Chapter 3

The Cottrell Scholars Collaborative
New Faculty Workshop: Early Lessons for Change in Teaching

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In 2011, The Cottrell Scholars Collaborative New Faculty Workshop (CSC NFW) was conceived to address deficiencies in pre-service professional development as individuals assumed their roles as chemistry faculty members. The workshop design arose from professional development literature and national workshops in other disciplines. Over the past five years, the CSC NFW has been successful by a variety of measures. Reflecting on the strengths and weakness of the CSC NFW, the workshop provides some lessons to promote change in teaching practice.

Introduction

In 2011, Research Corporation for Science Advancement (RCSA) decided to try something new. With a cadre of more than 200 Cottrell Scholars, RCSA gave the Cottrell Scholars impetus to self-organize and tackle the pressing problems at the interface of research and education. Thus, at its annual meeting, RCSA announced competitive awards for groups of Cottrell Scholars. It was an idyllic situation: Good money to address a problem of personal interest with a dream team of like-minded people. It was easy to find a group of individuals who were keen to address the shortfalls in pre-professional training for chemistry faculty, and the

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team wrote a successful proposal that year. The plan to initiate a Cottrell Scholars Collaborative New Faculty Workshop (CSC NFW) in chemistry was born.

The workshop team built two critical partnerships at that initial meeting in Tucson. The first was with the American Chemical Society. Naturally, the ACS would support an effort to improve chemistry instruction and aid in the success of new faculty—indeed, those motivations are borne out by a variety of ACS-initiated and ACS-sponsored activities to meet those exact aims. However, this kind of activity had not been attempted at ACS, and somewhat surprisingly, the ACS, from executive leadership down, expressed confidence in a group that was not trained in professional development to develop and execute such a plan. ACS has hosted the event at its headquarters since its inception and provided logistical support. That support was well and thoroughly augmented by the technical expertise provided by our primary contact, Dr. Jodi Wesemann, Associate Director for Educational Research in the Division of Education. Dr. Wesemann’s familiarity with these issues and understanding of the various factors at work was essential for success.

The second critical partnership was developed with Prof. Marilyne Stains, a chemical education researcher at the University of Nebraska-Lincoln. Prof. Stains studies the barriers chemistry faculty face as they choose to adopt (or fail to adopt) evidence-based instructional practices (EBIPs). She developed a protocol, a longitudinal, mixed methods quasi-experimental design, to study the workshop and its impact on faculty participants. While many may accept that the intervention itself is important, the data Prof. Stains and her team would collect was the basis for actual validation of the plans and a roadmap to greater efficacy.

The focus of the initial iterations of the workshop was on faculty at R1 institutions. That decision arose from the finite number of institutions and faculty as well as the personal experience that the initial team had in this area. It was a limitation. We would turn away faculty from other types of institutions for this reason, but it was also meant to be temporary. A goal in the entire project was scaling it to faculty nation-wide, and to meet that goal, we needed a successful model from which to grow.

**Conceptual Framework of the Workshop**

The workshop was designed to address the fact that few chemistry faculty receive training in the broad range of skills necessary to excel in faculty positions. Graduate and post-doctoral programs typically do an excellent job providing the skills necessary to select important research problems and personally tackle them at the bench. Faculty quickly realize, however, that their own two hands are a limiting reagent and that their success hinges on other skills from budgeting to personnel management and everything in between. Thus, the workshop covers a range of critical issues including cultural competency, time management, grant writing, and safety while providing networking opportunities. In addition, most faculty must devote substantial effort toward teaching. Given that the lack of pedagogical training for most chemists is their largest pre-service deficiency, addressing that deficiency is the core content of the workshop.
What new faculty do not need is a boot camp in traditional, didactic lecture. Contrary to recent anecdotal reports (1), repeated study has revealed that active learning is not only more effective for students to meet learning objectives, it also provides greater gains to underrepresented groups in science (2). Given the tremendous pressure to adopt more effective or evidence-based instructional practices (EBIPs) (3–5), it was clear that a critical way to serve these faculty was through an introduction to practices that have been vetted in the educational literature.

