Nurturing Interdisciplinary Engagement: A Case Study of Resourcing and Recruiting Strategies in an Early Academic Career Interdisciplinary Project-Based Learning Course

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Full Paper: Nurturing Interdisciplinary Engagement: A Case Study of Resourcing and Recruiting Strategies in an Early Academic Career Interdisciplinary Project-Based Learning Course

Abstract

Interdisciplinary, problem-based learning courses offer valuable experiential learning opportunities for undergraduate students that augment traditional in-class learning. Implementation of these programs is complicated by many factors, including student recruitment and retention. This paper explores strategies and outcomes of recruiting and retaining students in an interdisciplinary problem-based course over multiple semesters. Our findings reveal that while students perceive word of mouth as the most effective marketing tool, initial participation necessitates alternative marketing efforts, especially for new programs or projects. Leveraging allies of the program (e.g. academic advisors and disciplinary faculty) proves to be an effective strategy, as they can use their social capital to encourage participation in previously uninvolved academic units. Students express a strong desire to participate once aware of such programs, reporting hands-on experience and interdisciplinarity as key motivators. Structural constraints within academic programs often limit flexibility in elective course options, necessitating flexible credit options to support enrollment. Consistent mentorship from faculty coaches and the draw of extended problem-based learning are factors contributing to team persistence and success. Returning students serve as effective advocates, promoting the program through word of mouth.

Introduction and Background

In engineering contexts, interdisciplinary programs are most often designed for the graduate level and located institutionally in programs outside of traditional disciplinary units such as departments and colleges. For example, at our university the interdisciplinary Disaster Resilience Graduate Certificate is funded by an NSF Research Traineeship and is administered by the Virginia Tech Graduate School in spaces provided by the Fralin Institute [1].

For undergraduates, the university's Pathways program enables students to put together electives that satisfy general education requirements established in university governance. If students pursue a Pathways minor, they may enroll in a cross-disciplinary collection of courses but the minor itself is administered by a sole department. For example, the authors of this article previously designed and implemented the Innovation Pathways Minor with a spine of required courses hosted by three separate colleges and a wide selection of cross-campus electives, administered by the Department of Engineering Education. More recently, faculty in the Department of Engineering Education established an interdisciplinary senior design course that counts for capstone credit for students in three engineering majors.

In addition, opportunities for experiential learning, even within majors, are limited for engineering students. The primary opportunities for hands-on project-based learning in engineering occur in the second semester of the required first-year engineering program, where students participate in design teams with other engineering students, and department-based

senior design capstones, where students within a major work in teams on a client-defined project. The first-year problem-based projects offer a rare opportunity for all engineering students to collaborate in hands-on experiential learning; often this kind of experience is not available again until their senior year. Likewise, in other majors beyond engineering there is a dearth of opportunities for students to participate in authentic experiential learning. Finally, opportunities for undergraduate students to work in interdisciplinary project teams are even more limited and primarily occur in Pathways electives. While every student is required to take the same number of electives to satisfy learning standards of a liberal education, most departments and students strategically select coursework that relates to their disciplinary area. Many official plans of study are constructed to count courses from Pathways electives that also satisfy requirements within their major. The result is that the opportunities for students to learn in environments that resemble the workforce must now be specially created.

The benefits of problem- and project-based learning and interdisciplinary learning are well-documented in the literature, confirmed by external (company) partners of the university, and continuously supported by university initiatives [2]. For example, in 2015 President Tim Sands introduced the "Beyond Boundaries" and Destination Areas initiatives, and now the current Quality Enhancement Plan (QEP) is focused on building out experiential learning in the form of "Bridge Experiences" for all undergraduates [3]. This 5-year plan sets out pedagogical guidelines based on Kolb's Cycle of Experiential Learning that includes concrete experience, reflective observation, abstract conceptualization, and active experimentation [4]. Although there is little additional resourcing for the program, it establishes undergraduate research and field study course designators that are flexible, available to all departments, and count toward the new requirement of Experiential Learning credits. These university-wide courses provide a way for faculty to offer interdisciplinary courses that can be embedded in degree requirements but not restricted to a single departmental home.

Truly interdisciplinary courses face multiple obstacles: incentive structures, resource allocation, and administrative barriers often discourage faculty collaboration across disciplines, resulting in programs interdisciplinary in name only. What interdisciplinary projects do exist oftentimes lack the structure for sufficient cooperation and effective communication between disciplines, which can result in the disinterest of students already working in interdisciplinary environments [5]. Student recruitment poses two challenges to recruit and retain students in the course: students must be made aware of the course, and students must be able to integrate the course into the stringent requirements of their academic programs. Students are inundated with announcements for opportunities vying for their attention, and it is difficult for a program or course to stand out. With full academic and extracurricular schedules, students struggle to allocate time and space for credit-bearing courses, an issue more pronounced for project-based learning courses requiring time for collaborative group work. In addition, project-based research is most successful when students are able to effectively connect with faculty, mentors, and peers that align with their personalities, research interests, and educational goals—situating interpersonal connections as key to the success of interdisciplinary students [6].

