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New Instructor Teaching Experience in a Research-Intensive University: Implications for Professional Development

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This study explores the adjustment of new chemical and biological sciences faculty members at a research university. Eleven faculty members were interviewed twice, first in 2007, shortly after they came to the university, and again three years later. The study documented their participation in professional development activities, with special attention to their participation in activities that were organized by the disciplinary Teaching and Learning Center. Changes in teaching philosophy were evident, including modification of teaching goals and greater use of appropriate terminology. Based on these findings, the authors suggest resources that universities can offer to facilitate new faculty members' adjustment to their new positions and, moreover, help prepare them to be change agents within their new institution by taking leadership roles in departmental cultural change.

Introduction

This study is part of longitudinal research that explores the teaching experience of new chemical and biological sciences faculty members in a research-intensive university. Eleven new faculty members were followed for three years. The data collected were used to develop supportive

programming to ease the transition of new faculty members to their new positions.

New faculty members come to the university with diverse backgrounds and experiences. One challenge that they face is adjusting to their varied roles and responsibilities, which include teaching, research, service, and mentoring (Boice, 2000; Reybold, 2003). While graduate programs provide extensive preparation for research, comparable emphasis on teaching is lacking (Cox, 1995; Golde & Dore, 2001; Handelsman, Miller, & Pfund, 2007; Luft, Kurdziel, Roehrigh, & Turner, 2004). Because they lack training, many faculty members replicate in their classroom the traditional lecture style that they experienced as an undergraduate student (e.g., Henderson & Dancy, 2008; Redish, 2003). This is a serious concern, especially in light of the growing national movement to reform undergraduate science, technology, engineering, and mathematics (STEM) education (Association of American Universities [AAU], 2011; Henderson, Beach, & Finkelstein, 2011; Project Kaleidoscope, 2006; Sunal, Wright, & Bland Day, 2004).

At research universities, the support system for new faculty members in terms of teaching and research is greatly influenced by the priorities of the institution (Austin & McDaniels, 2006; Bouwma-Gearhart & Schmid, 2012; Boyer Commission on Undergraduates in the Research Universities, 1998). Tenured and tenure-track faculty who are coming to a research university usually form faculty research communities to participate in journal clubs, discuss common research interests, get feedback on proposed research projects, and learn about innovations in their field. However, when it comes to teaching, they usually work in isolation to select course content and decide on preferred pedagogy (Tanner & Allen, 2002).

Analogous to faculty research communities is a movement to encourage new and experienced faculty to join or start Faculty Learning Communities (FLCs). FLCs provide individual mentoring in teaching and support for professional development in teaching through regular opportunities to discuss classroom issues (Cox, 2004; Layne & Froyd, 2006). Additionally, new faculty can find assistance from teaching and learning centers (Tagg, 2010), especially those with a disciplinary focus (Fairweather, 1996). These centers can address pressing teaching issues, provide professional development activities, and offer individual consultation. In our university, there is a disciplinary Teaching and Learning Center (TLC) for chemistry and biology faculty members that is available to assist new and experienced faculty members. The TLC also supports several established FLCs.

This study explored the experiences of new faculty members in terms of the supports and barriers they encountered in the first three years of their new position. Specifically, we focused on their initial concerns, the

resources they used, their teaching philosophy, and their overall teaching experience. Based on the experiences of these 11 new faculty members, we recommend professional development activities and different ways to support new faculty during their transition.

Literature Review

Teaching Experience of New Faculty in a Research-Intensive University

The teaching experience of new faculty members is typically influenced by many factors, including other faculty members, the departmental culture, and the university's atmosphere (Austin & McDaniels, 2006). However, new faculty members often experience social isolation on campus (Boice, 1991, 1992; Williamson, 1993). Moreover, they report experiencing difficulties in fulfilling their teaching responsibilities, such as excessive worrying, unclear job expectations, unfulfilled promises made during hiring, trouble allocating their preparation time appropriately and efficiently, and classroom incivilities (Boice, 2011). Despite these obstacles, they often hesitate to ask for help from other faculty (Boice, 2000), which can, in turn, hinder their performance, morale, and competence as scholars and educators (Turner & Boice, 1987).

Teaching represents a special challenge for new faculty, especially if they experience a lack of support and information regarding teaching and receive poor teaching ratings from students (Boice, 1991). Many new faculty members report not understanding the criteria on which their teaching will be evaluated (Fink, 1984). At the same time, administrators expect new faculty to already possess essential research and teaching skills and to know how to be a successful faculty member (Whitt, 1991). A common fear of new faculty members, especially those in tenure-track positions, is that asking for help from departmental colleagues could lead to repercussions that will affect tenure and promotion (Boice, 2011).

