Empowering Educators in Lab and Design Courses: A Community of Practice Approach

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Introduction

Social learning in college-level STEM education is an effective tool for instructional improvement [1, 2, 3, 4, 5, 6], benefiting new faculty and more experienced instructors alike [7, 8]. Communities of Practice focused around improving education based on evidence tend to lead to more coordinated efforts within their membership to make instructional changes, rather than having isolated "heroes" [9]. The pooling of ideas in these communities may also equip teams to address complicated instructional problems more effectively than individuals [10].

The reality of busy schedules often makes it difficult for STEM instructors to have capacity to participate in, much less lead, social learning groups to troubleshoot and improve their teaching. At our large Midwestern research-focused institution, we have observed the dissolution of our formal teaching-focused faculty community as the community became large and its purpose unclear. Meanwhile, the Strategic Instructional Innovations Program (SIIP), which provides funding and institutional structure for small multidisciplinary teams to work on emergent problems from their engineering education spaces [11, 12], has been strong for years. A collection of teams that have formed around specific projects or ideas in this formal program have continued past the originally planned lifetime of those SIIP projects.

The authors of this paper are members of a SIIP team that has operated somewhat differently than most in the program: Instead of focusing on one type of educational improvement, we have worked to build up a community of practice among laboratory and design instructors in the College of Engineering. We have found that our core group has been a useful space to explore and implement sub-projects, many of which have become papers and presentations at conferences for Engineering Education and Physics Education. We see this community and its core group as having potential to be an ongoing space; yet as we reach the end of the formal SIIP timeline, the leaders of the group are aware that formal structure and recognition are important components to ensure ongoing commitment. Ultimately, we want to use our experience with this group to propose a structure for a renewed Teaching Professionals community with support from our College's leadership in high-quality engineering education.

To that end, as core members of our Laboratory and Design instructor community, we seek to understand the functioning of our group over time, as well as how others get involved and stay involved in similar emergent, education-focused small communities. For this paper, we use a self-study to understand what has worked and what hasn't for our core group and community. We present the themes that emerge and provide initial guidance for the creation and support of similar communities in our College of Engineering or at other institutions.

The Laboratory and Design Community of Practice

The community for this self-study unites STEM laboratory and design instructors across multiple departments to discuss and share around 'pain points' that are more common across the type of instruction — that is, experiential learning — than they are across the topic of instruction (e.g.,

Physics or Electrical Engineering). We have been operating under a Community of Practice (CoP) model [13], having a core group that has ranged from 6–8 members, and offering workshops and coffee hours for peripheral members.

Our core group initially formed as a mutual support tool during the COVID-19 pandemic. At the time, six members met on a weekly basis to discuss challenges and solutions for adapting laboratory and design activities for remote and hybrid instruction. After several months working together, the team decided to formalize the project with a SIIP proposal to build up the support community for laboratory and design instructors in the College of Engineering. We have been working as a formal SIIP team since.

The core group currently consists of eight members, all of whom are Teaching Faculty or Instructors. Members of our team come from four departments in the College of Engineering and one other technology-related department. We teach and/or supervise laboratory and design courses ranging from introductory service laboratories to senior design courses; class sizes range from small (20–30 students) to large-enrollment (1000+ students). Our responsibilities include designing content, improving laboratory activity equipment and design, training and supervising graduate student instructors, and overseeing and/or improving the pedagogy of our courses.

Over time, we have found it most natural to sustain the activities of the core group, who continue to meet for an hour each week to chat about teaching and to make progress on subprojects. Participation in the core group has benefited members by providing a space to talk through ideas and get feedback for implementation in the classroom. In many ways, the core group has functioned as a think tank: this has included pooling the collective experience of our team members as well as subgroups splitting off to work together on specific subprojects. These subprojects have included coordinated interventions to improve students' communication with their group members, survey research to understand the experiences of disabled students in engineering laboratory courses, and alignment of learning objectives and practices across multiple laboratory courses in a curriculum. The experiences of this community, our pooled knowledge and advice, and the results of these spin-off projects have been disseminated through annual publication of 2–3 conference papers in the ASEE Annual Conference and Frontiers in Education Conference, workshops given by our core team members at the College, University, and national levels, and publication of several KEEN cards on Engineering Unleashed.

The original vision of the core group was to grow the Laboratory and Design CoP to include many instructors within the College of Engineering at a peripheral level. However, we have found the broader community to be difficult to grow. While attendance was initially high (10–20 people), we have found that events have become less well-attended. Many of our early events focused on sharing our experiences with the community. More recently, we have focused on providing time to chat and to organize lightning talks or other structures that invite peripheral group members to share their knowledge and brainstorm with us. Many of our pivots over time have been in response to our limited capacity to organize activities for the broader community.

Lessons Learned: Self-reflection

We have engaged in self-study to understand what has contributed to the success and longevity of the core group and what has been challenging. For this self-study, the core group dedicated three

weekly meeting sessions for conversations to reflect on the group, ensuring that all members had an opportunity to provide input. Authors Katie Ansell and Rebecca Reck took notes during these meetings to be used for thematic analysis. Additionally, members of the core group answered reflection questions about their motivation for participation and their evaluation of the group's alignment with the seven recommendations from Plessis *et al.*'s self-study of their Scholarship of Teaching and Learning (SoTL) community of practice [14]. We have studied notes from the core group meetings and the self-reflection responses to synthesize our understanding of the core group's needs. What follows are our key takeaways from the thematic analysis of both data sources.

Core members see mutual benefit in participation

The origin of this community was to share ideas and experiences, and this remains one of the most important things we do. In their self-reflections, every group member brought up this aspect of the core group as important to their participation: Everyone has something they can offer to the group, and everyone has something they can gain.