Context

Using the "field study" credit-bearing vehicle, faculty in engineering education have created the Interdisciplinary Projects (IDPro) course with the goal of making interdisciplinary, experiential learning available to students in early academic years through a vertically integrated projects model that enables students to repeat the course over multiple semesters. Essentially, the course follows the principles of problem-based learning [7]. Students from across the university are formed into interdisciplinary teams, assigned a faculty coach, and tasked with a problem proposed by a faculty at the institute, an external entity (industry, non-profit, or government), or brought to the course by students themselves. Projects can be sustained over multiple semesters or years of student engagement, liberated from traditional semester-based timelines. IDPro teams are provided access to a student-centered maker space, a moderate staffed machined shop, and a modest budget for materials and supplies.

To provide a balance of student independence and guidance, each team is assigned a coach (faculty, community/company partner, and/or graduate student) that meets with the team weekly. The instructor fills a project manager role of handling 12-15 distinct projects. The class meets once a week for two hours, with the first 20-30 minutes dedicated to lectures and the remaining time spent in teams working on projects. To manage project partnerships and ensure appropriate scoping, a partner liaison works with the instructor, coaches, sponsors, and external partners to identify projects, establish deliverables, and negotiate resourcing. To ensure that a range of projects is available to students, the partner liaison and instructors aim for a diverse portfolio of projects that are faculty-led, student-sourced, industry-funded, and community service.

Our ASEE 2024 publications describe the key steps and challenges in designing and implementing a project-based, student-centered course in partnership with faculty, community, and company partners [8], as well as student perceptions of our performance-based assessment model [9]. In this paper, we focus on the strategies and early outcomes of addressing the challenges of recruiting and retaining students in the course over multiple semesters.

The pilot semester in Fall 2023 consisted of 12 teams composed of students new to the program. In the second semester in Spring 2024, projects followed an extended project-based learning paradigm, where a project is typically carried from one semester to the next and a degree of team formation and onboarding of new members occurs at the beginning of the semester. In addition, 4 new teams were added in the second semester.

Methods

The data presented here were collected through a pair of survey instruments – one created and administered specifically to develop an initial understanding of how students viewed the marketing and recruitment process (Instrument 1), and the second was administered to determine an estimate of the number of students enrolling in the program in the subsequent semester (Instrument 2). Each survey included a combination of closed-ended and open-ended questions. Instrument 1 contained 18 questions covering topics of recruitment and onboarding effectiveness, motivations and expectations, barriers to participation, program engagement, and

suggestions for improvement. The survey included optional sections to collect demographics and to indicate willingness to participate in follow up interviews or focus-groups, with personal identifiers collected only for consenting participants. Instrument 2 was designed to collect contact information for students interested in enrolling in the course in the subsequent semester. It included a limited section on demographics, questions on academic standing and background, and a question asking how students heard about the program. In addition to survey data, we compiled the details of students who continued from Fall to Spring semester.

Open-ended questions from the survey instruments, including multiple choice sections where participants could select 'other' and specify an answer were analyzed qualitatively to classify the mechanisms that students reported being made aware of the course as well as elements that contributed to students returning to the course for subsequent semesters [10]. We developed a pseudo code book in developing the instrument and supplemented this codebook using open-ended responses from participants.

Participants

The participants in this study were drawn from students who participated in either IDPro or another interdisciplinary, project-based learning courses administered through the Engineering Education department (GrayUR) [11]. Instrument 1 was administered to 223 students and yielded 18 responses (8% response rate). Instrument 2 was administered to the 63 students currently enrolled in the IDPro course and was linked on marketing materials to collect information about prospective new members to the course. Instrument 2 yielded 22 responses. The collective respondent pool was slanted heavily towards engineering (30/40), with many Mechanical Engineering (9/40) and Computer Science (7/40) students.

Results

Instrument 1 asked students to indicate avenues for becoming aware of the program from a list including academic advisor, word of mouth, student organization, faculty, or 'other'. Comments pointed to the program website and two types of faculty influence: being directly invited by a faculty coach in the program and hearing about the course through an in-class announcement by a faculty member not related to the course. Instrument 2 was not anonymized, making it possible to observe that students in the pilot section heard about the program from a faculty coach or academic advisor, whereas word of mouth was a key factor in the second semester. Qualitative results addressing the research question "What motivated student participation?" were compiled from questions "Why did you choose to participate in the course?", "Did any specific structural aspect of the program appeal to you?" and "Did you encounter any challenges or barriers that initially deterred you from participating in the program?". 94% of respondents reported a desire for hands-on experience, 38% reported a desire to participate in a highly interdisciplinary course, 61% noted that course flexibility helped them add the course into their schedule, and 22% noted technical elective equivalency.

