

## **Spreading Evidence-Based Instructional Practices: Modeling Change Using Peer Observation**

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*Evidence to date that active, student-centered learning in mathematics classrooms contributes to desired student outcomes has now accumulated to compelling levels. However, promoting and supporting widespread use of alternative practices is challenging, even amongst practitioners open to such changes. One contributing factor is the fact that a majority of instructional change efforts focus on only a small portion of the instructional system, while true transformation requires systemic reform. Successful institutional change initiatives have been shown to involve common features: they involve ongoing interventions, align with individuals' beliefs, and work within the existing landscapes of institutional values. Here we propose a theory to support instructional change in undergraduate mathematics by adding a new dimension – instructor peer observation– to an existing model for institutional change (the CACAO model), thereby aligning with evidence regarding what promotes effective change. An exemplar is given to illustrate how this theory might be realized in practice.*

**Keywords:** Institutional change, instructional change, active learning, peer observation

### **Introduction**

Significant evidence supports active learning as critical for student success in mathematics classrooms. Freeman and colleagues' 2014 meta-analysis of 225 studies found significant improvement in student grades and pass rates in classrooms with active elements compared to those with only lecture. Many other studies have identified additional benefits in active learning classrooms, such as demonstrable conceptual learning gains (e.g., Kogan & Laursen, 2013; Kwon, Rasmussen, & Allen, 2005; Larsen, Johnson, & Bartlo, 2013), reduced disparity between dominant and historically marginalized groups (President's Council of Advisors on Science and Technology, 2012; Kogan & Laursen, 2013; Riordan & Noyce, 2001), continued student gains in future classes (Kogan & Laursen, 2013), and improved STEM retention rates (Rasmussen & Ellis, 2013; Seymour & Hewitt 1997). In light of the mounting evidence, the National Science Foundation has called for wider propagation of interactive instructional methods (NSF, 2013).

Despite the clear evidence of effectiveness and the national mandates for change, classroom instructional practices do not reflect a prevalence of student-centered approaches. Lecture still dominates (Johnson et al., 2017; Hora, Ferrare, & Oleson, 2012) and, according to the National Science Foundation, "highly effective teaching and learning practices are still not widespread in most institutions of higher education" (NSF, 2013, paragraph 67). Change is difficult: even when instructors want to change and believe they can, lecturing persists in undergraduate mathematics (Johnson, et al., 2017). Providing people with evidence that active learning works is not enough to motivate change (Foertsch, Millar, Squire, & Gunter, 1997; Reese, 2014; Dancy & Henderson,

2010), and even disseminating research-based “best practice” curricular materials is insufficient to support meaningful shifts in undergraduate STEM instruction (Henderson, et al., 2011).

Some researchers have been working to provide ongoing supports to practitioners trying out innovative curricula, in the hopes of helping them successfully implement and sustain new practices (Lockwood et al., 2013; Johnson, Keene & Andrews-Larson, 2015). Because instructors must develop new knowledge and skills in order to teach in student-centered ways (e.g., learning how to elicit and understand student thinking, lead effective whole-class discussions, and build on student conceptions and strategies to advance course content goals), these professional development efforts focus on combating the finding by Henderson et al. (2011) that interventions lasting less than one semester were ineffective. These change initiatives focusing on ongoing supports have had some lasting success (Lockwood et al., 2013), but the cost is high. In one model, instructors are provided with comprehensive curricular materials and asked to engage in regular, ongoing (virtual) collaboration with other colleagues, thus the commitment required is extremely large. While effective, this type of intervention is feasible only for those with advanced practice who are interested in significant reform. This paper offers a more accessible alternative to these advanced-practice interventions, which targets instructors at any stage of the adoption spectrum. Namely, we propose peer observation as a research-aligned tool for supporting and sustaining systemic change of teaching culture.

