From Q&A to Norm & Adapt: The Roles of Peers in Changing Faculty Beliefs and Practice

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Abstract

This research paper reports on the impact of professional development across four years of a major change initiative. Research suggests students from groups underrepresented in engineering are particularly vulnerable to poor teaching, drawing inaccurate conclusions about their fit and potential. However, supporting faculty to make their teaching more inclusive and learner-centered can be challenging. Faculty may not have experienced such instruction themselves and may have few incentives to improve teaching. Our study, carried out in the chemical engineering department of a Hispanic-serving research institution, is part of a major change effort to meet diverse undergraduate students' needs. We qualitatively analyzed field notes and audio-recordings of faculty meetings, professional development workshops, interviews, and teaching. We identify four types of peers and how they functioned together to enable engineering faculty as designers of learner-centered approaches. The study provides practical insights for faculty developers interested in using peer-supported instructional change strategies.

Introduction and research purpose

Among the many reasons to support engineering faculty to adopt learner-centered teaching is to meet the needs of an increasingly diverse student body. Research suggests students from groups well-represented in engineering may be less vulnerable to poor teaching, viewing it as a hoop to jump through, whereas those from groups underrepresented in engineering may draw inaccurate conclusions about their own fit and potential in the field [1]. Therefore, supporting engineering faculty to develop as teachers capable of designing learner-centered approaches is central to diversifying engineering. However, this aim is notable for its difficulty, and the barriers are myriad: faculty may not have experienced inclusive, learner-centered approaches themselves as students and may have had few opportunities to learn about how people learn prior to becoming an instructor [2, 3]; focusing effort on teaching is disincentivized, especially at research universities where tenure is based on research productivity [2, 3]; and faculty may have few opportunities to discuss new approaches and learn from and receive support from their peers [4]. Just as STEM undergraduate learning is supported by positive interactions with peers [5], so too is learning and change among faculty. Our aim in this paper was to identify ways different peers can foster faculty to change their beliefs about student potential and support them to adopting and adapting learner-centered approaches We sought to answer the following research question:

- In what ways do different types of peers support faculty to change their beliefs and instructional practices?

This paper explores this question and offers practical suggestions for promoting peer learning among faculty.

Theoretical framework

Much research has supported the theory that people learn through active participation in communities of practice [6]. Communities of practice are "groups of people informally bound

together by shared expertise and passion for a joint enterprise" [7]. In these communities, participants learn new skills socially in a process guided by peers and mentors and situated within the context where the skills are used. The community discusses and reflects together, as beginners grow into full participants. Faculty, within the same department or across departments and institutions, form communities of practice in which new instructional practices can be learned, discussed, and refined [8]. This social theory of learning provides a foundation for the notion that peer learning, even in contexts where other types of institutional support may be lacking, can help faculty develop new, evidence-based instructional skills and approaches, as well as critically reflect on their beliefs and create new ones.

However, this theory also highlights barriers to change, as the commonplace culture and norms that new faculty come from and enter tend to prioritize research over teaching, and forms of teaching that are content- and instructor-centered [9]. We therefore also consider ways peer learning can foster critical mass of learner-centered communities of practice.

Past research has explored and identified various functions different types of peers may play in faculty development. Specifically these include departmental and disciplinary peers who are credible because of their knowledge of the students, context, and discipline, and who may also play a role in norming new practices; faculty developers (who may or may not be viewed as peers), learning scientists, engineering education researchers and others who have expertise in how people learn; and students who shed light on learner experiences. While there are many ways to structure peer interactions as part of faculty development, our primary purpose in this study is to investigate the functions each type of peer plays and what helps and hinders their credibility.

Departmental and disciplinary peers are credible

STEM faculty tend to view their own department or courses as unique cases to which educational research carried out elsewhere may not fully apply [10]. As such, peer learning may be particularly effective in engineering because faculty perceive their peers' experiences to be relatable to their own. Similarity of experience allows faculty to see how innovations might be adapted to fit their own contexts. This is backed by findings that teaching innovations tend to spread by word of mouth among faculty, rather than through journal articles [11]. Faculty members find their peers' feedback on their teaching to be "more credible and relatable" and therefore more useful, than those of the faculty developers [12].

