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Better together: Co-design and co-teaching as professional development

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Introduction

Co-teaching is well documented as a unique opportunity to deepen one's appreciation for teaching, share instructional knowledge, and expose students to multiple perspectives in the classroom [1]–[5]. There are co-instruction programs that exist for the purpose of onboarding new faculty, especially research-active and tenure track faculty; generally, the "mentor" figures in these relationships are selected for being experienced and knowledgeable in evidence-based teaching[6], [7]. There are also many teaching preparation programs for graduate students in STEM across higher education (for example, [8]–[10]). These professional development programs rely on learning opportunities like workshops, microteaching, and guest lecturing, and there are fewer documented opportunities for engineering graduate students to experience authentic teaching in which they have responsibility for *designing* and implementing a course while being mentored by a more experienced teacher.

While the descriptions and definitions of co-teaching exist along a continuum of shared responsibilities for in-class and out-of-class activities, here we use the term to refer to teaching scenarios in which both instructors are named as instructors of record and contribute appreciably to *all* aspects of the course design (i.e., co-design) and implementation, culminating in roughly 50% sharing of responsibilities. Below we describe the intentional redesign of a program that immerses graduate student and faculty participants in an authentic co-instructional experience. Courses in which a co-instructor serves as a guest lecturer inserted into an existing course and/or with few ties to students or the other co-instructor would not constitute co-teaching in our program. Unlike the programs described above, our program also tends to recruit strongly from a mixture of teaching and research-active faculty who have varying knowledge of evidence-based teaching practices, and thus our program is designed for a range of prior teaching knowledge and approaches. In particular, the core competency of awareness of power and privilege is a curricular element that connects to both their classroom presence and their mentoring relationship. We posit that co-instruction is as much about the relationship of co-instructors as it is collaboratively deploying a course.

Brief history of program

Historical administrators of the teaching fellowship program have since moved on to other roles and institutions. Therefore, the authors lack a detailed history of the program's origin and early years in which it was offered. We believe the program originated in 2012 and was based on a similar program elsewhere[11]. The information we do have about the legacy program is described in later sections. In 10 years, the program has served about 60 graduate students and postdocs.

Given the focus of this paper on a program redesign that began in 2020, we will focus on participants in the 2020-2022 timeframe. Table 1 details participation in the teaching fellowship

program by disciplinary area. In this time frame all PhD programs offered in the school are represented except for one.

Table 1. Program Participation (2020-2022)

	PhD	Postdoc
Biomedical Engineering	2	2
Chemical Engineering	2	0
Civil Engineering	6	3
Computer Engineering	1	0
Computer Science	1	0
Electrical Engineering	0	0
Materials Science and Engineering	2	0
Mechanical and Aerospace Engineering	2	1
Systems Engineering	2	0
TOTAL	**19**	**6**

The teaching fellowship program is offered twice a year through calls for applications, once each in the fall and spring semesters. The calls are sent to all engineering faculty and PhD students in the school for broad awareness of the opportunity. The competitive application requires both the student and a teaching mentor to contribute to the application process, ensuring that both participants in the pair are aware of the intention and requirements of the program, as well as demonstrating a commitment from each of them. Students may apply for the program to co-teach with their faculty research advisor; however, we also see many pairs where the faculty mentor is not the PhD student's research advisor.

The school has historically provided financial support to administer the teaching fellowship program in the form of funding for PhD student for the semester in which they participate in the program. This includes tuition and fees, health insurance, and the student’s wages for the semester at a standard school rate. The school also supports the cost of the pair attending the course design experience, described in more detail below.

Program redesign impetus

In the ongoing quest to ensure students’ success post-graduation, institutions have developed and reimagined ever richer and varied extracurricular and co-curricular opportunities to complement conventional graduate research education[11]. While comprehensive assessment of these programs is rarely a priority amongst competing priorities for administrators, this is partly due to substantial evidence which points to characteristics of effective professional development and meaningful learning, including intentional design and sustained engagement over time (for example, [12]–[14]). Starting three years ago, the authors, aware of the literature on professional

and faculty development, saw an opportunity to reimagine the program that is the subject of this manuscript.

There was limited documented history for the legacy program, mainly a record of participants and their corresponding departments. There were no other assessment data. Conversations with two previous program administrators, program-affiliated faculty, prior student participants, and other affiliated administrators sketched a rough outline of the program's strengths and how it might also be improved. The reputation of the program was overall positive, and we resolved to leverage evidence from faculty development literature, an eye toward program assessment, and continued administrative support to "renovate" the program to reinforce and sustain the school's teaching-supportive-while-research-active culture.