### **Institutional Change Theory and the CACAO Model**

Theories of and models for organizational change are myriad and, though often contextualized for the business and non-profit sectors, pertain to all types of organizations, though their adaptation to the educational context is relatively recent (Reinholz, 2017B). Change models range from “top-down” strategies that rely on policy set by organization leaders to “middle-out” and “bottom-up” approaches that initiate change from the starting point of individuals, or that target departments or other small teaching units. In 2011, Henderson, Beach, and Finkelstein conducted a meta-study of 191 published reports of organizational reform efforts that specifically addressed instructional change in STEM higher education. The authors identified four broad categories that captured the salient differences across the collection of systemic change initiatives. All approaches could roughly be characterized as focusing on one of the following: (1) disseminating curriculum and pedagogy, (2) developing reflective teachers, (3) enacting policy, and (4) creating a shared vision. These four headings emerged from their observations that change strategies tended to fall along one spectrum that measured intended outcomes (wherein efforts to achieve outcomes could be either *prescriptive* or *emergent*) and along another spectrum measuring the aspect of the system being targeted (either *individuals* or larger *environments and structures*). Taken together, these two axes suggest quadrants that distinguish types of approaches. For example, a project in the “disseminating curriculum and pedagogy” quadrant is characterized by a prescriptive effort that targets individuals rather than overall institutional structures (i.e., “*here are some teaching materials that you should use*”).

Amongst the various approaches implemented, it was found that two change strategies commonly used in education – providing teachers with “best practice” curricular materials, and enacting top-down policies intended to levy new practices – were “clearly not effective” (Henderson, Beach & Finkelstein, 2011). These authors, however, also distilled three features common to all the systemic change programs deemed successful with respect to realizing some portion of the intended outcomes. The salient take-home messages for change agents are as

follows: effective projects (1) align with the beliefs of the individuals involved (or seek to change their beliefs), (2) include long-term interventions (beyond one semester), and (3) are compatible with the broader institutional culture and structure (Henderson et al., 2011). These findings communicate an important message for the RUME community: disseminating research-based curricular materials may be a necessary component for widespread instructional change, but is insufficient to promote lasting change. Moreover, agents of reform must balance change efforts targeted at individuals with those addressing the larger systems at play.

The CACAO model for institutional change, described below, is one theoretical paradigm that has been adapted for use in higher education and has been applied to a variety of programs in which change agents want to promote an institution-wide shift in teaching practices (Maker, et al., 2015). A synthesis of models previously developed by Kotter (1990) and Rogers (2003), the CACAO model was introduced by Dormant in 2011 and integrates top-down and bottom-up approaches in order to leverage existing institutional supports and mitigate barriers to change. The model is flexible enough to allow change agents to weigh the benefits and drawbacks of the proposed change, incorporate the beliefs of adopters and their relative stages of adoption, and consider the institutional context in recruiting a diverse project team and developing a customized plan. As such, the CACAO model is naturally well positioned to include multiple of the “necessary” conditions observed by Henderson and colleagues (2011).

There are four dimensions addressed by the CACAO change model: Change, Adopters, Change Agents, and Organization. The *Change* dimension considers the proposed change itself – in our case, more widespread adoption of evidence-based instructional practices in undergraduate mathematics classes -- and guides an examination of the likelihood that a proposed change will be adopted by key stakeholders (i.e., instructors) by identifying existing incentives to change while anticipating and mitigating potential impediments. The *Adopters* dimension considers the audience – those poised to consider making the change – as well as the various “stages of adoption” that may describe a potential adopters' current mindset relative to change (awareness, curiosity, mental tryout, actual trial, sustained adoption). For example, the CACAO model would suggest that someone who is merely curious about the change but not yet ready for an actual trial is presented with the “2-minute elevator pitch” on the proposed change, rather than the one-hour, in-depth presentation that might be motivating for an adopter in the “mental tryout” stage. *Change Agents* is the dimension in the model that offers recommendations for building an effective leadership team with diverse expertise and broad influence with regard to proposed adopters. Finally, *Organization* is concerned with identifying and leveraging the complex organizational hierarchy and appropriately matching personnel with important roles within the change implementation plan. This dimension of the CACAO model is critical in identifying agents who can act as exemplars, early adopters, and opinion leaders, and who can provide perspective to new members about why the proposed changes are important to the overarching project goals and to an individual’s personal goals.