Norming learner-centered approaches and the need to change

Faculty also find benefit from sharing innovations with one another. In a study that investigated faculty reactions to a video-based peer review and improvement tool, engineering faculty appreciated opportunities to see learner-centered approaches that they initially thought would not work [13]. We frame such interactions as *near-peer*. Near peers are individuals whom we perceive as similar to us, but slightly more advanced in some areas [14]. Because of their proximity to us, they are sometimes better able to support our development. While much of the research on near peer mentors has focused on student learning, we build on this notion to characterize the role of within-discipline faculty who have already tried learner-centered teaching.

In engineering education research, the PEER Collaborative National Network is an example of how near-peer mentoring can support faculty development, albeit in that case primarily focused on supporting research capacity in a community that has fewer senior faculty [4]. As a near-peer network, it includes faculty from multiple institutions and provides not only support to develop new skills, but validation and membership in an emerging community of practice. This speaks to the importance of norming new practices and forming a space that is safe for collective discussion of teaching innovations [15].

Opportunities for faculty to discuss teaching innovations with peers allow them to critically reflect on their own assumptions and practices [13]; in turn, these opportunities function as a means to normalize the risk of making changes [16]. For instance, in a qualitative study of a professional development initiative, when STEM faculty peers discussed new methods and critiqued their teaching together, they moved from "simply applying strategies to developing a mature teaching identity" [17] and were more likely to sustain teaching change over time. Likewise, a mixed methods study of chemistry faculty found that those who made an initial attempt at using an innovative teaching technique were more likely to maintain the use of that technique and move toward learner-centered beliefs when they had continuing support from peers and mentors [18].

Experts in learning may or may not appear credible

Research presents mixed results on the effectiveness of help from faculty developers and experts in learning, in part because engineering faculty do not always view them as credible experts. When they do recognize their expertise, such collaborations have great potential to bring about change. For instance, in a professional development model that brought together learning scientists and engineering faculty to create and implement new curricula together, the engineering faculty were highly engaged, finding value in opportunities for collaborative reflection [19]; they were also more likely to teach in learner-centered ways. This finding suggests that peers from other disciplines can effectively support change initiatives in engineering.

However, because of the skepticism that faculty can hold about teaching innovations [10], they may also disregard the expertise of potential collaborators. In addition, experts in teaching and learning may need to be cautious about balancing the tension between emphasizing that their discipline has salient expertise, and providing opportunities for faculty to learn in ways that reflect the research on how people learn. For instance, in a case study of a teaching peer review program among engineering faculty, faculty developers from outside the department brought teaching and learning expertise; while their contributions were viewed as credible because of their references to scholarly sources, their contributions also limited opportunities for peer learning [12]. A challenge, therefore, for faculty developers is finding ways to assert their expertise while providing opportunities for faculty to construct their own understanding of how innovations might fit in their classrooms. Here, we also see a role for students.

A role for students-as-peers in faculty development

Although student instructors have more commonly served in lower-skill roles, such as grader, [20], they have also played important roles in making learner-centered pedagogy feasible in

high-enrollment courses by assisting with grading, managing conflicts, and checking student understanding during in-class activities [16, 21-23]. In such classes, faculty commonly develop relationships with these peer learning facilitators (PLFs) as they first seek to support their capacity to teach, and in doing so, also gain insight from them. Many faculty report seeking feedback from their PLFs as they make instructional decisions. Taking this further, some have argued that students should be co-designers. However, engaging teams of students and faculty in this way presents a clear power imbalance [24], but one that researchers have asserted can be overcome by positioning students as collaborators and discussing points of view and insights gained from these different vantage points. Others have argued that because of the power dynamics, an intermediary such as an expert in teaching and learning is needed to form successful student-faculty design partnerships [25]. We argue that because of the agentive nature of design, this role, when power dynamics are mitigated, positions student and faculty as peers.

