



## **Moving Toward Student-centered Learning: Motivation and the Nature of Teaching Changes Among Faculty in an Ongoing Teaching Development Group**

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## **Motivation and Background**

This research paper describes a study of science, technology, engineering, and mathematics (STEM) faculty who are participating in ongoing teaching development communities. The research literature provides a wealth of evidence that student-centered learning and practices that encourage student engagement positively affect learning and retention in STEM courses, particularly for underrepresented groups in STEM [1]. Despite evidence of effectiveness, STEM instructors can be hesitant to adopt research-supported practices for student-centered learning. Hence, identifying effective methods to bridge the gap between STEM education research results and classroom practice is a topic of significant interest. While a variety of workshops and similar one-time interventions have been developed to help STEM instructors adopt research-based teaching practices, research in professional development suggests that ongoing teaching development is much more effective than one-time efforts [2], [3], [4].

Building on the research results of the K-12 education community, we created a network of faculty learning communities [5] to support instructors as they learned about and implemented research-based interactive teaching strategies. The structure of these learning communities is described in more detail in the next section. A main element of the communities is that participants were asked to select a research-supported interactive teaching strategy to implement in the course(s) they taught. The learning community served as a forum for gaining ideas of possible strategies, as well as for sharing plans and results and receiving informal feedback and support on both. Rather than adopting particular prescribed strategies, participating faculty identified strategies that were of interest to them and/or addressed a challenge they were facing in their course(s). Hence, we are interested in learning about what strategies faculty chose and what factors motivated their decisions.

In this paper, we consider the following research questions: What are the motivations identified by instructors for participating in an ongoing teaching development group and changing their teaching practices, and what is the nature of the teaching changes participating instructors choose to make? We examine the reasons instructors cite for choosing to participate in a teaching-focused learning community, in particular whether and how these reasons relate to specific challenges and/or opportunities in their course(s). In addition, we study the choices made by participating instructors with respect to the nature and degree of teaching changes and the new strategies they implement in their course(s). Data to answer these questions is drawn from interviews with group participants and leaders, as described further in Methods. In the following section, we provide a description of the project under which the network of teaching development groups was established and the structure and intended purpose of the teaching development groups. Analysis of instructors' motivations for participating in teaching development and their choices around implementing research-based teaching strategies provides insight about what aspects of ongoing teaching development are most valuable to instructors and about what types of change toward student-centered interactive learning are most attractive.

## **SIMPLE Teaching Development Groups**

Supported by a grant from the National Science Foundation, this project focused on the formation and study of a network of ongoing teaching development groups (TDGs) in STEM disciplines [6]. The TDGs, which typically had five to eight members, were discipline-specific to facilitate sharing of ideas in similar courses and with similar backgrounds. Each TDG operated within a different STEM department. Each TDG was facilitated by a group leader who either participated in a year of training before leading or was part of a TDG in the year before s/he served as a leader.

Each group met regularly -- anywhere from every two weeks to a few times a semester. The focus of meetings varied by group but was generally a combination of learning about teaching strategies and sharing teaching experiences, particularly with respect to trying new strategies. Instructors worked together to become familiar with, implement, and revise/improve research-based interactive teaching strategies. Many groups employed resources for learning about research-based practices (e.g., [7], [8]). Group leaders were not given detailed instructions about meetings but were instead encouraged to facilitate the group in the manner most beneficial to the participants. As such, the level of structure varied significantly from group to group; some groups created formal agendas for each meeting, often inviting guest speakers, while others allowed conversation to flow based on topics participants brought to the group that day.

As part of participation in a TDG, instructors were asked to select at least one research-based strategy for interactive teaching that they would adopt in one or more of their courses. They were asked to share the planning and implementation process with the group, as well as to share results of trying the new strategy. Participants were also asked to write a design memo as a mechanism to reflect on the change they made and to share their teaching efforts more broadly so others could learn about the strategy. The memo described the strategy the instructor implemented, their motivation for selecting it, how they implemented it in their course, and potential challenges others might face in implementation.