### **Peer Observation**

Peer observation among instructors has been shown to be an effective tool for promoting and sustaining instructional change. In particular, structured peer observation has been shown to (a) stimulate reflection on one’s own teaching practice (Bell, 2001; Cordingley et al., 2005; Cosh, 1999; Reinholz, 2015), (b) improve collegial relationships and collaboration (Carroll & O’Loughlin, 2014; Shortland, 2010; Reinholz, 2017A), and (c) provide on-going support for

shifts in teaching (Byrne, Brown, & Challen, 2010; Martin & Double, 1998). An unexplored outcome of peer observation is its potential to transform teaching culture across an institution. We describe how previous literature on peer observation fits with this theory of local instructional change, and posit a theoretical contribution of how peer observation can be leveraged toward sustained institutional transformation.

### **Peer Observation to Support Reflective Practice**

The model of peer observation we consider is one that relies on personal reflection and close-knit cohorts, rather than external judgment, as the catalysts for change. Gosling (2002) characterizes this type of peer observation model as *collaborative*: rather than focusing on training or evaluation outcomes, the collaborative model focuses on developing teaching through dialogue, reflection, and collaboration.

The role of the observer is radically different in the collaborative model than in an evaluative observational approach. Rather than observing with the intention of making judgments upon others, the observer seeks active self-development. As Cosh (1998) elegantly explains, “the rationale of the observation here [is] to make us aware of different approaches, to encourage an open-mind and questioning attitude, and to provide an environment in which we can reassess our own teaching in the light of the teaching of others” (p. 173). Thus the observation serves as a mirror: the observer can more readily see themselves in the reflection of others. The observer is also freed from the cognitive constraints of teaching to notice elements of instruction more aptly (Reinholz, 2017A).

### **Peer Observation for Sustained Individual Change**

Peer observation has the potential to impact instructional change in a way that some professional development programs do not: it targets an instructor’s beliefs about mathematics instruction. Many researchers have noted that instructional change is extremely difficult, in part because our teaching practices stem largely from our beliefs about mathematics and mathematics instruction (Ambrose, 2004; Cooney, 2002; Stipek et al., 2001). Understanding learning theories or improved curricular materials typically has little lasting impact on instructional practices (Silverthorn, Thorn, & Svinicki, 2006). Peer observation offers the opportunity to expand one’s breadth of teaching styles and approaches. As part of peer observation, the peer is immersed in the classroom and takes part in the visceral experience similar to that of a student. We posit that this experience can be more powerful than a video club-style professional development program (which has been shown to have lasting impacts on instructional change) (Sherin & Han, 2004).

### **Peer Observation to Improve Collegial Relationships and Foster Community**

Ongoing peer observation initiatives also have the potential to develop communities of practice, a critical element in sustained change. Rather than being evaluated by a more senior mentor, graduate teaching fellows who participated in peer observations noted greater camaraderie with their fellow peers (Reinholz, 2017A). However, the expectations for peer observation must be carefully managed: exposing one’s teaching practice to a colleague and inviting feedback makes one vulnerable. If achieved, though, this vulnerability can lead to trust and deeper professional relationships.

## **Linking Peer Observation to Institutional Change**

As discussed, collaboratively-oriented peer observation programs have been shown to impact individual instructional practice. This theoretical report describes how peer observation can be leveraged toward institutional change as well. Sustained, low-stakes (i.e., non-evaluative) peer observation aligns with all three of Henderson and colleagues' (2011) elements of successful institutional change programs.