Across these findings, we synthesize four roles that function in different ways in faculty development initiatives. First, *peers* are departmental colleagues, who, because of their familiarity with both discipline and context, may play a role in maintaining status quo or promoting change. Second, *near-peers* are disciplinary colleagues and peers from other similar disciplines (i.e., STEM) who are similar but who have embarked on teaching innovations. Third, *co-peers* are experts in teaching and learning, including faculty developers. Fourth, *peer-designers* are students who bring firsthand experience to designing and refining teaching innovations with faculty. We investigate not only how these roles functioned in a particular, long-term change initiative, but also how they complemented one another.

Methods

In this study, we explored how different types of peers supported faculty members to change their beliefs and instructional practices through multiple case study [26]. Case study is a method of qualitative inquiry in which the researcher seeks to develop a fuller understanding of the complexities and uniqueness of a particular case, rather than viewing it principally in comparison to other cases [26]. In multiple case study, a researcher selects several cases that can help them understand a phenomenon that transcends a single case. The researcher first collects and analyzes data within each case to identify themes and understand the particularities of each whole. Then, the researcher conducts cross-case analysis in order to generate findings that are supported by evidence from the analyses of each individual case. The resulting findings shed light on a research question that would not have been answered by the analysis of a single case. Cases may be conventional units, such as individuals or events, or they may be constructs or phenomena that are defined and bounded by researchers [27]. In our study, we bound cases not based on individual faculty participants, but rather by the roles we identified both through literature review and early analysis:

1. *Peers*: departmental colleagues, from those in leadership and tenured positions to junior faculty and lecturers; we included all ranks of faculty in *peers* because we have operationalized this based on the kinds of knowledge they bring to bear. While a departmental chair has power that a lecturer does not, they both rely heavily on their experiences as they make decisions about their teaching.
2. *Near-peers*: disciplinary colleagues from other universities who have already made changes in their teaching;

3. *Co-peers*: faculty developers and faculty from other programs with expertise in teaching and learning; and
4. *Peer-designers*: undergraduate and graduate students who play key roles in developing and implementing learning experiences.

Participants and setting

Set at a Hispanic-serving research institution in the Southwest US, our study focuses on faculty in a chemical engineering department engaged in a major change process to better meet diverse undergraduate students' needs. The engineering department includes 14 faculty members who commonly teach in the undergraduate program and nine faculty members whose interaction with undergraduates prior to the project was limited to research labs. Funding for the change initiative provided incentives to faculty, including summer salary and opportunities to collaborate with a learning scientist to study the impact of changes, to work with PLFs as *peer-designers*, and to learn from *near-peers* in workshops. Three departmental faculty served as leaders of the change effort, along with two co-peers. The change effort focused on developing realistic design challenges for core courses, increasing use of rubrics and attention to professional skills in assessment, and teaching technical writing in ways that align to research-based approaches.

Data collection and analysis

We collected multiple kinds of data to document faculty participation. We recorded and transcribed multiple faculty meetings, including professional development workshops, retreats, and industry advisory board meetings, observed faculty teaching, and gathered field notes and reflective accounts. To supplement these naturalistic data, we invited faculty to be interviewed using semi-structured questions, resulting in seven audio-recorded interviews that we transcribed verbatim. Throughout the project, several authors also served in roles as *co-peers* or *peer-designers*. They documented their interactions and observations using participant observation techniques [27], including field notes and analytic memoing.

Our qualitative analysis focused on types of peers and their roles, peer interactions, faculty beliefs about student potential and learning, and faculty efforts to design and implement learner-centered teaching. First, we selected data relevant to each case and coded each individual case separately using a bottom-up coding strategy. Data collected from the faculty meetings, classroom observation, fieldnotes, and participant observations were triangulated during data analysis. We conducted cross-case analysis to identify patterns and draw conclusions from a cross-case comparison approach rather than on a case-by-case analysis [28]. To protect the anonymity of participants, we use the singular *they*.

Results

We consider how the four types of peers fostered learner-centered approaches, then consider how these roles and functions worked in tandem.