The decision to target new faculty was considered. One key rationale for delivery to this group stems from the understanding that senior faculty have resisted changes to passive lecture, and that group most commonly cites lack of time and incentive, as a result of university rewards structures, as the reasons for their reticence toward instructional change (6–9). An intuitive notion is that new faculty would be more receptive to EBIPs before they develop habits in their own teaching. Indeed evidence supports the idea that interventions are most effective for faculty before they develop a teaching style (10, 11). It was fully anticipated that the workshop and its ancillary activities would impact the participants’ professional identity (12) and help participants adopt a teacher-scholar model receptive toward understanding instructional practice rather than that of a researcher who teaches out of necessity.

The first resources for the workshop’s development came from the literature on instructional change in both organizations and at the undergraduate level (6, 7, 13, 14). We also looked toward workshops in other disciplines for guidance. There is a rich list of disciplinary workshops that cover various aspects of professional development (15). Among the potential candidates, we considered two events, the Physics and Astronomy New Faculty Workshop organized by American Association of Physics Teachers, American Astronomical Society, American Physics Society and the Howard Hughes Medical Institute/National Academy of Sciences Summer Institutes, to be close models for our efforts. These are successful events. For example, the AAPT workshop has reached approximately 25% of all new domestic physics and astronomy faculty since 1996 and has made significant gains in participants awareness of EBIPs (16). There are two ways in which the CSC NFW differs from the AAPT/AAS/APS workshop. First, the CSC NFW is shorter, approximately half the length of the AAPT/AAS/APS workshop. While this limited time with participants risked less robust outcomes (though, time has proven both workshops afford similar gains for participants), it was a calculated risk: It was felt that new chemistry faculty, particularly from R1 institutions, would elect not to attend a workshop longer than two days. Second, the CSC NFW targets “newer” new faculty. The CSC NFW audience is approximately half pre-service faculty and half one-year veterans in their independent position. Our aim was to intervene before teaching habits begin to solidify but also have some peer voice of experience as well during the event. The AAPT/AAS/APS workshop requires faculty have had at least one full year in their faculty to be eligible, and the Summer Institute program is open to faculty at all levels.

Another critical feature for our design was the incorporation of EBIPs as the mode for content delivery in the workshop. This was a structural decision. It
provides the participants models of the methods that they could adopt, experience with EBIPs from a student’s perspective, and opportunity for reflection about on their perceptions of EBIPs—and possible misconceptions—to make more informed choices about personal instructional practices.

Lastly, participants were provided the opportunity to practice with peers to develop comfort with implementation and receive constructive feedback on their efforts. This was a critical piece adopted from the Summer Institute program. To be able to practice these techniques, the participants would need to devise a lesson with one or more EBIPs, and that process—the development and execution of a lesson—would form the core effort of the workshop.

**Workshop Structure**

The structure of the workshop has been summarized elsewhere (17). A simplified schedule for the 2016 workshop is provided in Table 1, which shows an intense schedule to cover the range of EBIPs targeted, provide structured working time, and include content in non-teaching areas of interest. The core activity of the workshop is the development of a “teachable tidbit (18),” or lesson. The tidbit is constructed in parts, starting with learning objectives and ultimately utilizing any active learning practices that the participant wishes to employ. The process contains both delivery in which participants receive information about instructional practices as well as lesson design and assessment.