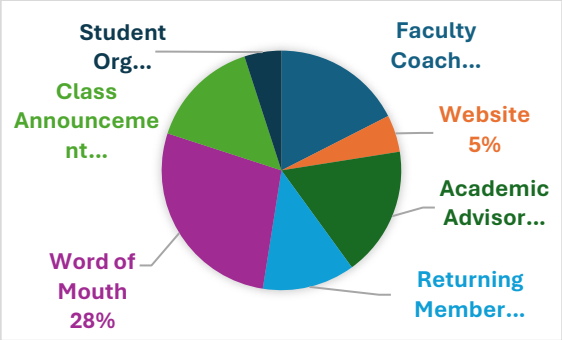

Figure 1. Student reported mode of hearing about the course, Fall 2023 and Spr 2024

Table 1. Aspects of the course that students reported as encouraging participation.

Motivator	Respondents
Hands-on Experience	94%
Course Flexibility	61%
Interdisciplinary Nature	38%
Equivalent Technical Credit	22%
Perceived Ease of the Course	17%

Discussion

The nucleus of the IDPro program originated in seven projects affiliated with faculty coaches who either proposed project ideas stemming from their own undergraduate research groups or supported research that students themselves had begun in their first year. For the Fall 2023 course, three teams were based on existing projects of faculty in departments outside of engineering, and two teams were on projects directly associated with company partners. In Spring 2024, all 12 original projects continued. One faculty project and one company project were added, and one company project was split into two teams, totaling 16 teams.

Going forward, 10 of the projects (9 faculty supported, 1 company supported) will continue in the third semester of the program (in Fall 2024). Two projects were completed within the first year, one team is taking a break due to increased commitments, and the remaining three projects will require re-scoping. The critical step in these six cases is to continue to build the relationship with the partner by generating new projects and recruiting new students.

One component that has proved critical for retention of students across semesters is consistent involvement of coaches. Teams with coaches committed to meeting once per week proved to be critical to be more likely to persist and succeed in reaching goals. For instance, one company partner provided proposals for two projects. However, once the teams were formed the coach was not readily available and one project failed in early scoping and team cohesion. The instructor cancelled the project and reassigned students to other teams.

In recruiting new students, the influence of faculty and name recognition of companies is effective. From Fall to Spring, we also saw increases by word of mouth. Several new students for Fall 2024 have been recruited by students continuing in teams. This activity is encouraged in the final report assignment, where students are required to document their accomplishments, set out a plan for continuing the project, and identify the roles required for achieving the plan. Students are also asked to invite stakeholders and potential team members to the course final showcase, where all projects are presented in a poster session and networking is encouraged. Allowing students to connect with potential teammates and mentors enables the facilitation of interpersonal relationships prior to the start of project-centric work.

Limitations

The data collected here are from two separate populations of students participating in two separate but parallel programs. While the programs have similar implementations and assessments, they are distinct programs from student perspectives. Furthermore, the GrayUR response rate was only 8%, and the IDPro response rate was 35%, yielding a relatively small participant pool. These lower response rates could imply a self-selection bias in the responses. Finally, our instruments have not been validated, opening questions about reliability and validity.

Conclusions and Future Work

This paper examines encouraging student enrollment in an interdisciplinary for-credit problem-based learning course. While word of mouth emerges as the most effective means for marketing such a program, our work demonstrates the need for more active marketing campaigns, especially during the initial phases of program establishment. For new programs, new projects within a program, or programs seeking participation from previously uninvolved academic units, the most effective strategies for making students aware of opportunities are leveraging allies who can expend a degree of social capital to encourage participation.

Our work also sheds light on structural barriers to participation. Students reported a strong desire to participate in such programs but noted that academic programs do not provide much flexibility in terms of elective courses. Structural components such as variable credit-hour and grading options coupled with securing technical elective credits were cited as facilitating participation. The hands-on, interdisciplinary, and small-team nature of the problem-based learning programs are also strong motivators, and returning students act as marketing agents for the program to their peers, providing effective word of mouth advertising of the program. Our work suggests that the initial establishment and reputation building phase of an interdisciplinary program is distinct from a sustainment mode of operation. Given the importance of networking and mentorship, strategic marketing and ally recruitment are essential in the early phases of the program while development of an alumni student network within different academic units is essential for sustained enrollment.

Moving forward, we are exploring ways to address structural barriers to participation, including developing a comprehensive guidebook for students outlining how the course aligns with degree requirements across disciplines and working with administrators to establish outcomes assessments to support technical elective equivalency and integrating the course into major or minor capstone requirements.

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