Program redesign approach

Because the program operates as a learning experience similar to coursework, we chose a well-known (re)design approach: backward design. In a modified backward design process for learner-centered course design, designers consider 5 stages in an approximately linear but iterative fashion: situational factors (context), goals/objectives, assessment/feedback, activities, and integration[15], [16]. We, the program administrators, focused on the desired objectives/goals/outcomes and the dominant situational factors that would constrain the program prior to re-thinking the specific program elements; only then did we seek to retain the program's historical strengths.

Design approach: situational factors

Situational factors comprise the specific context for the learning experience and include considerations such as the characteristics of learners (participants), characteristics of the teacher (in this case, the program facilitator), specific context for the experience, and outside expectations of invested parties. A non-exhaustive list of the dominant situational factors playing an outsized role in our design choices is summarized in Table 2.

Table 2. How context influenced specific program redesign decisions

Key situational factor	**How to address through design choices**
1. Faculty participants are often research active and have busy schedules.	Interactions should be flexible in access and not too frequent; high structure activities may not fit during a typical semester.
2. Participants have a range of experiences with mentoring relationships and power dynamics.	Participants may need learning and connection activities to directly address power differentials.
3. Participants have a range of experiences in teaching.	The program should include content related to evidence-based teaching and opportunities for the group's wisdom to be shared among participants.

4. Mentee participants are a more diverse group than the mentors.	The program needs an emphasis on power differentials and content to address the cultural context of a primarily white institution in the American South.
5. Not all participants wish to teach in the same semester.	Program should be offered each semester.

Notably many situational factors, including those not listed, interact in various ways—for example, the need for content to address power dynamics connects with situational factors 2 and 4 in Table 2. This highlights the importance of returning to these constraints as other aspects of the design fall into place. We considered many other situational factors in our design, some of which are alluded to in the discussion below.

Design approach: objectives

The program's purpose in 2019 was articulated as "to offer our graduate students the opportunity to develop and hone their teaching skills beyond a teaching assistantship, better preparing them for future careers in academia and beyond," which in 2020 we drafted into four specific objectives. Participants...

1. Gain knowledge in learning-focused pedagogical strategies and student-centered course design;
2. Work closely with their teaching mentor and learn from a cooperative teaching experience;
3. Gain confidence in designing and teaching a new course; and
4. Network with members of the [university] teaching community.

These new objectives implicate some of the strengths of the legacy program while also leaving room for the dominant situational factors to mold the implementation – for example, Objective 2 relates to situational factors 2 and 4, and is broad enough to encompass learning about power and privilege. The objectives, especially Objective 2, reinforce the starting criteria and intended process for participation in the program: mentor-mentee pairs work closely to co-design all aspects of their courses. The thread of co-design is essential to achieving all the program's objectives. While the objectives above are framed from the perspective the mentees, roughly the same objectives apply from the perspective of the mentors, which we discuss further in Assessment.

Design approach: assessment

The assessment segment of backward integrated design is typically a major focal point for course design because assessment of student learning in classrooms is often a high stakes endeavor and differentially impacts students, such as affecting grades and therefore financial aid and persistence in degree programs. In professional development program assessment, however, participants' outcomes are not "graded," and our assessment is used primarily for internal improvement and contributing to the body of research in the program area. Thus, we created an

assessment plan that can convey to stakeholders (ourselves, funders, and future participants) whether the program is meeting its objectives and what opportunities there may be for improvement. The program assessment includes items aligned with the objectives (Table 3) as well as indicators of scale and tracking participants' outcomes over time.

Design approach: activities

Table 3 also describes in brief the learning activities developed to align with the program objectives and assessment. In practice, they also consider the significant situational factors from Table 2 which strongly influence their form and frequency.

Table 3. Aligning program objectives with assessment measures and activities

Objective	**Assessment**	**Activities**
1. Gain knowledge in learning-focused pedagogical strategies and student-centered course design;	Survey* (self-reported awareness of evidence-based teaching) Syllabus and other artifacts Facilitator informal observations**	Course design institute Mid-semester feedback consultations
2. Work closely with their teaching mentor and learn from a cooperative teaching experience;	Survey* (self-reported experience with power differentials) Facilitator informal observations**	Course design institute Respond to and discuss power dynamics-based scenario Planning meetings with mentor
3. Gain confidence in designing and teaching a new course;	Survey*	Course design institute Actual teaching experience
4. Network with members of the UVA teaching community.	Survey* Facilitator informal observations**	Course design institute Cohort meetings Consultations with teaching center

*We designed two IRB-informed surveys to capture participants' experience in the program: one for mentors and one for mentees.
**The program facilitator uses frequent formative assessment approaches such as "show of hands voting" and open-ended questioning (e.g., "how are things going?"), as well as observing emotions, language choices, and general interactions during cohort engagement. These perceptions inform the facilitation choices in each meeting and are critical information for responsive facilitation (see "Outcomes" below for more).