Groups were very flexible in terms of structure but were designed to follow the SIMPLE Design principles, which were constructed based on our experience with faculty teaching development groups in a previous small-scale exploratory project. The principles are Sustainable – small ongoing groups; Incremental change – small, doable change; Mentoring – supportive environment; People-driven – responsive to individual needs and interests; Learning Environment – interactive teaching. The design principle is enacted by documenting change through design memos. Teaching was viewed as a design process in which instructors identified challenges, implemented solutions, assessed results, and revised accordingly [9]. The design memos were constructed to provide a tangible form for documenting the design process. The people-driven principle, supported by [4], is most tightly connected to the questions addressed in this paper about motivation to participate and choices about if/how participants change their teaching. Instructors are motivated to participate by their own teaching interests and are introduced to a variety of possible strategies. Similarly, instructors make individual decisions about what strategies they will use and how they will implement the chosen strategies.

## Methods

This study takes place in a large public university with a strong research focus (R1 designation). Six TDGs are included in the analysis. These groups operated in mathematics, global and community health, computer science, biology, physics/astronomy, and civil engineering. This paper considers the TDGs' activities over two years. All groups were formed in year one of the two-year span, with the exception of the global and community health group, which was formed in year two. It should be noted that the computer science group changed significantly between years one and two; it was originally a cross-disciplinary group including computer science, electrical engineering, and bioengineering, but in year two it became wholly a computer science group. The group leaders for the mathematics and physics/astronomy TDGs changed between years one and two, but the structure and participation across the two years were largely the same.

As mentioned above, each TDG was facilitated by a group leader. The initial round of group leaders was invited by the project organizers who identified STEM faculty who had shown an interest in interactive teaching. Group leaders who took on the role in the second year of the project had been members of TDGs in year one. The role of group leaders included recruiting members, as well as organizing and facilitating meetings. In addition, they often identified resources to share for learning about research-based practices.

The analysis in this paper is based on interviews with teaching development group participants. Group leaders and group members were invited to be interviewed at the end of year one and again at the end of year two. Twenty-one participants (5 leaders and 16 members) completed interviews at the end of year one; 31 participants (6 leaders and 25 members) completed interviews at the end of year two. Three group leaders and 5 group members completed interviews at the end of both the first and second years, and hence the total number of distinct individuals is 44. The interview was semi-structured [10]; each interviewee was asked a set list of questions about their participation in the group, the motivations and interest for participating, and their approach to teaching, and prompting for additional information was used as needed. The interviews were transcribed, and an inductive coding scheme with descriptive coding [11] was used to identify common patterns and themes characterizing participants' motivations to participate in the group and the nature of any interactive teaching strategies they adopted. An initial open coding of the year-one interviews was conducted before the year-two interviews were available; this initial coding provided a foundation for the coding of both years' interviews for this study.

Participating instructors' teaching experience (number of years, level of courses taught, types of institutions at which they'd taught, etc.) varied, as did they type of course(s) they were teaching during their participation in a TDG. Some taught very large, entry-level courses, while others taught small elective courses or graduate courses; some taught in traditional classrooms, others in collaborative learning spaces, and still others in a hybrid format or entirely online.

## Results

Instructors' reasons for participating in SIMPLE teaching development groups can be categorized broadly as either relating to a specific teaching challenge or situation, or relating to a

general interest in engaging with colleagues around improving teaching. In the first category, participants identified a particular teaching-related issue they hoped to address with support from the group. The most common specific motivations identified were teaching a high-enrollment course and improving critical thinking. In the case of instructors teaching high-enrollment courses, some were new to teaching large courses (though often familiar with interactive teaching), while others were experienced in teaching large courses but were new to interactive teaching with high enrollment. Some instructors motivated by a desire to improve students' critical thinking skills mentioned challenges in thinking and writing critically in the context of laboratory courses. Other specific issues instructors mentioned as motivators for their participation included the opportunity to include interactive teaching strategies from the ground up when designing a new class and helping students retain knowledge beyond the stereotypical "cramming" before exams.

