

Partnering with Industry: Practical Considerations from Two Programmes (Practice Paper)

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SUMMARY

Reflecting on both research and anecdotal evidence from two different engineering education programmes, we have developed practical implications for engaging with industry to support learning. While through our collective experience we have determined many positive reasons to consider partnering with industry, we also present areas of caution to consider when engaging with external partners for a learning experience. The two initiatives discussed in this paper are a school outreach programme that partners a university, industry, and school systems in the United States (Programme A) and a capstone integrated civil engineering design project that partners a university and nearby engineering firms in the United Kingdom. Despite the disparate nature of these programmes, we found points of comparison in consideration of the industry partnership aspect that they share.

BACKGROUND

There is a growing body of support for industry partnership to improve learning experiences in engineering. Outcomes from collaborations with industry in engineering education have been studied in a variety of contexts including school/community engagement (e.g., Buxner et al., 2014; Googins & Rochlin, 2000; Pawloski, Standridge, & Plotkowski, 2011) as well as undergraduate courses (e.g., Shin, Lee, Ahn, & Jung, 2013). Stakeholders in partnerships between industry and educational institutions must be sensitive to unique factors such as supervisor perceptions of time spent away from work (Rogers & Cejka, 2006) and connections and conflicts between social and business goals (Stadtler,

2011). Through our two programmes, we have seen firsthand these and other considerations in practice.

PROGRAMME DESCRIPTIONS

Programme A: Programme A is three-year National Science Foundation funded project titled Virginia Tech Partnering with Educators and Engineers in Rural Schools (VT PEERS). It was awarded through the Innovative Technology Experiences for Students and Teachers program and brings together the University, three school divisions, and three local engineering industry partners. The project has two major goals:

- (1) Increase Youth Awareness of, Interest in, and Readiness for Diverse Engineering Related Careers and Educational Pathways.
- (2) Build Capacity for Schools to Sustainably Integrate Engineering Skills and Knowledge of Diverse Engineering-Related Careers and Educational Pathways.

Middle school teachers and industry participate in one classroom intervention per month and a summer summit event with the goal of integrating engineering into the regular science curriculum. Lesson designs were iteratively improved using guidelines adapted from Cunningham and Lachapelle (2014).

Programme B: Programme B is a civil engineering integrated design project for 4th year Masters of Engineering students and Masters of Science students. In the current structure of the project, students work together to develop a solution to a major civil infrastructure problem over two terms. Although they work in teams, they individually focus on a subdiscipline of civil engineering and lead a particular aspect of the project. Similar to other capstone projects (Pembridge & Paretto, 2019), teaching focuses on developing students' professional and technical skills in design including communicating with broad audiences, applying engineering knowledge, and exercising engineering judgement.

EVALUATING CRITERIA FOR THE PROGRAMMES

Programme A: VT PEERS has been the focus of several recent publications (Gillen et al., 2019; Grohs et al., In Press). Additional evidence that has informed some of the implications in this practice paper comes from the analysis of 76 semi-structured interviews with participants over the first year of the programme (i.e., teachers, teacher-leaders, university personnel, and industry participants) (Gillen, Grohs, Matusovich, & Kirk, Under Review).

We used the seminal work in interorganisational collaboration from Gray (1989) and the framework from Thomson, Perry, & Miller (2007) to guide our analysis of the collaborative processes involved in the first year of partnership.

Programme B: Informally, the civil engineering integrated design project has been evaluated and adjusted over time by teaching-focused staff at the University. For example, newer project briefs highlight social issues and their connection to engineering problems. Research is currently a work in progress, but we plan to focus on both the organisational aspects as well as student learning. The frameworks that will guide this research effort are still under consideration. The implications described below for the project are informed by instructor reflections as co-coordinator of the programme for many years.

WHY PARTNER: INSIGHTS FROM OUR PROGRAMMES

Reflecting on our research and experiences, we have developed three main ideas around how partnering with industry is beneficial for university departments. Firstly, partnering with industry may help with professional development goals such as allowing youth to see a variety of engineering-related career pathways or build professional skills and experience in undergraduate students. Secondly, partnering with industry has the potential to add authenticity and realism to coursework. Lastly, we found hidden fringe benefits to working with industry in both programmes.

