Enabling a Culture of Change: A Life Science Faculty Learning Community Promotes Scientific Teaching

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Enabling a Culture of Change: A Life Science Faculty Learning Community Promotes Scientific Teaching

Significant challenges to education transformation in lecture-oriented science departments include initiating and supporting a dialogue about teaching and learning among faculty whose priorities are primarily research. We established a faculty learning community through which participants made significant changes to how they think about student learning and how they approach teaching.

By Karen L. Sirum, Dan Madigan, and Daniel J. Klionsky

Research scientists and educators are supporting the call for teaching reforms in the sciences, and the need for these reforms is gaining acceptance, as evidenced by the increased undergraduate curricular reform efforts across the nation and the increased funding available for such programs through agencies such as the National Science Foundation and the Howard Hughes Medical Institute. One important goal of these reforms is to increase the scientific literacy of our society, by facilitating the development of students' analytical and problem-solving skills and by developing their higher-order thinking skills and their ability to undertake scholarly inquiry—in other words, by training "citizen scientists" (Handelsman et al. 2004). The American Association for the Advancement of Science says, "Science should be taught how science is practiced at its best" (AAAS 1990). In these calls for science education reform, recognized and accepted by scientists, the goals are to create an environment in the classroom that allows students to become personally involved in inquiry (Dewey 1933; Kolb 1983), developing as learners through collaboration with other students and faculty members (Johnson, Johnson, and Smith 1998; Millis and Cottell 1997), and developing and practicing their own powers of investigation. This kind of student learning environment parallels the learning environments in scientific laboratory research programs where collaborations, challenges, and inquiry form the foundation for critical thinking among academic researchers. Training and practice in asking good questions, thinking critically about problems, and sharing ideas are the foundation of what it means to be a scientist. And, as scientists, these are the kinds of experiences we need to draw upon as teaching faculty who seek to create a dynamic and interactive learning environment for students in the sciences.

Unfortunately, many science faculty members teach almost exclusively through lectures, a format that often promotes passive rather than active learning. These science faculty teach the way they were taught, are unaware of the research on what types of environments best promote learning, and are resistant to change because they feel they do not have the time or because teaching is not valued in their department. Thus, one of our biggest challenges as academics is to overcome this current dichotomy

TABLE 1

Session 1.

Topic	Learning goals	Activity	Methods	Resources
How Humans Learn	Identify concepts of how people learn & what makes a good learning environment	Participants think of a time and environment that provided them with an exciting/rewarding learning experience. In pairs, they share that experience while the listener lists factors that encouraged and enriched the experience. The note taker shares with the larger group and a recorder lists key factors on a whiteboard.	Think alone, share with others, discuss with group, reflection	Dewey (1933), Bransford, Brown, and Cocking (2002), Zull (2002), Donovan, and Bransford (2005)

between how we teach and how we do research. We need to move our research practices into a pedagogical experience that transforms the way we teach. As research scientists, we work within a network of collaborators who contribute to and value our work. For example, publishing and public seminars are critical elements of formal scientific advance, and "hallway conversations" play an equally important although informal role; however, none of these activities typically define the pedagogical aspects of our careers. Teachers tend to work in isolation, "often disconnected from administrators, colleagues and many of their students" (Baker 1999). In isolation, neither the researcher nor the teacher seems to have much of a chance for sustained discovery, growth, and positive change. The culture in a typical research-oriented science department is one that often discourages faculty from putting time into their teaching, because it will be at the expense of advancement of their research. Therefore, science faculty are often actively discouraged from even talking about teaching, because the perception will be that if faculty are taking the time to reflect on and discuss their teaching, then they either do not care enough about their research, or there must be something going seriously wrong in their classrooms!

While thinking critically about teaching and learning, the authors began working toward science curriculum reforms through a collaborative effort, with a goal of recruiting science faculty members to participate in a learning community (LC). That is, we wanted to bring together life sciences faculty members who would discuss and support each others' teaching and learning goals, breaking down the communication barrier that characterizes most teaching activities in the sciences. This paper describes this yearlong science faculty learning community, outlines the key elements of how it was organized, and provides specific ideas for how key topics were approached in each session, including the resources that were provided to the participants. By documenting our efforts in establishing the science faculty LC, we hope to provide guidelines that other research-oriented science departments can consider and implement.

One such example is for the science education specialist in a department to establish and facilitate an LC, perhaps in collaboration with the university's center for teaching and learning. Science faculty with an education specialty (SFES) are appointed to a science department to be the department's science education researcher (Bush et al. 2006). That such positions are becoming more numerous in science departments across the nation (Bush et al. 2006) bodes well for the future of science curricular reforms. These faculty members have an opportunity to bring visibility to science teaching and learning issues in their departments. These SFES may find that, like one of the authors of this paper, establishing and facilitating a science faculty LC is an avenue for making connections and establishing collaborations with science faculty with a broad range of research interests, and the LC is a strategy that provides the potential to change the culture to one that values talking about teaching.