While the project leaders initially envisioned specific teaching challenges as providing instructors' motivation to participate in teaching development groups, a general interest in improving teaching and in sharing with and learning from other instructors was a much more common motivator for participation. Eleven instructors cited general enthusiasm for being part of a group that was focused on teaching, noting that faculty meetings were typically focused on administrative issues and perhaps curriculum/scheduling, but not on what it means to teach well or differently. Four respondents directly commented that no other venues existed for talking to other STEM instructors about teaching; one mentioned that he'd been teaching for 33 years and had never found such a group. Most instructors expressed an interest in both giving and receiving ideas for teaching strategies, though some were primarily focused on learning from the other members in the group. Three instructors mentioned a desire to learn from a group leader, and one mentioned learning from term faculty whose role is 100% instructional. One department chair who was participating in a group noted that he wanted to be aware of the various approaches instructors were using even if he would not be likely to adopt them himself. Three instructors were motivated by sharing their experiences and expertise to motivate others to adopt research-based practices. Two of the groups included graduate students who served as the primary instructors for either a lecture course or a laboratory. Nearly unanimously, graduate-student participants described plans to pursue an academic career and cited participation in the teaching development group as a way to prepare for the teaching aspects of that career. Some graduate-student participants planned to pursue teaching-focused academic positions; others were interested in traditional tenure-line positions at research-focused institutions.

In addressing the value of having a group dedicated to talking about teaching, several instructors noted that it provided a venue for sharing both what did work and what didn't work in the classroom. They mentioned the value of hearing from others what they had tried in the courses and what elements had been successful, thereby avoiding "reinventing the wheel." Five instructors mentioned that participating in a teaching development group provided accountability, making them feel responsible for following through on their plans to make teaching changes and share the results. Nine instructors identified affirmation and support as valuable elements of being part of a teaching-focused group; they noted that they were much more comfortable trying new things and/or pushing forward through rough spots when other members of the group were able to confirm that they had success with similar strategies and/or that they also experienced bumps in the implementation process. When instructors presented new

ideas, they were motivated by other participants' enthusiasm for the ideas and interest in trying them in their own courses. Highlighting the value of sharing ideas and learning from others' experiences as her motivation for participating, one participant said, "So I wanted to engage with other people who are just as passionate about teaching as I was. And I think teaching makes you very vulnerable, and I think that sometimes my stuff flops. Like I have this great genius idea. . . . Most of the time I think they go really well – but sometimes I walk away and I'm like, 'I could have done that differently,' or 'I wonder if I would have done this?' or 'How do people do something like that?' And I thought this would be a good group to talk that through with. To sort of see how they handle that. I have these long conversations in my head after I teach. I would love to bounce that off of someone else. That's why I joined."

In addition to studying instructors' motivations to participate in ongoing teaching development groups, we also studied if and how their teaching changed during participation in a group. As mentioned above, participating instructors were asked to identify an interactive teaching strategy to incorporate in their course(s) and to share results and lessons learned with their group. Twenty-three instructors identified a specific strategy they implemented while part of a teaching development group. The list of strategies was long (approximately 20 different strategies were adopted), pointing to the idea that changes were people-driven and not prescribed. Three instructors made modifications in the direction of a flipped classroom, moving some of their content into videos students watched outside of class and incorporating more group problem solving in the classroom. Three instructors also adopted a notecard approach to calling on students to ask or answer questions during class. This strategy, in which each student fills out a notecard with his/her name, major, interests, etc. at the beginning of the semester, was particularly popular in high-enrollment courses to engage more students during class. Two instructors incorporated demos and interactive coding/simulations in their courses to keep students engaged and break up a lecture format.

Other strategies adopted by participating instructors included establishing central anchor ideas to which various course elements could be connected, incorporating concept maps, engaging students in interactive homework review, organizing classroom debates on course topics, grading for both functionality and style in a programming course, providing note skeletons (rather than full notes) for students to flesh out during class, introducing online quizzes and/or oral reviews to prepare for larger in-class exams, having students read and present research papers in the field, using student response tools (e.g. iClickers), incorporating assignments that ask students to reflect on assignments and exams, and introducing quotes that are drawn from a wide range of sources and contexts but that relate in some way to the topic of the course.

When asked about if/how their teaching changed, three instructors responded that they had made small changes as a result of group discussions but couldn't identify a specific change – "...some small changes here and there, which I guess is in line with the incremental part of this stuff." In a similar vein, another noted, "...conversations about teaching tend to help you frame your own approach to teaching, in ways that may not be measurable. And so, I mean, I think the most thing that I took away from it was, it is helpful for me to have a community of people to bounce ideas off of." Of the 44 participants interviewed, eight said that they hadn't made any changes to their teaching since joining a teaching development group, though all confirmed that there were new strategies they would like to try. Most participants who did not make changes cited course

scheduling or lack of time: either they hadn't taught the course in which they planned to make changes, or the changes they wanted to make required more planning time than they could devote to the effort.

