Creating institution-level change in instructional practices through faculty communities of practice

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Introduction

The teaching culture at the University of Illinois at Urbana-Champaign is being transformed under the rallying message of "teach like we do research." The university, and Science, Technology, Engineering, and Mathematics (STEM) disciplines especially, have a vibrant, collaborative research culture that stimulates innovation and excellence. As is true at many research-intensive universities, we also have a traditional, fiercely independent teaching culture that resists the adoption of Research-Based Instructional Strategies (RBIS); transmission-model lectures are normative, and faculty often have sole jurisdiction of their courses. Prior efforts to create better learning environments had thus generally relied on "lone ranger" heroes who invested individually in their courses, but had little impact on their peers or the teaching culture at large. Beginning with the College of Engineering's Strategic Instructional Initiatives Program augmented to other STEM disciplines through NSF funding, we are undertaking an effort to transform the teaching culture in gateway STEM courses through the creation of faculty Communities of Practice[1,2] (CoPs) that organize faculty into collaborative, joint ownership of their courses.

Under this model of change, we organized faculty into course-focused CoPs, which will integrate and sustain the use of RBIS into their courses. These course-focused CoPs are organized into an institution-level network of CoPs (i.e., a team of teams), which are overseen and supported by a central cross-college leadership team. Coming from the Colleges of Engineering, Liberal Arts and Sciences, and Education, the leadership team is composed of faculty and faculty developers who have experience with RBIS and are invested in creating change. These members attend the weekly meetings of the course-focused CoPs to provide just-in-time training and cross-pollinating fruitful efforts and practices. These observations also provide rich opportunities for understanding how the CoPs formed and functioned, allowing the leadership team to characterize the habits and behaviors of effective and ineffective CoPs.

Critically, the CoP environment supports a teaching culture that aligns with our research culture, providing a structure that enables faculty to be supported in research-esque activities in their teaching activities. Within CoPs, faculty work collaboratively to identify next steps in knowledge advancement or ability. Acting as mentors, the leadership team provides just-in-time training, access to feedback mechanisms, and resources to evaluate progress and prepare for future improvements. Through these iterative implement-evaluate development cycles, it is expected that faculty will emergently adopt RBIS that meet their course design goals and objectives such as increased student learning, motivation, and retention.

The purpose of this paper is to (1) describe our initial experiences with creating the CoPs and with attempting to change the teaching culture to be one of collaborative joint ownership within CoPs, (2) describe the groups of instructors who are successfully forming CoPs and discuss the characteristics of effective and ineffective CoPs, based on observation data, and (3) describe the different RBIS that have been implemented, and the fidelity and success of implementation thus far, based on informational surveys completed by the CoP observation teams.

Background

Educational change efforts can be categorized along two axes: the intended outcome of the change effort (prescribed vs. emergent) and the aspect of the system to be change (individuals vs. environments and structures)[3]. Change efforts in engineering education have historically focused on changing either individuals through dissemination, faculty development, or by changing policies such as through accreditation standards[4]. There have been few efforts to change engineering education that are both emergent and focused on the environments and structures in which faculty practice engineering education[4]. Yet these long-term approaches that address faculty's belief systems, motivation, and institutional culture have generally been more successful than other types of change strategies[3,5-10].

Learning theories such as transformational learning theory[11,12] and other situative frameworks such as Communities of Practice[1,2,13] (CoPs) provide insights into why emergent, environmentally-focused change strategies can be effective. Decision-making during instruction and curriculum development are driven by faculty's implicit epistemologies, beliefs, and commitments. When these implicit value systems do not align with the implicit value systems of RBIS, faculty resist the initial adoption of those RBIS or will fail to persist in their use[14-21]. Transformational learning theory posits that implicit value systems can be changed only through mutual reflective engagement about communal practices[11,12] such as teaching practices or curriculum design practices. CoPs provide a place for this mutual reflective engagement, inviting faculty to engage in continuously deeper levels with RBIS, from the periphery to the core[1].