Implementation

Background

Our own successful experiences with active learning coupled with knowledge of the published pedagogical literature led us to suggest changes in the curricula of our respective institutions. One key to curricula and cultural reform in the teaching of science is that faculty members need to become engaged as leaders in an effort to improve student learning. Unfortunately, the very principles of active learning suggested we would be unsuccessful in our initial attempts to gain converts. Most faculty members are not convinced of the value of spending their limited time modifying their current teaching methods simply based on a verbal or written explanation (i.e., essentially a lecture) setting forth the benefits of active learning. After meeting with large-scale resistance to our suggestions for curricular change, we realized that we would likely achieve greater success if we introduced faculty members to active learning by demonstrating the process in practice. This line of thinking led to the idea of a learning community that would utilize the very principles we were advocating.

We approached both new faculty in our departments (three participants) and experienced faculty (one participant), none of whom had previous experience in active learning, and we reached out to a neighboring institu-

TABLE 2

Session 2.

Topic	Learning goals	Activity	Methods	Resources
Active Learning and How to Transform a Lecture-Based Classroom	Identify concepts of active learning and be able to visualize and verbalize how interactive course activities can be effective.	Participants discuss research articles, share teaching experiences, and tell how they might use, or have used, active learning strategies within their course structure. Also discuss: 1. What is good about your current teaching approach? 2. What do you think needs to be changed? 3. How will you manage change?	Group discussion, share experiences and learn from one another, reflection & application	Fedler and Brent 1999, 2003; Klionsky and Tomashek 1999; Handelsman et al. 2004

tion for mutual support and another viewpoint. In addition, we included faculty development staff researchers (two participants). Together, the initial nine of us formed a LC we titled "Bringing Active Learning to the Classroom" to reflect our goal of facilitating pedagogical changes based on current research on how to promote learning in life sciences classrooms.

The primary goal of our group was to create active- and cooperative-learning environments and experiences for students by first allowing life sciences faculty members to experience that environment themselves. To achieve this goal, we wanted to avoid the typical workshops in which faculty members hear about new ideas and teaching methods in an intensive format over a couple of days, then are left to go back to their own classrooms and try to figure out how to implement some of what they learned on their own. Instead, we established a community of learners (Baker 1999; Angelo 2000; Cox 2004) that provided an important continuity—a community that met over an entire academic year so that participants as a group had time to reflect on new knowledge about teaching and share ideas of practice that came directly from their own classroom experiences (Schon 1983). This approach also extended the collaborative structure that we were familiar with as research scientists: In this case, our focus was scholarly teaching with an emphasis on practical application.

Our LC first met for 90-minute sessions in the summer as a prelude to a fall teaching schedule in which three of the science faculty were teaching for the first time. Over five summer meetings, we were able to introduce ideas and help prepare participants for new and first-time classes they would be teaching in the fall. During the fall and spring semesters, we met once a month for eight sessions.

In preparing for our first meetings, we considered certain points. For example, some of our participants might not have placed teaching and learning in a priority position in their careers. In many cases, science faculty are very limited in the amount of additional time they can put into preparing for their classes; they have major commitments to their science research programs. Accordingly, just as we do for students in our classrooms, we needed to consider motivation and relevance. In other words, we had to help the faculty learn why they should be interested in pursuing teaching as a scholarly endeavor. We also recognized that the changes we were going to ask them to consider needed to be things they could actually readily do, especially with regard to time for the research-focused faculty. In other words, these changes had to be things that could be integrated into faculty careers as science researchers.

Finally, because we were working with researchers, we decided it was important to present them with published data demonstrating that interactive engagement methods promote deep learning, and that a lecture-focused approach does not consistently produce the learning gains that we want (see examples in Hake 1998; Klionsky 2004). However, we did not want to weigh them down with theoretical discussions. Instead, we let theory, often introduced through selected readings, inform the practical activities that became a major part of each session. In particular, we believed that to achieve the cultural change we had in mind for this learning community,

TABLE 3

Session 3.

Topic	Learning goals	Activity	Methods	Resources
Learning Goals and the Value of an Integrated Course	Identify learning goals, develop activities and assessments that support learning goals, and identify key resources for supporting change.	Participants were asked to identify and discuss one or two key learning outcomes from one of their courses; how activities and assessments are, or might be, aligned with such outcomes; and begin to design specific interactive activities and assessments.	Individual presentations, group discussion, think pair share	Paulson and Faust 2004; Fink 2003

we needed to allow the participants to learn in the same way that research has shown promotes deep learning in the classroom, in other words, learning that is active, engaged, hands on, and collaborative (Bransford, Brown, and Cocking 2000). Tables 1–6 below describe essential elements for a dynamic life sciences learning community and provide an overview of the content, processes, and resources for our sessions.

