it was useful to have defined commitments for each member of the team. That definition of effort helped with flexibility, as there was commitment from each institution to support a long-term approach to curriculum building that would have to work out some novel features – particularly in non-technical training – that would require iteration to succeed.

With space made administratively, the team was able to lean into a strong shared values of effective communication and a design thinking ethos.[8][9][10] Through multiple working sessions weekly over several years, the team shaped a curriculum, delivered it, and received feedback from stakeholders that helped shape future directions. The team practiced the deep listening required of the design thinking process, was biased toward action in prototyping different approaches to content and actively sought feedback from participants. The design thinking process served not only to develop an effective curriculum, but it also helped the team bond and connect. Our leadership helped make the space flexible and safe for divergent thinking while also knowing when to bring the ideas back together and converge into a specific course of

action. Through that process, the team built trust internally with its members and externally with its stakeholders. And students began to have impact through awards and fellowships. Our efforts to accelerate student success have begun to bear fruit.

The program described here is delivered through a series of courses, trainings, coaching, and experiential learning opportunities conducted through the bioengineering program's facilities and directed by its faculty and administrators, but it relies on networks and programs developed and cultivated elsewhere in the university. In addition, those programmatic needs from bioengineering have helped shape course offerings in other parts of the university as students have sought outside expertise in developing broader expertise and insight into innovations based on basic and applied research.

Doctoral students in this bioengineering program take a mixture of courses focused on Impact Training and technical science and engineering concepts. By the numbers, they take 6 technical courses that are 3-4 credits each and 4 Impact courses, most of which are 1-2 credits. Impact Training requires students to take one course per quarter for the first year and an additional grant and proposal writing course in the second year. The differing credit loads are intentional in this framework – we are trying to build in topics like science communication and layer them with other training that students have in the program. They draw from work that they're already doing and apply the lenses of design thinking, science communication, and innovation and entrepreneurship to those STEM-based experiences.

Career Acceleration Sequence
Phil and Penny Knight Campus for Accelerating Scientific Impact, University of Oregon

	Fall	Winter	Spring
Year 1	Impact Week Science Communication and Design Thinking **Faculty involved: BioE, Journalism, Business, Library**	Technology Ventures **Faculty involved: Business**	Writing for Impact **Faculty involved: BioE, Journalism, Library**
Year 2		Grant and Proposal Writing **Faculty involved: BioE, Journalism, VPRI office, Library**	
Elective			Strategic Communication for Scientists **Faculty involved: BioE, Journalism, Library**

The career acceleration sequence is four credits spread across four classes and two years. The courses include participation from a variety of disciplines outside of bioengineering, including business and journalism.

Based on principles of and shared interest in effective design and best practices in communication, the Career Acceleration Program we describe reframes graduate student education from the first week that students arrive on campus. The program builds on an immersive boot camp, our Impact Week, and then leads into a term-long course in science communication and design thinking. In the next term students have the option of taking a business course in innovation and entrepreneurship led by a senior faculty member in the business school. In their third term, students are required to take a basic scientific writing course that is team taught by a senior faculty member from the journalism school. In subsequent terms they then focus on grant writing and have the option to go deeper in business school curriculum with an area of concentration focused on innovation and entrepreneurship. All that said, curriculum content is important, but the real power is in the trust the curriculum team has built with students. They are confident that they can connect with team members to help solve a wide variety of issues, and team members are excited to connect with those students and help them.

As we have laid the groundwork of a formal course of study for bioengineering students in innovation and entrepreneurship, we find that students also engage faculty partners regularly for non-curricular-based opportunities, particularly around innovation, communication to underserved communities, and specific funding opportunities.[11] Additionally, the curriculum building in engineering has translated back to the non-technical home departments. In particular, the partnership helped shape a journalism and communication minor in science communication that has strong partner ties to the STEM disciplines.

Build and Learn

In conclusion, this work in progress has led to a few key principles for incorporating interdisciplinary contributions, particularly from non-technical partners, into an engineering curriculum. Among them are the following:

- Interdisciplinary academic partners, particularly those from very different fields, need to have a clear agreement about time and space allocated for faculty members contributing from different disciplines.
- That time and space can be used creatively over time to conceptualize a new framework for delivering content that's not traditionally incorporated into STEM programs.
- Shared group vision and leadership is required to make the most of those spaces. Having a common conceptual framework for problem solving – like design thinking – can help with those connections.
- The motivation of key personnel will carry the project for the first few years, but what's created must translate to new team members, administrators, and faculty who come on board. New champions for the effort should be a constant point of recruitment.
- While the focus of this paper is on creating engineering curriculum, ideally curricular outcomes for the interdisciplinary partners will transfer back to their diverse fields with new coursework, curricula, and research and creative projects.

Over time and through this approach, faculty from outside the sciences have also built trust with the graduate students by being regular participants in their coursework and serving in informal coaching and mentorship roles, bolstering their preparation for talks, pitches, and future career decisions. In the future, we hope to connect with other non-STEM-based mentors in STEM programs – particularly in the areas of science communication and innovation and entrepreneurship – to learn more about their experiences in similar environments.

The principles outlined above will help shape future curricular offerings and continued expansion and development of our bioengineering program, and the team remains a robust element of the institutional strategy, contributing beyond course delivery and into shaping the culture and brand of the institution.

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