At research-intensive universities, faculty primarily engage in research CoPs. The primary mark of membership within these CoPs is recognized depth of understanding in a field of study, as demonstrated by key cultural artifacts such as dissertations and research articles[22]. These communal practices create a central identity of faculty as researchers and as experts. In contrast, the practices promoted by most RBIS do not value faculty as researchers or as experts, promoting student-centric practices that build on students' prior knowledge and experience[22,23]. The mismatch in values can create a psychological "immune response" that seeks to guard existing identities and value systems and ward off invading identities[23].

CoPs provide a safe environment for challenging this immune system, surrounding resistant faculty with respected colleagues, thus mitigating the perception of identity threat. Within CoPs, faculty engage in long-term situated learning, participating in community-valued practices[1,2,13].

Description of the Change Effort

As described by Henderson et al.'s change axes[3], the primary goal of creating faculty CoPs is to organize faculty into a new teaching environment that fosters emergent changes in the way that faculty teach and design courses. This process is moderated through our three-stage model of change (see Figure 1). First, faculty are organized into CoPs through which they will innovate their courses. Second, faculty commit to an implement-evaluate development cycle for which the CoP must commit to collecting data about their innovations and using the data to inform iterative development. Finally, we expect that the adoption of RBIS will naturally emerge without any mandates from the leadership team or administration.
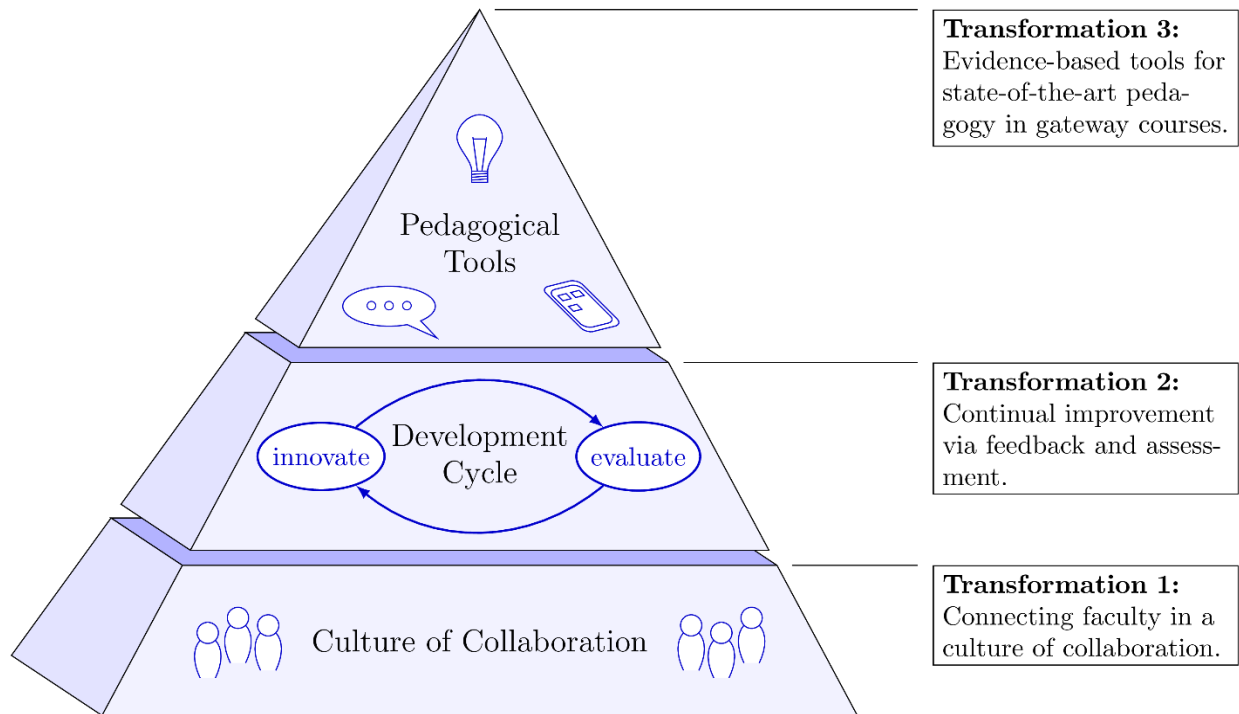
Transformation 3: Evidence-based tools for state-of-the-art pedagogy in gateway courses.