**Table 1. Schedule for the 2016 CSC New Faculty Workshop**

*Day 1*

3:00 pm Workshop Check-In: Just-in-Time Teaching exercise due

3:30 pm Opening Session: *The Difference between Teaching and Learning*

5:00 pm Panel: *Writing Proposals and Managing Grants*

*Day 2*

8:00 am Breakfast at ACS: *Welcome and Introductions*

8:45 am Session: *Just-in-Time Teaching*

9:00 am Session: *Introduction to Scientific/Research-Based Teaching*

9:30 am Break

9:45 am Exercise: *Active Learning*

11:00 am Teachable Tidbit, Part 1: *Learning Objective, Backward Design – Syllabi and Selection of Content*

12:00 pm Teachable Tidbit Report

12:15 pm Lunch Session: *Learning Taxonomies*

1:30 pm Teachable Tidbit, Part 2: *Making a Content Element Active*

Continued on next page.
Table 1. (Continued). Schedule for the 2016 CSC New Faculty Workshop

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>3:00 pm</td>
<td>Teachable Tidbit Report</td>
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<tr>
<td>3:30 pm</td>
<td>Break</td>
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<tr>
<td>3:45 pm</td>
<td>Session: Assessing Student Learning</td>
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<tr>
<td>4:15 pm</td>
<td>Teachable Tidbit, Part 3: Developing Formative Assessment to Assist Student Learning</td>
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<tr>
<td>5:15 pm</td>
<td>Teachable Tidbit Report</td>
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<tr>
<td>5:30 pm</td>
<td>Self-select Sessions: Teaching Large Lectures, Course-based Undergraduate Research Experiences, or Peer Learning</td>
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<tr>
<td>6:30 pm</td>
<td>Dinner at ACS</td>
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<td>7:00 pm</td>
<td>Session: Addressing Student Diversity</td>
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<tr>
<td>7:45 pm</td>
<td>Session: Mentoring and Group-Building</td>
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<td>8:30 pm</td>
<td>Adjourn</td>
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Day 3

<table>
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<tr>
<th>Time</th>
<th>Activity</th>
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<tr>
<td>8:00 am</td>
<td>Breakfast at ACS</td>
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<tr>
<td>8:15 am</td>
<td>Teachable Tidbit, Part 4: Trial Run – Try out Your Project in Small Groups</td>
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<tr>
<td>10:15 am</td>
<td>Teachable Tidbit Feedback</td>
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<tr>
<td>10:45 am</td>
<td>Break</td>
</tr>
<tr>
<td>11:00 am</td>
<td>Session: Managing a Safe Laboratory</td>
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<tr>
<td>11:30 am</td>
<td>Session: Time Management</td>
</tr>
<tr>
<td>12:30 pm</td>
<td>Workshop Wrap-Up and Evaluation</td>
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Workshop Data

There are three critical outcomes from the workshop. 1) Participant faculty are more aware of EBIPs, particularly those described in the workshop; 2) participants self-report a higher likelihood of using these methods in their classrooms; and 3) observational data shows that participant faculty have classes with a more student-centered learning environment. Of course, all data were collected and analyzed by Prof. Stains and her team (17, 19).

The workshop participants were aware of more EBIPs than they were prior to the event. On first glance, this finding may appear obvious. After approximately two days of exposure, the participants should have greater familiarity with EBIPs. However, this is the first finding in which the utility of the control group in Prof. Stains’s study is illustrated. By identifying a group of peers who were not attending the workshop, Prof. Stains was able to identify that the gains in EBIPs are a result of the workshop as intervention rather than personal interests of the participant faculty (Figure 1) (11).
These results illustrate the power of the longitudinal component of Prof. Stains’ study. What can be seen from the “delayed post-treatment” data, surveys collected one year after the original intervention, is that the gains in EBIPs are maintained—if not slightly increased—for workshop participants. The persistence of the participants familiarity with these practices is important as is observation that faculty not engaged in an intervention are not acquiring familiarity with EBIPs in their routine practices.

Workshop participants reported greater instances of EBIP use after participation in the workshop. For example, Figure 2 shows the responses of workshop participants who were asked about the frequency of group work in their classrooms before and after the workshop. To measure if this is a change in behavior, only data for workshop participants who completed one year as an assistant professor before attending the CSC New Faculty Workshop is shown.