One aspect of mutual benefit is the professional development opportunity offered by discussing and addressing similar challenges we encounter in our teaching practices. For example, we have had recurring conversations about working with graduate student instructors. Ideas from these conversations have been incorporated into the core group members' teaching practices. We have extended this benefit to the local instructional community with workshops and to the broader community with a Tips and Tricks paper recently presented at ASEE.

Subprojects in this group have emerged from alignment of group members' teaching interests with an individual's research or SoTL agenda. For example, a subgroup formed to address teamwork issues in their lab and design classes, documented in Ref. [15]. A core group member with research interests in teamwork led the project and did much of the background research, while all subgroup members co-designed the intervention, implemented them in their courses, and organized their experiences. In another case, a subgroup formed to study accessibility issues in engineering laboratory classrooms (documented in [16]). A core member with experience in Engineering Education Research led the study; other subgroup members joined both to support their interests and to build their research experience. Such subprojects have typically been short-lived, typically for 1–1.5 years to complete the project and disseminate the results.

Internal and external structure support progress and output

Our core group has benefited by having one of our members take an active leadership role. This member acts as a project manager (a role in which she has previous experience from working in Industry), planning agendas for meetings, timelines for projects, papers, and proposals, and generally keeping the core team organized during our weekly meeting times. Many members reflected that the organization and efficiency of our team is not perfect — some time is spent in off-topic conversation — but the focus of the team during weekly meetings is much better when the leader member is present.

We have found it invaluable to set clear dissemination and project funding goals that are tied to deadlines and support professional success. The structure of the SIIP program that has supported our work requires annual proposals, which has cued us to have conversations that clarify our

current goals and objectives. We have found we have needed to "right-size" the role of our core group and its service to the broader community of laboratory and design instructors in the College. The SIIP program also requires dissemination, so our annual goals have included conference papers, whose deadlines require us to prioritize CoP projects within our busy schedules. Both of these aspects of external structure are also important to the team as records of sanctioned academic activity for career progress.

We have struggled to define our scope

Throughout the life of this community, we have framed it as a Community of Practice. Yet the strong aspect of our group has been with the core members, which has served as an excellent Faculty Learning Community [7] . This core focus is nevertheless inconsistent with the CoP framework, which has community membership outside the core group, and offers these members legitimate ways to participate [13].

Over several years our team has attempted to improve broader membership of the Laboratory and Design CoP (in fact, our first two years of SIIP proposals included this goal) with diminishing results. There are several potential reasons for this outcome, which likely overlap. The initial boost in participation that we observed in the 2021–2022 academic year may have been in response to the isolation of the COVID-19 pandemic, and faculty have recently become more protective of their time. Similarly, our core group members are time-limited, making it difficult to organize and publicize events and to support asynchronous communication channels. Finally, our activities designed for our community are designed with a top-down approach: the core group organizes the activities based on our interests, and it may not be clear to those members who are not in the core group how they can participate or what mutual benefit is available. All core members are aware of these difficulties and identified them in their self-reflections.

Recommendations

Based on our self-reflection, we propose the following recommendations for the development and maintenance of education-focused faculty learning communities:

Recommendation 1: Unite diverse groups around a shared idea or domain

Formal and informal aspects of mutual benefit are crucial to the engagement of team members over time. This mutuality is made possible when core group members come from different departments yet work in similar-enough contexts [17] — for us, that has meant laboratory and design courses — and are committed to improving their teaching. Similar small learning communities may be successful if they unite instructors from different departments who around improvements within an intersectional instructional context, such as finding solutions to the challenges of large-enrollment courses or navigating the blurry area between computation courses and lab courses.

Recommendation 2: Establish clear leadership

While the needs of every group differ, we suggest modeling groups with clear leadership to act as project managers for the team. Operational responsibilities should be clearly established so they do not fall by the wayside. Groups may consider co-leader models or distributing responsibilities

to limit the load on a single individual and encourage group function if the main leader is unavailable.

Recommendation 3: Provide institutional support for recognition and structure

The maintenance of a group like ours relied on the legitimacy bestowed by formal campus programs. The title and recognition benefited our core members by taking an otherwise 'extracurricular' service activity and turning it into formal leadership roles. We strongly recommend that institutions that want to promote groups like ours consider means to legitimize the work done by participating members. Such recognition may be particularly synergistic for teaching-focused faculty, whose leadership in the College can be added to their promotion dossiers. Additionally, an annual proposal and review structure helps maintain team focus by having members reexamine goals on a regular basis.

Conclusion and Future Directions

Our group is a proof of concept that a small team focused on a specific teaching area can be sustainable over several years and produce both impact on teaching practice along with output to the SoTL community, including with products like this paper. Our outreach includes ASEE and KEEN workshops, presentations to new faculty, and the growing presence of our group members as leaders in the educational improvement community at our large, research-focused institution.

As this group moves forward, we will continue reflecting on the identity of our group and its service to the Laboratory and Design instructor community. One option is to lean in to being a Faculty Learning Community without the need for building up the peripheral community, but to seek out new members via our local professional networks to bring in new ideas. However, to have a true Community of Practice we need to learn ways to partner with our peripheral community to find opportunities for mutual benefit and build values together.

The lessons learned by our community of Laboratory and Design instructors will help us be more thoughtful and deliberate about our future direction. They also offer a blueprint for the sustainability of new groups to improve teaching practices across an interdisciplinary common interest. Institutions that wish to support these kinds of communities should consider structures that legitimize the work done by members of these communities and provide frameworks for planning, goal setting, and assessing progress. By setting both external and internal structures in place, small teams of faculty and instructors can support members' professional development, empower educational improvement across multiple disciplines, and be positive, supportive communities.

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