Partner for Workforce Development Goals

Both programmes allow for interaction with staff from a wide range of professional engineering companies and disciplines. For outreach with youth, this means that students are able to interact with people who arrived at engineering from a variety of pathways, not just traditional undergraduate programmes. For students in the integrated design course, partnership is an opportunity to gain awareness of a range of professional practice approaches. The way that engineers from differing organisations and disciplines approach a problem will vary and students found it useful to witness this range towards developing professional judgement.

While youth in VT PEERS see industry monthly, students in the integrated design project benefit from meeting with their industry mentors on a weekly basis, often at the mentor's place of work. This gives students exposure to a professional work environment which better prepares them for life after university. This experience can also help hone their self-awareness of what sort of work environment or career path they may want to pursue.

Bringing outside expertise, whether into the middle school classroom or university course, also provides information for students on contemporary issues in engineering. Coupled with the academic coursework, this arms future graduates with a wider perspective and a more diverse awareness of the issues, approaches, and opportunities facing industry.

Partner for Added Authenticity

Bringing engineers into the classroom is not just an opportunity to provide a role model but is also a chance to provide a more authentic learning experience. Adding authenticity and a sense that the classroom situation is akin to the real-world situation is beneficial for student motivation (Ambrose, Bridges, DiPietro, Lovett, & Norman, 2010). In the VT PEERS outreach activities, students heard testimonials from engineers about how their classroom lesson mirrored their professional work. In the integrated design project, the briefs have been designed with industry professionals and are often based on real projects. For example, one brief this year is focused on social housing design on a brownfield site.

Partner for Fringe Benefits

Partnering with industry is an opportunity to network for undergraduate students. Many of our graduates go on from the integrated design project to work for their mentor's organisations and apply for jobs or work experience with some of our other industry partners. The industry staff involved also interact with other students not in the course when they visit the department and this has led to opportunities such as lunchtime seminars which are open to civil engineering staff and students from all years of study. In the VT PEERS outreach project, some industry partners and teachers have begun to work together on side projects, separate from university influence.

IMPLICATIONS FOR COLLABORATIVE PRACTICE

Although we have highlighted several benefits to partnering with industry, there are also significant challenges to consider with implications for collaborative practice. These challenges are twofold: issues pertaining to different organisational cultures and approaches and challenges establishing mechanisms for monitoring and feedback.

Culture clash: Aligning Industry and Instructional Approaches

In our experience, when engaging with an industry partner it becomes important to have extensive discussions before a commitment is made to ensure that the approaches and views of both partners are broadly aligned. It is also important to be open about general philosophies and ethos towards engineering education to ensure that the aims of the

partnership are not in conflict. In an undergraduate setting in particular, questions to discuss might include:

- Where do we see the future of the industry?
- What do we want our future graduates to be able to do?
- What do we see as the pressing issues of the day?
- What do we view as effective pedagogy?

A healthy diversity of views on all of these issues is appropriate, after all there is little point in collaborating with someone who will deliver exactly the same content that you would. However, clashing views may result in an inefficient amount of time trying to reach a consensus, rather than focussing on design and delivery of effective educational content.

For outreach, some school participants worried about the way that industry would act in the school environment. Industry also felt uncertain about what to expect from their partners and the experience (Gillen, Grohs, Matusovich, & Kirk, Under Review). University-mediated training for those new to an educational environment, might help alleviate some of these issues.

Learning to Improve: Establishing Methods for Monitoring and Feedback

Although it is challenging enough to have tough conversations around organisational values at the start of a project, it is perhaps even more challenging to turn this into an ongoing discussion. In both projects, the way that feedback has been shared and processed has occasionally fallen short of expectations. For example, in VT PEERS, it was unclear how to share critical commentary on partner behaviour in the classroom (Gillen, Grohs, Matusovich, & Kirk, Under Review). Similarly, in the integrated design project, there is often only an opportunity to share formal feedback from students at the end of the year. Using reflective questions like those found in Grohs et al. (In Press) may help catch issues before they become toxic to partnership success. For example, reflective questions may include: how partnering impacts day-to-day operations, how I see my and my partner's role, what is a comfortable balance of costs and benefits, and are the benefits too long-term for the short-term sacrifice?

CONCLUSIONS AND FUTURE WORK

When partnering to improve in an educational system, care needs to be taken to avoid common pitfalls and emphasise benefits. The focus of this paper was practical, but we hope to expand our research efforts as well. Specifically, we are currently developing a research plan to build understanding of how best to partner with industry in capstone design. We hope that by letting our professional experiences inspire our research questions, we will

come to conclusions with not only scholarly significance but local impact on our instructional practices.

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