Figure 2. Frequency of implementation of group work before and after participation in the workshops for participants who were entering their second year as assistant professor. Reprinted from ref (17). Copyright 2014 American Chemical Society.
These data have limits. For example, some workshop participants indicated having utilized an EBIP that is based on group work, but these individuals failed to indicate that they use group work in their course. This disconnect and other limitations are known and have been described for self-reported data in prior studies (20–22).

More than the self-reports, study of participants attitudes and beliefs about teaching were assessed through the Approaches to Teaching Inventory (ATI) for both groups. The workshop participants demonstrated significant increase on the student-centered scale as compared to the control group after the workshop (Figure 3; data for control not shown here). However, these data also show that the gains are limited. Delayed post-survey assessment, or observation one-year after the workshop, shows some loss on the student centered scale. It is an unfortunate loss but consistent with the notion that a single intervention is not sufficient for long-term change.

![Figure 3. Changes on the student-centered and teacher-centered scale of the Approaches to Teaching Inventory over the course of one year based on matched pre/post/delayed post surveys. Reprinted from ref (17). Copyright 2014 American Chemical Society.](image)

Using the Classroom Observation Protocol for Undergraduate STEM (COPUS) (23), Prof. Stains and her team have assessed participant and control faculty member’s classroom practices. The observations were conducted from video recorded classes that were sent to the Stains group and analyzed remotely. The most striking observation (Figure 4b) is the decrease in didactic lecture practiced by the workshop participants (i.e., control vs. treatment post). The greatest gain from that change is substantially more Socratic classrooms, but some peer instruction and collaborative learning is also observed. For reference, Socratic instructional style is typified by a high frequency of lecture (>80% of time is two minute intervals of lecture), but the intervening time involves student questions and students addressing instructor questions in a distribution that demonstrates short interactions between the students and instructor at regular intervals (24).
Both Figures 3 and 4b illustrate a critical problem: Gains from the workshop erode over time. To remedy this problem, the workshop is part of an evolving, year-long program. At present, participants are connected with the teaching center on their respective campuses at the time of the workshop, and throughout the year following the workshop, monthly virtual meetings between the organizers and workshop participants are convened on topics of interest. For example, meetings on assessment, homework, and tenure process are commonplace. The data above are from earlier workshop iterations, so continued monitoring of these data and adjustment to post-workshop programming is critical to sustain the gains made.

Post workshop surveys, which is the most common assessment among faculty workshops (15), show high satisfaction with the program. Indeed, the workshop has been meeting participant expectations for content and delivery with an increasing degree of satisfaction over the past five years (25). Some of that improvement in participant impression is doubtlessly the results of the workshop moving from an unknown program to one with some reputation in the community (26, 27). Regardless, the organizing team has sought to be cognizant of the participant feedback to optimize the content that high perceived value and minimize that which is perceived unnecessary within the objectives of the workshop.

The Elephant in the Room: Change

The CSC New Faculty Workshop was conceived to promote change. According to a summary of change strategies in undergraduate education (28), the design of the workshop and subsequent interventions is directed primarily toward change in the personal domain. Because there is high personal ownership of the efforts in the workshop and the participant faculty are nominated and supported by their chairs, the workshop has both emergent and prescriptive characteristics. Thus, as an activity, we would ask, can we inform and promote decisions about teaching that lead to greater student-centered learning? That is, of course, a measurable objective. The degree to which participants have familiarity
with more EBIPs can be measured as well as the degree to which a classroom is a student-centered learning environment (vide supra). Impacting a faculty member’s professional identity is more complex. Our premise that experience with EBIPs as well as peer feedback on one’s own practices may help initiate a more reflective attitude toward teaching. Further, the structure of post workshop meetings, meant to promote discussion, is an effort to foster the workshop cohorts as learning communities around issues of teaching (29).