Case 1: Peers

During the four years of the project, departmental colleagues spoke to each other both formally and informally about their teaching innovations. At faculty meetings, retreats, and industry

advisory board meetings, they formally shared both successes and, in one case, a "train wreck," engaging in critical and reflective discussion together. Informally, like-minded peers discussed their changes with each other and provided moral support. Many faculty were cautious and risk averse at the beginning of the project, advocating for gradual change and raising concerns about obstacles such as class size and time constraints.

> Well, I do the lecturing thing, and we have also recitations. [...] And of course in lecture, everyone's free to ask questions, and they usually don't do that the first couple of weeks.

In the second year, three faculty who primarily taught graduate courses took over a notoriously difficult class. With little more than a week's planning, they launched a sequence of three authentic design challenges. They later characterized the experience as a "train wreck," and shared this at a retreat and later at an advisory board meeting, perhaps hoping this evidence of failure would lead others to abandon the effort. Instead, they were greeted with compassion and suggestions for improvements from their peers.

As faculty participated in the formal and informal opportunities to share their innovations with each other over the years of the project, they noted changes that others were making.

> I've watched [my colleague] totally change how she teaches her classes and how she sets up her teams and stuff and how much, I know that it's more successful with her students.

Such comments normed the process of changing to learner-centered approaches and highlight the importance of a community of practice that tolerates implementation dips for making such changes.

Case 2: Near-peers

Disciplinary colleagues from other universities, particularly those who had already made changes in their own teaching, were invited to give workshops on educational research and teaching practice every year. Initially, near-peers were selected by the team guiding the change, but over time, faculty proposed near-peers they had met at conferences or while visiting other departments. The examples of teaching innovations shared by near-peers and discussed with peers during workshops further normalized the use of learner-centered approaches. For instance, one faculty member shared their experience learning from both near-peers and peers in a workshop:

> The speaker said, like, "Anybody have an idea," and I was like "I would love to change my class." And then everybody starts interjecting and saying, like, "Oh, have you tried this?" "Oh, what about this?" You know, that kind of thing. That was really helpful. We hadn't really had that kind of an interactive style before. I really like that.

Here, we see that not only did interactions with near-peers inspire and normalize the idea of learner-centered approaches, but also of collaborative efforts to make such changes. Analysis of workshops by near-peers highlights that many opened space for faculty peers to discuss how techniques might be adapted for their own context. Specifically, they left time for faculty to pose

questions, such as ways a new strategy might lead to the need to assess learning differently, practical matters tied to the logistics of implementing a new activity in terms of material storage and equipment set-up, and deeper concerns about whether activities might come at a cost to coverage. In the few times this did not occur, we note that there was no up-take of new practices. While not all workshops that included such time led to implementation, they still served as a means to normalize the changes faculty were making.

Case 3: Co-peers

Co-peers, as we have defined, can include faculty and staff with a range of expertise and titles, such as faculty developers and learning scientists [12, 19] who offer teaching and learning expertise and can provide demonstrations, troubleshoot alongside faculty, and guide a process of critical reflection. Our analysis showed that co-peers provided ongoing, threaded support and coached faculty through implementation dips.

In our study, a learning scientist shared teaching and learning expertise at critical junctures, modeled teaching innovations for faculty, coached them through implementation, and engaged faculty in collaborative engineering education research. This multifaceted support allowed faculty to implement change with less risk and helped them see educational research as a viable pursuit for them. One faculty member commented on the impact of this co-peer's involvement in the project:

> [The learning scientist]—There's a whole discipline of engineering education that disciplinary people like us who are really not trained how to teach, we don't know anything about it. So kind of by bringing that world of literature, that world of knowledge into our teaching has really been transformative.

The learning scientist worked closely with faculty, co-teaching and supporting them to reflect on "train wrecks." For instance, a faculty member explained that they kept asking students if they had questions, yet they did not ask any, and it became clear that they "should have." The learning scientist pointed out that the students may have heard "What do you not know that you should?" placing the students in a vulnerable position. The learning scientist suggested instead asking, "Can you update me on your conversation?" Faculty observed that the "constant exposure, talking about it, and seeing examples of what changes people have made to their classes" normalized that it was safe to make changes, even if the changes might need refinement.