During the design process, switching perspectives between the constraints dictated by context (situational factors) and the program objectives is an iterative and sometimes messy mental planning process for program designers. In short, we sought to balance synchronous meeting frequency with a combination of structure and flexibility, as well as to incorporate high structure elements early in each cohort's experience. We considered the workload and tolerance from

faculty and graduate perspectives and consulted with previous participants about what breadth and depth of support could accomplish the program's goals. The overall program activities are:

- Course Design Institute. A structured five-day design experience in which instructors design or redesign a course; facilitated by the university's center for teaching[17]. A remotely facilitated online version is offered for courses beginning in January.
- Mid-semester feedback and consultations. Based on the "Small group instructional diagnosis" approach, experienced facilitators from the center for teaching conduct focus groups with students at the request of the instructor[18]; some teaching pairs choose to do this together, depending upon the style of co-instruction they have.
- Cohort meetings. These meetings are lightly structured conversations to share teaching experiences, highlight course design decisions, and provide support for the teaching pairs. While informal, they are facilitated by the program advisor/facilitator to address topics germane to the timing in the semester during which they occur (e.g., Figure 1).
- Individual pair meetings. The co-teaching pairs meet on their own time to plan and navigate their course management. Some have frequent standing meetings, while others communicate on an ad hoc basis, including over email and digital tools such as Slack.

The full alignment of objectives and activities within the constraints of situational factors revealed the program's essential elements and the interactions to support them. Figure 1 describes these within the timeline of a typical fall semester.

Interaction	**Course design (5 days)**	**Meeting 1 (60 minutes)**	**Meeting 2 (60 minutes)**	**Meeting 3 (60 minutes)**
Timing	Summer	Early semester	Mid semester	End of semester
Activities	Course design institute; cohort-building	Power dynamics scenario; "How do you like to give and receive feedback?"	Soliciting and responding to feedback from students; small group instructional diagnosis	Anticipating student feedback; looking ahead

Figure 1. Timeline of program activities across a typical semester for entire cohort. Mentor-mentee pair meetings for course management not shown.

The modalities of these engagements have fluctuated since the redesign; typically, meetings are offered in hybrid format. Participants overall prefer the in-person interaction with light refreshments, while the remote option works well to support participation in a short meeting that may not be centrally located for all.

Differences in the elements after redesign

We show how the backward-designed program elements relate to the legacy program's elements in Table 4.

Table 4. Comparison of legacy program and redesigned program

Program elements	**Legacy program**	**Re-designed program**
Application process	Submit required materials to program administrator.	As before, plus stated commitment to co-designing and co-teaching
Documentation	Both instructors recorded as instructors of record.	As before.
Formation of pairs	Mentee and mentor find each other before program begins.	As before; ad hoc assistance for matching offered from program administrators.
Pair planning meetings	Mentor and mentee meet for general course planning.	As before, and program facilitator sends readings and questions about power ahead of semester.
Guiding pair dynamics	Not addressed.	Communication from program facilitator about power dynamics and dedicated Meeting 1 topic of discussion.
Cohort experience	Informal cohort meetings with program advisor 1x semester.	High structure course design experience supports cohort bonding. Meetings 3x semester with an emphasis on facilitated discussion.
Course design	Informal, ad hoc.	Facilitated cohort experience in evidence-based course design institute with intentional collaboration of mentor and mentee (co-design).
Teaching feedback	Informal, ad hoc.	Structured and unstructured – mid semester feedback and ongoing feedback from cohort.

Through backward design, the more specific program objectives compared to the previous program description yielded a net increase in activities and opportunities to demonstrate the program's efficacy, as well as reinforcing cross-cutting concepts within the program. For example, the course design institute offers a distinct moment to invoke questions about power dynamics via the situational factor of instructors. In other words, the context created by having a particular instructor, that instructor's perspectives, identities, lived experiences, relation to the course material, and so forth, will inextricably inform the course as a product and how it is experienced by students and therefore should be its own design constraint[15]. Thus, program co-instructors are asked to reflect on their own roles in the course during course design sessions. During the cohort meetings after course design, they also reflect on their interactions and

approaches to collaboration and feedback. In Meeting 1 (Figure 1) co-instructors are invited to consider their positionalities as they relate to each other [19]. How will the pairs address the inherent power differential between them? How will they approach differing opinions in the classroom in real time? What are their preferences for giving and receiving feedback to each other, and how can the mentor instill a sense of self-efficacy and advocacy in the mentee?