If changing professional identity is difficult to measure, our more subtle goal to promote change broadly would be impossible to measure. We continue to operate under the assumption that providing new faculty with an early exposure to vetted instructional practices and effective alternatives to didactic lecture will create a bottom-up acceptance of these methods. When these faculty accept the methods, they will be more receptive and supportive of colleagues who are adopters. Furthermore, the workshop participants will, one day, lead departments and drive the direction of teaching at their institutions. Perhaps this is already happening. In a few anecdotal instances, some of the workshop participants, as junior faculty, have been asked to serve on campus-level committees on education largely due to their participation in the workshop.

In the meantime, however, the discourse and the nature of that discourse is critical. The value structures at universities will not change unless the issue of quality teaching over competent lecturing is addressed. That discourse will be more successful if it starts in departments because if it does not, then suggestions of change will appear forced or mandated and doubtlessly not succeed. A discourse in departments is also more likely to be collegial. Considering how best to achieve learning outcomes for students is something that colleagues are well equipped to do and likely to consider alternative instructional practices, if these are available to them and straightforward to implement. That kind of conversation requires a leap into a reality wherein the quality of student’s learning rather than one’s “teaching” is the key indicator.

Across the lifetime of the workshop, the nature of the discourse has been changing. In the first years, some participants would argue—literally argue—that lecture is equivalent, if not superior, to EBIPs, despite the data that was presented (2). In more recent years, there is simple acceptance. Armed with the data, new faculty recognize the success of EBPIs—if they did not arrive at the conclusion already. This past year was the first in which several participants had sufficiently extensive experience with implementing EBIPs that they deemed the workshop content too basic for their needs (25). Thus, there is diminishing need to convince new faculty of the need for EBIPs, rather it is the content and opportunity for development and practice that are needed.

It is unlikely that the CSC New Faculty Workshop has been the driver for significant national change yet. However, it is reasonable to anticipate that the workshop has been accelerating a process that has been ongoing, and our continued observation of new faculty will better inform how the dialog could be managed in years to come.
Future for the Event

We have two long-term objectives with the workshop and affiliated programming. First, we would like to expand to serve all chemistry faculty. As such, the CSC New Faculty Workshop is evolving. In 2016, Research Corporation sponsored an expansion of the model to include faculty from primarily undergraduate (PUIs), masters grating, and comprehensive institutions, which was held at ACS Headquarters in Washington, D. C. This effort is the tip of the iceberg. We have yet to address faculty across all institution types, particularly two-year and community colleges. Worse still, the word ‘faculty’ in the title excludes lecturers as well as the nebulous population of adjunct instructors. While it is gratifying to expand this year with a level of success similar to that of the R1-only events (25), there is much more work to be done than has been accomplished.

The second objective is to obviate ourselves. By expanding the number of faculty aware of EBIPs, empowering them to try EBIPs, facilitating a national conversation about these methods, and fostering networks to support change, we should eliminate the need for this workshop. If faculty embrace EBIPs and share the value of these with Ph.D. students, who are instructed in their use as teaching assistants, the loop would be closed and new faculty would no longer need the workshop. While that objective seems perhaps as distant as the first, the inaugural cohort of CSC New Faculty Workshop participants will soon be graduating their first Ph. D. students. We can truly start to close the loop.

Conclusions

The CSC New Faculty Workshop has helped more than half of new R1 hires to develop and execute a more student-centered approach toward their teaching. Those successes are tempered by the loss of some gains made among participants over time. Regardless, the workshop does broadly inform efforts to change instructional practice nationally and across disciplines. The success of the workshop results from the participants understanding of the value of modern, vetted pedagogy. Armed with that understanding, the workshop provides the participants with two critical ingredients for success. First, they have time—albeit it limited—to develop experience and comfort with EBIPs. Second, they make connections with peers over teaching to support that growth. Thus, the ingredients that we have identified as important are exportable and scalable.

Acknowledgments

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