After a faculty member raised concerns that their efforts seemed to have no impact on student writing, the team sought guidance from another co-peer, a faculty member in English, who appeared to faculty to be psychic as he correctly guessed at their approach to teaching writing, before explaining both that is has been shown to not work, and what to do instead. After assessing their interest in making research-based changes, he brokered an arrangement in which a recent graduate of his program became an embedded writing specialist, supporting faculty to learn research-based strategies to improve students' writing. This co-peer's presence in the classroom lessened the risk for the faculty member, allowing them to observe the technique in action and then adapt their own teaching techniques at a comfortable pace. For example, a faculty member who relied heavily on lecture began to step out from behind the podium and ask questions of students after having seen this modeled by the co-peer for several weeks. Later, rather than ask questions and then give the answer if students failed to do so, the faculty member

began to ask follow-up or scaffolded questions to help students think critically, as the co-peer had modeled.

In the fourth year of the project, faculty members commented on the change brought about by working with co-peers:

> So we did a one year experiment and we got [the writing specialist] involved with all the labs, even in graduate classes, undergraduate classes. [The writing specialist] helped them to make the revisions. We created rubrics together. We made all these things. In that way, the department has completely changed. So now we are re-defining the curriculum.

Thus, we see that co-peers played a critical role in supporting faculty change by modeling learner-centered approaches, bringing research-informed ideas and techniques to the table, and working closely with faculty, helping them to recover from missteps.

Case 4: Peer-designers

Both graduate and undergraduate students served as peer-designers, supporting faculty to create and implement design challenges and research-based writing instruction in their classes. In addition to the kinds of roles commonly noted, such as dealing with students' issues and connecting with them, peer-designers played a key role by providing insight into student interests. While faculty peers provided the initial ideas for design challenges, peer-designers developed much of the scenario and context for the design challenges, including identifying resources and developing activities. As one faculty member explained, their design challenge was "suggested by a colleague and further refined with the help of a student. The feedback provided by the [peer-designers] was helpful in the overall design process." Peer-designers invested time and insight, and this in turn made it more feasible and less risky for faculty to make such changes.

Cross-case analysis

We found roles served both overlapping and unique functions. Both peers and near-peers normalized learner-centered approaches. Near-peers opened spaces for discussing and adapting strategies to fit local needs and context, which peer-designers provided. Co-peers brought forward insight as peers and peer-designers planned, and also supported peers to make sense of successes and the unexpected (e.g., students not asking questions, activities that went poorly).

> I feel like without this cohort of colleagues who are making changes, […] and identifying [co-peers], and that person giving me ideas about how I could make these changes, I don't think I would have made it, right? It would be something that I will think about, but I don't know how to make the changes. […] It definitely kind of, you know, kinda moved that inertia into change, into thinking, "Oh yeah, I could do this." And then, and-oh and then, and then, you know, there are people that I can talk to, who will give me ideas about, you know—and it doesn't need to be, like, long in-depth discussions, but you know just a few discussions with, with, with, with [the writing instructor], with [the learning scientist], and, and, she said, "Oh, you should include this and this," and I was like, "Oh, okay!"

Thus, collectively, these brought about changes in faculty beliefs and practice. Revisiting the four peer types, we found the following primary functions:

1. *Peers* brought local knowledge and normed new approaches;
2. *Near-peers* opened spaces for faculty to try new approaches;
3. *Co-peers* helped faculty distinguish between hype and research, and provided insight into why new approaches succeeded or fell short; and
4. *Peer-designers* brought insider knowledge of learner experience critical to adapting new approaches to fit local context.