Pedagogical Tools

Transformation 2: Continual improvement via feedback and assessment.

Development Cycle

innovate

evaluate

Transformation 1: Connecting faculty in a culture of collaboration.

Culture of Collaboration

Figure 1: The three key levels of transformation that form the objectives of this project; each layer supports the transformations above.

Faculty are invited to form or join CoPs, by rallying around the simple message of "teach like we do research." This initial invitation language is critical in purchasing the preliminary buy-in of faculty to participate in the change effort without activating faculty's immunity to change. This simple message carries several important messages to maintain faculty buy-in. Like research, faculty governance is respected, giving faculty jurisdiction over how their courses are designed. Like research, improving teaching is an incremental process, in which data and peer review drive decision making and knowledge generation. Like research, teaching is a career long endeavor rather than an activity engaged in once per semester. Like research, teaching innovation must be recognized and supported by administration. Like research, faculty get to choose with whom they collaborate, creating collegial partnerships rather than receiving mandated course assignments.

To support the formation and function of these CoPs, a leadership team and an evaluation team were formed. The leadership team is composed of faculty who are advocates for RBIS, STEM-education researchers, and faculty developers. Members of the leadership team are committed to providing just-in-time resources to the CoPs as they implement their proposed course revisions. The evaluation team helps faculty collect and interpret data on how their CoPs and courses are functioning. This team's support is intended to enable an implement-evaluate development cycle that will drive faculty to the research literature and the leadership team. As faculty seek out these resources, they will identify and implement RBIS in their courses.

Formation of CoPs
To ensure that faculty perceive that their expertise and norms are valued, faculty are invited to consider how they would want to innovate their own courses. In the College of Engineering, this

process is brokered through a competitive grant process. To participate in this process, faculty must identify a community that will work collaboratively to design and implement changes to a course or set of closely related courses. During this process, faculty are challenged to begin forming their CoPs before funding for faculty-led efforts is granted. Faculty must identify the shortcomings of the course and propose potential innovations that they will pursue. The leadership and evaluation teams help the CoPs identify potential RBIS that may address identified shortcomings, but let faculty decide which RBIS (if any) to pursue. The evaluation team concurrently helps faculty develop evaluation instruments to measure progress toward stated goals.

At a minimum, CoPs are expected to meet on a regular basis (i.e., weekly) and commit to an evaluation plan. The goal of these commitments is for the faculty to create jointly-owned courses that will be delivered by various members of the CoP according to the CoP's course philosophy rather than an individual's philosophy. Changes to course format or pedagogy are the purview of the CoP. In accordance with our emergent approach, CoPs are not committed to implementing any particular RBIS.

Evaluation of CoPs
The evaluation of the project has focused on examining the formation and culture shifts of the CoPs. The evaluation is led by the evaluation team, but the leadership team also engages in project evaluation. Members from both teams attend the weekly meetings of the CoPs in the role of action researchers[24], observing faculty outcomes and behaviors but also engaging with faculty to potentially change those actions: evaluation team members focus more on observing while leadership team members focus more on advising.

Members of the leadership and evaluation teams meet on a weekly basis to discuss the progress and development of each of the CoPs. Twice per year, the evaluation team produces an evaluation report to each of the CoPs. At least once per year, the leadership team also evaluates the CoPs to determine which CoPs merit continued mentorship and membership within the larger community of CoPs. In these evaluations, teams are evaluated based on which RBIS they are implementing, the administrative support for the CoP, their commitment to collaborative development and joint ownership, their commitment to developing faculty competencies, their documentation of student outcomes, and their progress toward sustainable ownership of the course by the CoP.