### **Alignment with Beliefs**

As described previously, peer observation has been shown to develop and promote self-reflective practice. In the process of self-reflection, instructors have the opportunity to articulate their beliefs more clearly; only when made explicit can beliefs be examined and possibly changed. The experience of being in a class and observing from the point of view of a student may create productive conflict within the observer's beliefs (*What does it mean to engage students?*) and help problematize their own classroom practice (*Are my methods as effective as I hope? Could my students benefit from what's being modeled here?*). Additionally, when the observed instructor hears feedback about their teaching that conflicts with their own self-image, it creates an opportunity for them to reflect on their beliefs from this alternate perspective. Putting beliefs in direct conflict with one another is how beliefs change (Gill, Ashton, & Algina, 2004). Thus, peer observation can be helpful in drawing out and formalizing one's own beliefs, engaging with the beliefs of others, and potentially shifting beliefs as a result of experiencing different teaching practices. Of course, there is a risk that peer observation will reinforce an instructor's existing beliefs in an unintended way: upon seeing another instructor struggle to implement a student-centered activity, an observer predisposed to lecture might conclude that lecture is indeed the preferred way to teach. The hope in this case is that the self-reflection and peer-to-peer conversation built into this collaborative observation model are enough to compel participating instructors to reflect on how change might serve them and their students.

### **Long-Term Intervention**

Peer observation (as formulated here) is also a long-term intervention. In our proposed model, instructors collaborate for an entire year, mutually observing one another (in pairs or trios) at least twice a semester. Unlike some interventions that can be extremely costly to implement, peer observation has very little cost in terms of curricular adoption (though there is the cost of instructor time). It can "grow with" the participants, supporting instructors at various stages along the adoption spectrum. For example, those merely curious about active learning are given the opportunity to try-out the practices mentally when observing student-centered teaching in action. At the other end of the adoption spectrum, instructors with advanced evidence-based practices will benefit from the sustained support from regular peer observations and the relationships developed therein.

### **Alignment with Institutional Culture**

Finally, peer observation is a practice that can be molded to fit within virtually any institutions' culture. Presently, formative peer observation is not widely employed within collegiate instruction. Many instructors of mathematics enjoy the privacy and autonomy of their classrooms: opening up one's classroom can be uncomfortable and potentially invasive. However, even though formative peer observation is not currently a part of the teaching culture

at many institutions, it can be leveraged as a tool that addresses other institutional concerns. For example, if used conscientiously and carefully, it can provide a platform for better informed insights into peoples' classrooms and, in turn, benefit teachers, students, and administrators alike. It has been well documented that student evaluations are systematically biased (e.g., Centra & Gaubatz, 2000), and yet reviews from students form the primary assessment measure for teaching at most institutions. Many faculty are dissatisfied with the "consumer-based" model of education this implies. On the other hand, having specific feedback from colleagues who can attest to the reflective growth one's practice has undergone could be especially helpful in awarding teaching accolades or offering informed perspectives that supplement student evaluations in letters for promotion cases. Thus, while peer observation can be introduced to shift teaching culture, its potential to address other institutional needs could add both to the longevity of the change effort and its fit with the institution.

### Instantiation

The REFLECT project is an example of how change agents are applying the CACAO model together with collaborative peer observation to encourage systemic change across STEM departments on the campus of one small, private, comprehensive institution in the Pacific Northwest. The goal of the REFLECT project is to increase the awareness and use of evidence-based and student-centered practices by STEM faculty on campus, while helping shift the teaching culture to one that widely embraces active learning and views peer observation as a valuable and regular part of reflective teaching practice. Project organizers considered all facets of the CACAO model and identified a number of affordances specific to the institution that could be leveraged in support of the project (e.g., growing interest among faculty for evidence-based practices, an administration that supports reflective and innovative teaching, a desire among faculty for teaching feedback that is not student-based). They also identified ways to mitigate potential barriers to change (e.g., avoid top-down pedagogical prescriptions, work with entire departments to build support for change, compensate participants for their time), and identified key players who could support and enhance institutional change (e.g., the university provost and president, regional experts, respected faculty opinion leaders).