Description of the key elements and topics for each session

The facilitator(s) plays a key role in supporting a dynamic LC. The facilitator was responsible for (a) setting the agenda for each session; (b) preparing materials and resource packets; (c) communicating with members between sessions; (d) facilitating each session so that interactive discussions took place; (e) providing the group with an overview at the completion of each session; and (f) making sure that there was continuity between and among all 13 sessions. Co-facilitation was a dynamic that worked well for us, bringing the insights of an SFES, a director of a center for teaching and learning, and an established science research faculty member together to guide and lead the LC sessions.

We began our inaugural meeting with an inquiry about how people best learn. From this perspective, we linked what participants knew about their own learning to what research says about how people learn (Table 1). The first session reinforced the notion that students learns best when, among other important factors, they take ownership of their own learning through problem solving and reflection. This served as a good transition for our second session on active learning, described in Table 2.

As summer progressed and participants began to understand the notion of interactive learning and its processes, we planned the third session around learning goals. Specifically, as Table 3 describes, we wanted participants to understand an integrated course design. In the fourth session (Table 4), as faculty made commitments to improving teaching and curricular change, we addressed an important question that emerged. That is, what impediments will incur as you seek transformation in pedagogy and the life sciences curriculum? Our last session of the summer (Table 5), addressed a key issue for faculty: starting the semester with excitement, commitment, and buy-in from students who might not be motivated or disposed to think critically about the life sciences or to engage in an interactive learning environment.

Academic-year sessions

We acknowledge that one of the greatest obstacles to implementing change in teaching, for both the new and mid-career faculty who participated in this learning community, is lack of collegial support (Bland and Bergquist 1997; Karpiak 1997; Boice 2000, Romano et al. 2004). Accordingly, once the semester began, we met at least once per month to provide and encourage collegial support for teaching improvement, to provide resources and activities promoting practical applications of active learning, and to answer questions and concerns about teaching and learning as they arose throughout the academic year. Table 6 represents an overview of selected topics, processes, and resources we utilized in the academic-year sessions.

For implementation of a science faculty LC, three important points must be kept in mind. First, it is not necessary to have experts in every pedagogical area preside over these sessions. The collective experience of the LC members is the critical component. Second, revisions to a course do not have to be made all at once, but can be introduced gradually. Third, there are no right answers for how an individual should introduce active learning into their classroom. As with bench research, successful revisions typically require repeated experiments and assessment of the outcome.

Outcomes

For our group, the LC became a place to try out ideas: We could run a new idea past the members of the LC, try new things in our classrooms, and then come back for more feedback. We developed one-on-one relationships with members of the group and talked about teaching in an informal way, inside and outside the sessions, that is not common in our research institutions. Faculty members were able to recognize the importance of scholarly teaching and to see that their efforts to improve student learning were valued. By talking about teaching, we came to an understanding about the power of our collective knowledge and to the realization that it should

TABLE 4

Session 4.

Topic	Learning goals	Activity	Methods	Resources
Curricular Change and Obstacles to Overcome	Identify potential obstacles and problems one would encounter when promoting pedagogical and curricular change, and develop strategies to overcome such problems and obstacles.	Guest speaker introduced curricular reform efforts and problems and solutions for overcoming resistance to reform. She led a jigsaw activity in which participants were assigned to four different groups: administrator, faculty colleague, student, and faculty reform leader. Information was shared and combined for a broader outlook and further discussion.	Small group, jigsaw, presentation, large-group discussion	Boyer 1990; Felder and Brent 1996; Boice 2000; Romano, et al. 2004

TABLE 5

Session 5.

Topic	Learning goals	Activity	Methods	Resources
Setting the Tone for the First Week of Class	Identify and develop activities that create excitement and interest about the course focus and about learning in general.	Participants were asked to read several short papers about the importance of setting the right tone during the first class session and discuss creative methods for transforming their first class sessions to engender excitement, motivation, and familiarity among students and teacher.	Readings, discussion, individual sharing, brainstorm	Wright 1999; Felder 1995; Povlacs 2004

not be embarrassing to ask for help, just as it is not an indication of lack of ability when we consult with others regarding our labs' research endeavors. Today, the collective knowledge we share about teaching and learning continues to grow and spread to others we interact with along the way. Such a teaching/learning impact is too often not accounted for when we assess the value of faculty development on learning. However, even in our modest efforts, LC members often talked about how they shared teaching/learning ideas with colleagues, who in turn acknowledged their interest in improving their own teaching.

As the one-year anniversary of the formation of our LC approached, we asked participants to answer a survey regarding their experience in the group. The results indicate that faculty members are changing how they teach and making informed choices when it comes to teaching strategies. They feel empowered and are encouraged to take risks, are fostering collaborations in their teaching, and are talking about teaching. For some, the change in how they teach has been radical. For others, the change has been small but noticeable. For us as facilitators of the LC, all of the positive changes have been considered critical to accomplishing a cultural change among science faculty that is much needed and long overdue.