According to these metrics, the evaluations and observations have revealed that CoPs vary in their effectiveness for sparking sustainable change in faculty attitudes and teaching practices. To better understand the effectiveness of the CoPs, two research-focused members of the leadership team reviewed team evaluations, interviewed other members of the leadership team, and used personal reflections from CoP observations to compose a set of metrics to describe the CoPs.

After identifying a set of metrics, these two members created CoP diagrams (see Figures 2-5) building on the idea of Legitimate Peripheral Participation. As members participate in the CoP, the perceived legitimacy of a member's practice and the centrality of a member's practice moderate how that member impacts the CoP's learning and growth. Thus, we constructed semi-circular plots that capture the centrality and legitimacy of a member's practice.

After constructing these CoP diagrams, these diagrams were shared with the remainder of the leadership team for member checking to establish the validity of the diagrams. Validity of the diagrams was established when non-creating members of the leadership could identify which CoP was represented by anonymized diagrams and agreed that the diagram matched their perceptions of the identified CoP.

Describing the CoPs

The observation data of CoPs has revealed four salient dimensions of individuals and their roles in making effective CoPs: 1) Academic **Rank**, 2) **Disposition** toward RBIS, 3) **Power** in decision-making, and 4) **Engagement** in the decision-making of the CoP. In the following figures, we have created a visualization for these CoPs.

For the **rank** dimension, we represent tenure-track or tenured faculty with a diamond shape and all other CoP members as circles. Tenured faculty are represented with a T in their diamonds, non-tenured faculty are represented with a F in their diamonds, lecturers (non-research faculty) are represented with an L in their circles, non-teaching course staff are represented with a St in their circles, and students are represented with an S in their circles.

For the **disposition** dimension, CoP members were rated on their attitude toward RBIS. Antagonist members are skeptical of the research-evidence for RBIS, actively arguing against their adoption. Ambivalent members have little knowledge of RBIS and will neither oppose nor support the adoption of the RBIS as long as other interests (e.g., time spent on the course or minimal student complaints) are satisfied. Accepting members have little knowledge of RBIS and are trusting of the research literature and peers who use RBIS. Advocate members are aware of RBIS and their associated literature and encourage their adoption by their peers.

For the **power** dimension, CoP members were rated on how much weight their opinions carried in decision-making processes. In other words, a member with higher power can veto the decision of a member with lower power. Graduate teaching assistants may have a strong influence on the delivery of a course, but will have little power with regards to decisions about course design as their decisions are subject to the approval of a faculty member. Darker shades of gray represent higher power, black members are heeded authority figures, while white members are easily dismissed.

For the **engagement** dimension, CoP members were rated on their level of involvement in the decision-making process and execution of decisions by the CoP. In accordance with CoP language, members that are on the inner semi-circles represent core members while members on outer rings are peripherally involved members. Core members attend weekly meetings, teach the course, and execute course reform efforts. As the radius of a member increases, they lack engagement in one of these aspects (e.g., they may teach the course and are committed to the reform efforts, but do not attend weekly CoP decision-making meetings, accepting the decisions of the CoP after they have been made). Peripheral members are typically departmental administrators who may provide occasional input, but are not engaged in any day-to-day operations of the CoP.

To facilitate understanding of the diagrams, we describe the diagram for CoP B in Figure 2 in depth. CoP B is led by a tenured member (member B.1) of the project leadership team. This member organizes weekly meetings, instructs the courses targeted for reform, and advocates for the adoption of RBIS. Thus this member is represented on the center ring of the CoP, toward the advocate rank with high levels of power (black color) in decision making.

Member B.2 is a head graduate teaching assistant who has taught the course multiple times and helps maintain organization of the CoP meetings. He enthusiastically helps execute innovations and contributes to decision-making, but has no ability to veto the decisions of other members and no particular knowledge of RBIS, thus member B.2 is in the center ring but has no power (white color).