Discussion and implications

We explored how peer roles and functions affect faculty members' beliefs and practices in a chemical and biological department. Our analysis of data gathered over four years highlights a constellation of peer functions forming a community of practice [6]. Collectively, the peers helped position faculty as designers of learner-centered approaches. Our work is significant because it engaged not just the willing faculty who typically show up to faculty development workshops, but also more hesitant faculty. We deliberately characterize such faculty as "hesitant" rather than "resistant," because we have adopted an asset-based framework. If we want faculty to view students as having potential, then we must also find potential in the faculty.

We consider our findings in light of existing research. Research suggests that peers can serve to prevent change, using their credibility to discredit teaching innovations [10, 12]. Without additional supports, faculty who adopt and adapt such innovations can be vulnerable *lone wolves*. By engaging with a broader network of near-peers who have experience with learner-centered approaches, faculty peers have opportunities to draw inspiration and gain confidence [13]. Our work aligns to these and other findings that such experiences also help normalize these efforts and risks [16], provided there are safe spaces for discussion [15]. For instance, at a workshop, a near-peer presented her innovative work and during discussion, a faculty member asked about assessing such learning. A co-peer suggested trying two-stage testing, with students completing a test individually then collaboratively. Peers discussed this and several agreed to—and did—try it in their classes. Thus, we see that the constellation of peers functioned to inspire, norm, and encourage faculty to adapt teaching innovations. This also potentially seeds emergent change efforts [10].

Based on this, we advise faculty developers to reserve time at workshops to "norm & adapt." For instance, faculty developers could provide specific prompts that foster a sense of shared understanding, such as by showing an example of practice and providing time for faculty to begin planning not just what they can take back to their classes, but tools for how. This could mean connecting near-peers who attended the workshop and identifying peer-designers. Engaging students as peer-designers is perhaps one of the most transferrable and sustainable roles, as many students look for ways to set their resumes apart. Thus, providing time for faculty to identify members of their networks who can support them to make changes could boost their sense that they are not lone wolves. Specifically, providing the roles and functions of each type of peer, along with time for them to plan how they will engage with each peer can help them develop a plan that will normalize the experience of making adaptations. This is especially important as faculty think about their particular contexts and ways they should adapt strategies to

fit their students' particular needs. For instance, a visitor from a school that served a population in which few students worked critiqued our use of team formation software and lack of focus on extracurricular activities. We shared that a majority of our students work, and many also are care-takers, making team work particularly difficult if team formation has not included common schedules. While this may not an issue at every Hispanic-serving institution, it is one way that our faculty have considered meeting students' needs within curricular experiences.

Although past research suggests that the roles of co-peers are varied [10, 19], our results suggest an important, embedded, and long term role. Notably, brief encounters at one-off workshops are unlikely to bring about lasting change. Our results suggest that building a network of peers with different roles and functions may greatly enhance the impact, even of such workshops.

Limitations & future directions

Our study, set in a particular, single department, provided an opportunity to understand functions of peers across roles and over time, based on rich and nuanced data. Yet, this approach carries limitations. Notably, if faculty are not in a position to feel safe, they are unlikely to take risks in their teaching [29]. In our study, leadership strongly endorsed and supported change efforts, and funding provided opportunities for co-peer and near-peer involvement. Elsewhere, we report on the form of our change process [30].

Despite one "train wreck," we observed few negative reactions. Future work can compare our project to other NSF RED teams to broaden the data set to include teams that struggled to overcome barriers. Future studies may investigate ways the four peer roles function in other settings, and importantly, ways to foster the roles to function in coordinated ways in the absence of grant funds. Our analytic foci and approach to qualitative study did not focus on power dynamics at play in departmental change efforts. Elsewhere, we have begun to explore how power dynamics impact change efforts [31], but future research may elucidate in particular the conditions under which those in leadership roles should constitute a separate category, and be excluded from peers. In our case, despite power imbalances, the leader approached change enthusiastically, but with little initial understanding of how people learn. In relying heavily on co-peers, he modeled ways to interact and treated co-peers as credible. Additionally, future work that takes up credibility as an analytic lens may contribute to understanding about how co-peers and peer-designers might most effectively play roles in changing faculty practice, and ultimately, in creating more inclusive learning environments for diverse students.

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