## **Discussion**

In considering the results of this study it is worth drawing attention to the large number of participating instructors who were eager to be part of a group focused on sharing teaching experiences and improving teaching. Instructors recognized that collaborating and sharing lessons learned could contribute to improving the teaching of all involved, as well as reducing the feeling that teaching is an "isolating" activity. Their identification of the SIMPLE TDGs as their only opportunity to discuss teaching with STEM colleagues in a somewhat structured and focused setting points to the need to provide these venues and to obtain institution-level support for both leaders and participants. In the words of one group member, "I called the group – informally – I called it Teachaholics Anonymous. We don't share enough of our ideas...I will never be a hundred percent of the teacher I want to be, and I think that's probably a good thing that I approach it that way. I'm always supposed to be evolving and getting better, and part of that is sharing our ideas, and we just don't do that. So I was attracted to joining that group because it was a forum for sharing ideas about teaching." Describing the additional enjoyment that comes from treating teaching as a collaborative activity, another group member said, "I like teaching more, because I feel that it won't be just go in there and repeat what I already know to the students, so mechanical. And the thing is that after I hear so many people - everybody's issues - I feel that teaching itself is a lively thing. It's alive. Teaching is not just mechanics. It's really dynamic. Because of this change, this viewpoint change, I think my way of approaching students is also different."

As suggested by the quote above, the information instructors shared during interviews also highlighted the value they saw in having a safe space around teaching in which to share both success and failures, receive supportive feedback on new, untested ideas, and be encouraged in their teaching efforts. Many instructors noted that changing teaching, particularly when adopting interactive strategies, involves risk taking and introduces vulnerability. Reflecting on sharing teaching challenges within a TDG, one participant said: "It was challenging to sort of expose yourself and open yourself out to thinking critically about your own ideas about teaching. I think it makes anyone a little bit uncomfortable to put themselves under a microscope." About the risks of trying new strategies, another participant noted, "Most people think they are doing a really good job, and to take chances where it looks like to the outside world that you are not on top of things – this can be really scary." Instructors remarked that support from group leaders and members gave them the confidence to try new things. One participant gave the following description of how the group helped her try out a new teaching activity in her class: "The idea that it was OK to kind of color outside the lines...it kind of gave me a little permission to try something that, you know, doesn't seem to be exactly the usual."

In addition to providing support, instructors frequently commented on the accountability introduced by participating in an "official" teaching development group. Tied to the idea that participating in a teaching-focused learning community moved teaching from an isolating activity to a collaborative activity, many of the group leaders and members appreciated the fact

that reporting results to the group gave them a reason to prioritize introducing new teaching strategies, activities that had perhaps been on their “to do” list but had not had a deadline in the past. With regard to accountability, one group member said, “It’s like going to the gym. You know, if you are going to the gym by yourself, you can say, “Well, I’m not gonna do it today,” and nobody knows, but if you go to the gym with a friend, then when you say, “I’m not gonna do it today,” then that friend is by themselves, or... So it’s like, knowing that somebody else, you know, other people were also committed to teaching excellence and that they’re committed to making a change.”

It’s also important to acknowledge that a number of participating instructors did not make changes to their teaching during the semester of the group meetings. Certainly, since the goal of the project was to broaden the use of research-based interactive teaching strategies, we hoped to see that all instructors who were part of a TDG made changes to their teaching. That said, barriers related to competing career demands (research, service, etc.) and limited time are very real and have been identified in much existing work. Given that all participants, even those who had not made changes, showed interest in implementing new strategies they believed would improve their courses, and several instructors who had not yet implemented new strategies identified future courses in which they planned to do so, there is potential for more change in the years following the two years we studied. It was also clear in our prior work that it can take significant time over multiple semesters for faculty to adopt new teaching strategies. To facilitate ongoing and sustained change, however, institutions must support teaching development groups and provide instructors with the time and resources necessary to make research-based changes to their teaching. One possible structure would be teaching development groups that continued indefinitely with a rotation of members that evolved organically as instructors identified a need for support and change.

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