Member B.3 is a lecturer who was historically responsible for teaching the courses targeted for reform by the effort. Due to his resistance toward the implementation of RBIS in the course, the tenure-track faculty were able to lobby for teaching assignments that removed this member from instruction of the course, thus this member is on the outer ring of the CoP with no power (white color) and no legitimate peripheral participation.
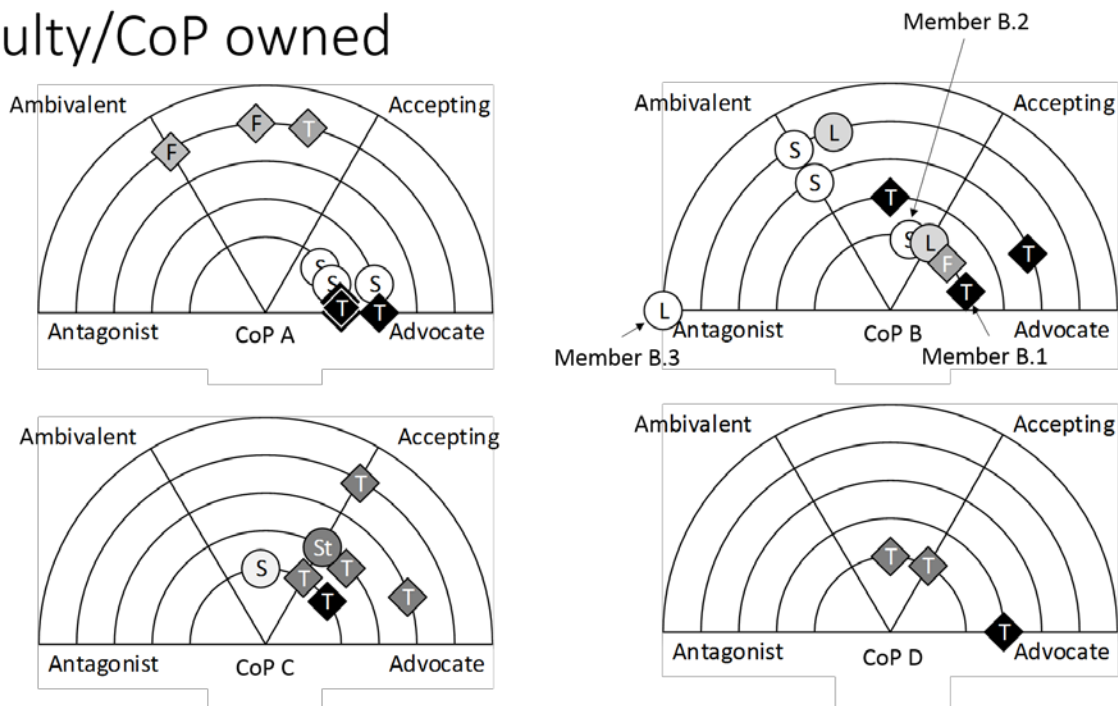

Figure 2 – Faculty-led CoPs who owned the teaching assignments and design of their courses. T – Tenure-Track faculty, F – non-tenured Faculty, L – Lecturers, S – Students, St – Staff.

Identifying the characteristics of effective CoPs
Based on the leadership team's assessments of high functioning and low functioning teams and the CoP diagrams, we identified two primary characteristics that predicted the particular challenges and behaviors of the CoPs. First, the structure, membership, and function of the CoP was moderated by whether tenure-track faculty or lecturers were primarily responsible for

instructing the courses targeted for reform by the CoP. Second, the level of functioning of the CoP was moderated by how teaching assignments were made.