The REFLECT project has three major components: (1) a week-long "innovation institute" designed to expose participants to rationale and techniques for implementing active learning, forge collaboration between new adopters, and provide planning time; (2) a one-day peer observation training, wherein participants examine, refine, and practice applying a protocol focused on student-centered teaching (via a customizable rubric); (3) monthly lunch gatherings to discuss teaching practice; and (4) an ongoing peer observation cohort consisting of both participants and project leaders, intended to provide continuing support for adopters by fostering reflection on participants' teaching through conversation and shared experience. An overview of the REFLECT project components and how they align with the Henderson et al. (2011) findings is shown in Figure 1.

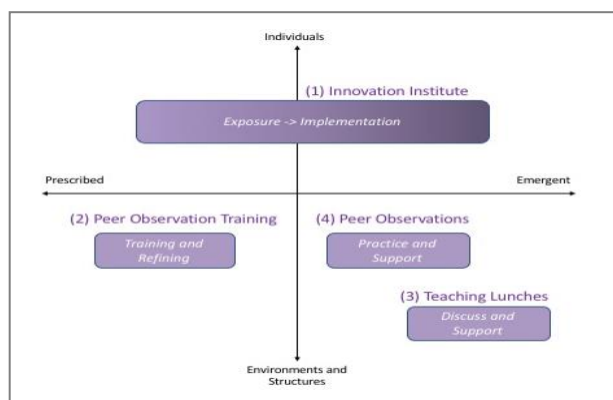


Figure 1: Summary of REFLECT project components mapped to Henderson et al. (2011) framework.

The observational protocol includes three components: pre-observation discussion prompts, a customizable rubric for observation, and a post-observation discussion and reflection. The pre- and post-observation meetings are intended to build trust, establish instructional context, and provide formative feedback (post-observation) from the observer's perspective regarding topics of the observee's choosing. The rubric is designed to provide both guidance for the observer and individualization for the observee. For example, the observee is asked to select one dimension of practice they would like the observer to focus on during the observed class (such as responding to student thinking, use of technology, goal-oriented instruction, or others). The observee then reflects on where various aspects of their current practice fall within the rubric, which in turn provides aspirational examples for advanced practice without implying judgment or inviting summative external evaluation. While the rubric targets specific components of effective instruction, any new teaching practices implemented are determined primarily via self-reflection and cohort feedback. As such, specific changes being adopted by instructors are emergent, rather than prescribed, and can align more effectively with participants' beliefs. Further, beliefs are made explicit and then examined in the pre- and post-observation discussions. Since these conversations are necessarily conducted by instructors immersed in the ambient teaching culture on campus, they imply an understanding of the broader institutional context. Thus, used with other elements in the CACAO framework, the peer observation protocol helps achieve balance between the emphases on individual and community, and avoids the main pitfalls of the unsuccessful efforts identified by Henderson and colleagues (2011) (namely, disseminating specific pedagogical materials and enacting top-down policies for change). Furthermore, this model allows change agents to incorporate the three dimensions evidenced as necessary for success: the proposed changes align with participants' beliefs (or seek to change them via self-reflection and community conversation), involve ongoing supports (a year or more of collaborative peer observation), and are consistent with the broader institutional context (in which reflective and innovative teaching are celebrated).

## Conclusions

Peer observation is demonstrably effective for increasing self-reflection and promoting *individual* instructional change. In this theoretical paper, we propose peer observation as a powerful tool that will enhance an existing model (CACAO) for systemic *institutional* change by helping it address the dimensions common to successful change efforts identified in Henderson et al. (2011). To date, it appears that this particular combination of a CACAO-based program for organizational change with a formal peer observation framework is untested, and thus represents a new theoretical contribution. We believe it offers a promising direction for change agents who wish to promote instructional change at scale, particularly in cases where the institutional context is similar to that in the REFLECT project. Moreover, by tying work already being done by the RUME community (in developing research-based curricular materials, and examining what supports are needed to help instructors reshape their teaching practice) to further evidence about how to achieve institutional change, this offers compelling invitations for RUME researchers who wish to accelerate the uptake of student-centered practices.

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