Overall, we consider the redesigned program as a more intentional, more supportive, and higher touch experience for both mentors and mentees.

Outcomes

Owing to the continuous adjustments made in response to the Covid-19 pandemic and crises within our community, our program implementation proved to be a moving target, and we opted to extend program assessment and delay IRB-approved research. Our conclusions here are therefore not a neatly wrapped story, but a collection of semester-specific takeaways on a journey to efficacy and sustainability of the program. In four semesters since the redesign, we have weathered unexpected challenges and welcomed unexpected outcomes.

The pilot of the redesigned program coincided with a continued, uneasy reemergence of on-campus life in the Spring of 2021. Many participants continued a primarily remote work modality as Covid waves came and went, and teaching was loosely hybrid as students experienced periods of isolation and quarantine based on ever-shifting university protocols. Thus, the first iteration of the redesigned program was facilitated remotely. Some participants in the Spring 2021 cohort had not taught (or learned) remotely in Spring 2020 or Fall 2021, and the program was a much-needed opportunity for them to experience remote or hybrid learning themselves and to confer with colleagues about this unanticipated addition to their teaching toolkit. The general structure for the redesigned program was still deployed, and the flexibility of the program allowed it to serve as a space for the cohort participants to reimagine flexibility and modalities in their own teaching.

Spring of 2022 was an opportunity to deploy the redesigned program as intended, with a greater emphasis on face-to-face engagement after remotely facilitated course design.

Fall of 2022 was the first full-fledged, face-to-face cohort of the redesigned program. The summer course design institute proved to be a formative experience for the participants, wherein their close work together for 5 days built friendly and trusting relationships as compared to the previous semester of remotely facilitated course design. When the Fall Cohort Meetings kicked off with the start of classes, the conversations were rich and participation vibrant. Unfortunately, once again the flexibility of the program was called upon when an on-campus shooting locked down and horrified our community, leaving several students dead; with classes canceled, faculty scrambled to understand their roles in a time of grief and what this crisis would mean for students' learning in the short and long term. Many days after the initial shock, our cohort met to hold space for each other and with no other agenda. This was one of the first moments they had taken to consider the impact of the tragedy on themselves rather than on their students, and we felt the comforting power of the cohort relationships laid just few months earlier. We discussed

the blurred boundaries of supporting students and colleagues in crises, and what it meant for sustaining ourselves in this profession and the humanity necessary to do our work well.

At the writing of this paper, another cohort has embarked on the fully-realized program and without a major campus crisis. Both faculty and student participants in recent years have shared anecdotally that the program has positively influenced their teaching experiences and professional trajectories, information which we will collect systematically with IRB-approved research. The intentional co-design and co-teaching features of the redesigned program have been fundamental in recruiting and retaining participants. During the cohort meetings, pairs often discuss how co-designing helps them bring multiple perspectives to the course curriculum, experiment with new pedagogical approaches, take stock of intended course objectives and actual student outcomes, design new assessments and learning activities, and engage in high level philosophical and value-oriented conversations about teaching. This is especially helpful to faculty members who have been teaching the same course for several years. Faculty participants have also appreciated how co-teaching helps them step out of their comfort zone, relate more to the students' perspectives, and share responsibilities like lesson planning, grading, and office hours to reduce workloads. The student participants have gained valuable insights in the behind the scene process from their faculty mentors, such as juggling the big three components of academic life: teaching, research, and service. These key outcomes, inextricably tied with true co-instruction, make this program unique, meaningful, and effective.

What we have learned thus far, with imperfect rollouts and the best intentions, is that good program design can be robust and flexible enough to withstand seismic shifts on campus, and that the relationships formed between co-instructors and within a cohort can be the strongest assets to a teaching community. Beginning our redesign with clear program objectives helped us decide how to pivot within the program when our original plans were disrupted; what was *essential* in those difficult moments? The redesign provided enough structure and flexibility that we could be responsive to instructors' needs, just like we advise them to do with their own course design when responding to students' needs. Our program redesign evidences that legacy programs can be renovated and refreshed by key advocates.

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