While some departments assign their tenure-track faculty to teach gateway courses, others rely on lecturers to teach them. When faculty are responsible for teaching the course, the CoPs have demonstrated an increased potential for disseminating RBIS between faculty (See Figures 2 and 4). While tenure-track faculty want to sustainably improve instruction in gateway courses, most have upper-division and graduate courses that they also would like to teach, creating an incentive to recruit like-minded faculty to join the CoP. By recruiting new CoP members and engaging them in legitimate peripheral practices, responsibility for the actual instruction of the course can rotate between members of the CoP, exposing more faculty to the RBIS and potentially changing beliefs and practices within the department and relieving a burden of teaching the same course repeatedly. In contrast, lecturers are often assigned to teach a single course or a couple courses repeatedly. Lecturer-centric CoPs (See Figures 3 and 5) tend to form around several lecturers who each teach their own course. Practices are shared between members, but tenure-track faculty are unlikely to be recruited or centrally engaged in the CoP. While each lecturer-centric CoP had tenure-track faculty verbally commit to the CoP before formation, few of these faculty actually maintain any form of engagement with these CoPs.
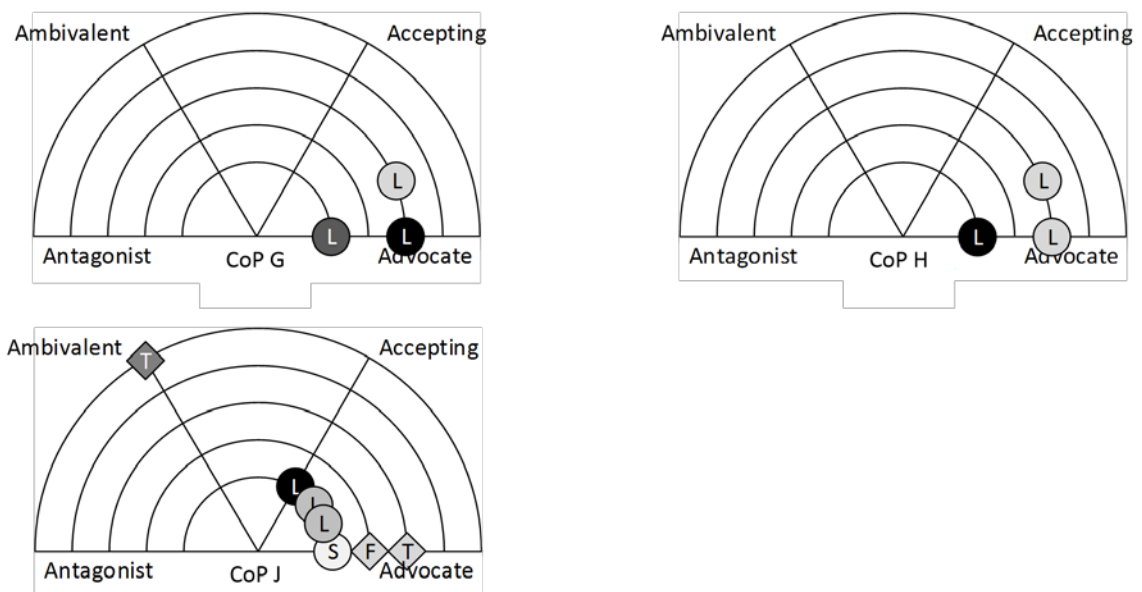

Figure 3 – Lecturer-led CoPs who had control over teaching assignments or had profound ownership of course designs and structure. T – Tenure-Track faculty, F – non-tenured Faculty, L – Lecturers, S – Students.

Administrative practices toward teaching assignments also play a critical role in the formation of CoPs. When faculty or lecturers become defacto CoPs because they are jointly assigned by an administrator to teach a course, collaboration and community formation are undermined. For example, CoPs E and F were formed in response to initial efforts to create institutional change, but have since dissolved because the CoP members refused to meet on a regular basis to discuss