There are many models for the stages of human behavioral change. When addressing the impact of instructional development workshops, Connolly and Millar (2006) suggest that workshop design must address the following stages: unfreezing or challenging previously held beliefs, cognitive restructuring and learning about instructional approaches that fit with the new beliefs, and finally, refreezing to adopt the new instructional paradigm. The yearlong, learning-community structure provides sustained support and helps avoid backsliding and refreezing previously held beliefs about teaching and learning, especially when it is inevitable that challenges will arise as faculty apply new pedagogical strategies. The learning-community support and feedback come at a critical stage of change and facilitate the professor-to-professor dissemination important for cultural reforms in science departments (Handelsman, Miller, and Pfund 2006).

Excerpts from each participant's comments are offered here:

"Since I didn't have much of a teaching philosophy, participation in this program has been invaluable. A year ago, I did not know what 'active learning' meant. I feel like an expert now… This positive reinforcement gave me the courage to revamp my class to incorporate more active learning methods…The class that I taught this past fall was completely overhauled after my experience with the LC."

Tangible outcome: This faculty member used an active-learning format the first time teaching a course and is continuing with this approach.

"I'm considering approaches other than a straight lecture format. I do intend to utilize some level of active learning (problems and case studies at minimum) in other undergraduate courses upcoming…I implemented an active learning approach in a graduate course I taught (two sessions) and it seemed to be very well received."

Tangible outcome: This faculty member used an active learning approach for a mini-course and published a paper describing the activity he designed with input from the LC members that formed the basis of the two-day course (Kumar 2005).

"I am much more willing to minimize the amount that I lecture and develop more class discussions and activities. The big change for me is that I no longer regard poor response by the students as a signal to give it up and go back to lectures but instead as an opportunity to learn and improve—largely because of the support I have had from the LC…For me, the best part of the experience has been the sharing of ideas, the reference materials, the support of colleagues, and the opportunity to talk about teaching in an informal atmosphere. I now feel I have a vocabulary about pedagogy that makes it much easier to seek out additional information and resources."

Tangible outcome: This faculty member currently teaches undergraduate- and graduate-level courses with minimal lecturing and a focus on group problem solving applied to real-life environmental issues.

"I tried to make my lectures more engaging by asking a lot of questions and having the students ask their neighbors to compare notes. But in the future as I am able to change the

TABLE 6

General Session Format

Sample Topics	Learning goals	Rationale for Activities	Examples of Methods	Resources
Participant's interests and pedagogical needs determined the topics. These included student motivation, teaching with technology, authentic assessment, getting students to read before class, & active learning in the large and small classroom.	Goals varied according to faculty learning needs, but always included the goal to improve teaching through discussion, sharing experiences, & application of new methods, skills and philosophies regarding teaching and enhancing student learning.	Participant's interests and immediate needs drove activities and the selection of reading resources for each session. In addition, each participant presented an activity that they had implemented or wanted to implement in class. Such experiences promoted the use of the group's collective knowledge to brainstorm ideas and methods for improving activities. For example, as faculty strove to achieve an interactive classroom, they came up with methods to implement group learning in various ways that promoted individual student responsibility as well as a demonstration of the power of collective knowledge.	Typically used readings, demonstrations, discussions, group work, brainstorming, and reflections prompted by written overviews for each session.	Each session was complete with select readings appropriate to the topic and the interests of participants.

course, I plan to add more active learning strategies and to get the other lecturers to do the same…The most valuable thing for me was meeting other faculty and hearing their experiences, both about what worked and what didn't work for them. The next most valuable thing was learning about different activities I can use in the classroom…The best part was just talking to other faculty about what they are doing and getting their suggestions for what I can do."

Tangible outcome: This faculty member became the organizer of a medical school course and instituted an active-learning format among all of the participating faculty members.

Conclusions

What made our LC approach work? (1) We saw that we are learners together in this learning community and we are our own resource: Our collective knowledge is an invaluable asset. (2) The common underlying benefit that all members reported was that this LC empowered them to try something new in their classes. Faculty members felt less fear and could see how making their class more interactive was really possible. The LC gave them a chance to think about teaching and learning in an environment away from the grant- and paper-writing pressures of a demanding science department that may not place a high value on teaching as a form of scholarship. They realized that developing as teachers is a process and change in teaching methods and styles does not have to happen all at once but can evolve as we grow as scholars of teaching and learning.

If we approach teaching scientifically (Klionsky 2003; Handelsman et al. 2004) and focus on learning, utilize our collective knowledge through collaboration, and begin by talking about teaching, we can develop as scholars of learning who in turn support communities of learners. ■

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