course innovations. Similarly, because an instructor has historically been assigned to CoP L and been allowed to work autonomously, CoP L failed to develop a community of lecturers and faculty who were committed to the efforts. CoPs K and M faced initial similar challenges, but are slowly developing community and collaborations, becoming more like the lecturer-led, CoP-owned innovations.
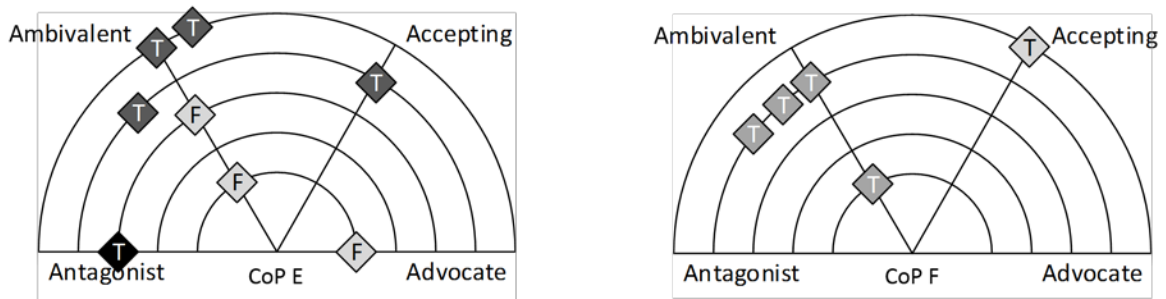
Faculty/Department assigned

Figure 4 – Faculty-led CoPs whose composition was primarily dictated by administratively assigned teaching assignments. T – Tenure-Track faculty, F – non-tenured Faculty.
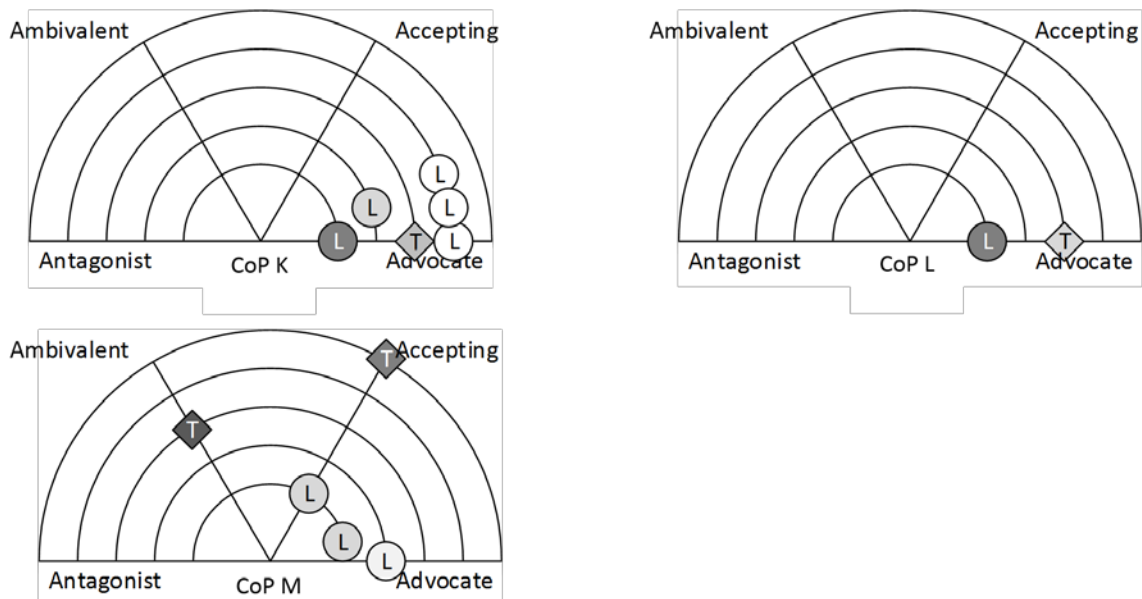
Lecturer/Department assigned

Figure 5 – Lecturer-led CoPs whose composition was primarily dictated by administratively assigned teaching assignments. T – Tenure-Track faculty, L - Lecturer.

Adoption of RBIS

As expected from our change model, the CoPs have been emergently implementing various RBIS into their courses. To learn which ones have been implemented, as well as the fidelity and success of implementation thus far, the CoP observation teams completed informational surveys

for each CoP. These surveys listed several RBIS and their definitions (provided below), and consisted of four questions:

- Did the CoPs use any of these RBIS? Possible responses were (a) The CoP never used it, (b) The CoP tried it for <1 semester, (c) The CoP tried it for 2-3 semesters, or (d) The CoP tried it for >3 semesters.
- If the CoP used any of these RBIS, what was the fidelity of adoption? Possible responses were poor, adequate, good, or very good.
- Please describe how the team used each RBIS, and your perception of the fidelity of implementation.
- If you selected "Other," please describe the RBIS, how long it was used for, and your perception of the fidelity of implementation.

Seven RBIS were included in the survey:

- Case studies: Case studies are "narratives that present real-life scenarios/problems and allow students to experience how professionals address problems encountered in the field[25]."
- Collaborative learning: In collaborative learning, students work together in small groups to "become knowledgeable of some particular subject matter[26]" or to achieve a goal.
- Project or problem-based learning: In project-based learning, students work on "one or more open ended projects[27]," and in problem-based learning, students work on "complex, ill-structured problems[28]." Problem and project-based learning are similar to each other in that they involve students working on complex projects or problems, often in a "real world" context.
- Flipped courses: In a flipped course, lectures are delivered outside of class, such as through a video, and in-class time is used for active learning activities[29].
- Peer instruction: Given a question, students take time to think about an answer on their own, and then work in small groups to discuss their answers and "convince each other of the correctness of their own answer by explaining the underlying reasoning[30]." Peer instruction can take place with or without the use of clickers.
- Labs/field work: Opportunities for students to practice what they learned in lecture, typically in a setting other than the classroom.
- Online access to course materials: This can include videos of lectures for students who were absent or would like to watch again, and any other materials.

<u>Survey results</u>

The survey results indicated that each RBIS was used by at least one of the CoPs, although the fidelity of implementation did vary.

<u>Case studies:</u> One CoP has used case studies for 2-3 semesters and has been doing so with high fidelity, as rated by the observation team. This CoP presented case studies in class throughout the semester, and the case studies were typically led by different members of the CoP.

Collaborative learning: Four CoPs have been using collaborative learning for two or more semesters and have been doing so with high to very high fidelity. Students work together on assignments and often have both individual and group accountability.

Project or problem-based learning: Two CoPs have been using PBL for two or more semesters, and one CoP has just started using PBL and is in its first semester of implementation. The fidelity of implementation varies by CoP: as expected, the CoPs that have been using PBL the longest have a high or very high fidelity of implementation, while the CoP that has just started using PBL has a fidelity rated as adequate by the observation team.

Flipped courses: Four CoPs currently use elements of a flipped course: two CoPs have been doing so for more than three semesters and two CoPs are in their first semester of implementation. The former have a very high fidelity of implementation, as they have been using the flipped model for several semesters (years, in one case); the latter, being new to the flipped model, were rated as having a low fidelity of implementation.

Peer instruction: Peer instruction is being used by seven CoPs, with six of these using clicker questions as part of the peer instruction. These six CoPs have been using peer instruction for at least two semesters; the seventh CoP is in its first semester of implementation. Fidelity of implementation varies from very low (two CoPs) to high or very high.

Labs/field work: Four CoPs incorporate labs and/or field work throughout the semester and have been doing so for two or more semesters, with high or very high fidelity.

Reflections on the effort
Our efforts to create course-focused CoPs is demonstrating immense promise for creating an effective model for the sustainable, emergent adoption of RBIS. As described by Henderson et al.[5], this model focuses on changing the environments and structures around faculty to maximize their chances of successful change. Our observations of these CoPs have identified two critical structures that must be considered when forming these CoPs. First, change agents must consider who bears the primary responsibility for teaching courses. CoP formation and outcomes will vary depending on whether faculty or lecturers are responsible for instruction. Second, change agents must consider how teaching assignments will be made. CoPs whose membership is controlled solely by administration are less likely to be successful.

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