It is critical that new faculty members learn the skills and knowledge of the profession and have supportive and informative interactions with other faculty members. A system that provides new faculty members with the support they need without jeopardizing their career advancement is necessary. Wilkerson and Irby (1998) emphasize the importance of engaging new faculty members in professional development activities that establish teaching norms, values, and expectations and outline the steps needed for academic advancement, such as how to document teaching accomplishments. Furthermore, new faculty members need to establish a network of experienced colleagues to help them in their transition to

their new position. Teaching and learning centers, communities of faculty members that provide a safe and trusting environment, or one-on-one mentoring can accomplish these goals.

Daily interaction with peers has been found to be highly correlated with a new faculty member's feelings of effectiveness, job satisfaction, commitment, and intention to stay with the organization (Louis, Posner, & Powell, 1983). Moreover, faculty members that made successful transitions had positive relationships with colleagues and faculty members, which provided them with resources to deal with problems or confusion when they arose (Corcoran & Clark, 1984). When administrators, faculty mentors, and teaching and learning center staff understand the nature of faculty members' transition to their new position, they are better able to provide appropriate assistance in the beginning years.

Teaching Philosophy and STEM Education

One recommendation for new faculty in this transition is the development of a teaching philosophy, which represents a faculty member's beliefs and values about teaching goals and the practices best suited to achieving them (Simmons et al., 1999). New faculty members often come to their new positions without a formal teaching philosophy or with an underdeveloped one, especially because they are rarely expected to develop a formal teaching philosophy during their graduate and postdoctoral training (Schussler et al., 2011). Instructors' beliefs about teaching are strongly linked to instructional practices (Dahlgren, Castensson, & Dahlgren, 1998; Kember & Kwan, 2000); therefore, assisting new faculty with their teaching philosophies is a critical first step in helping them become effective educators. Teaching philosophies evolve based not only on individual beliefs, but also on disciplinary norms and recommendations for teaching promoted by the scientific community.

In the last decade, there have been strong national and international recommendations (American Association for Advancement in Science (AAAS), 2009, 2010; AAMC-HHMI, 2009; National Academies, 2006; National Research Council, 2003; Woodin, Carter, & Fletcher, 2010) to improve teaching in higher education, especially in STEM fields. These recommendations stem from the high level of dissatisfaction among STEM undergraduates with the instructional methods used (Henderson, Beach, & Finkelstein, 2011; Henderson, Beach, Finkelstein, & Larson, 2008; Seymour & Hewitt, 1997), as well as doubts expressed by policy makers, practitioners, and the public about the quality of education (Arum & Roksa, 2011). The recommendations have emphasized the need to change

teaching strategies from passive student learning in a teacher-centered context to active engagement in a student-centered context as a means to promote critical thinking (Handelsman et al., 2007; Knight & Wood, 2005; Redish, 2003; The White House, 2009; Wiggins & McTighe, 2006). As a result, professional development activities for new faculty members should focus on helping them develop teaching philosophies that align with these national recommendations (Henderson et al., 2011). However, new faculty members are not blank slates. They begin their faculty positions with beliefs about teaching that are constructed from their previous experiences as students, which mainly involved extensive lecturing (Adamson et al., 2003; Anderson & Helms, 2001; Marbach-Ad, Schaefer, & Thompson, 2012; van Driel, Beijaard, & Verloop, 2001). Even when faculty teaching philosophies are in alignment with national recommendations, classroom practices do not always reflect their tenets due to time constraints and other barriers (Labov, Singer, George, Schweingruber, & Hilton, 2009). Currently, little is known about how the teaching philosophies of new faculty members change over their first few years, what types of professional development activities would help influence such changes, and how the faculty philosophies are reflected in their teaching.

Disciplinary Teaching and Learning Centers and Faculty Learning Communities

Teaching and learning centers are a powerful mechanism for influencing teaching philosophies and, therefore, teaching practices (Tagg, 2010). Teaching and learning centers have become increasingly common in higher education, especially as the importance of reforming higher education has become more salient. These centers typically aim to improve undergraduate education by helping faculty create curricula and develop instructional skills by providing a variety of services and programs, such as consultation with individual faculty members, teaching evaluation services for faculty, and workshops on innovative teaching methods (Kressel, 1999).

Tagg (2010) identifies three types of relationships that centers can have with faculty: (a) the center strives to serve the needs of the faculty by addressing pressing issues, (b) the center provides professional consultation to faculty who seek out assistance, and (c) the center establishes goals about how to work with faculty in advance and seeks to achieve them. Faculty vary in their openness to teaching and learning center resources: Some actively seek professional development opportunities, while others are more skeptical of new techniques and less willing to participate in teaching and learning center activities (Brent & Felder, 2001). Moreover,

institutions often reward research over teaching and discourage faculty from incorporating teaching practices that are known to be effective, because they seem more time-consuming (Labov et al., 2009). Thus, faculty who spend time learning and implementing new teaching methods do so in spite of the belief that they will not receive institutional rewards or colleague appreciation (Brawner, Felder, & Allen, 2001).

Nevertheless, evidence indicates that teaching and learning programs can be an effective way to involve faculty in learning new teaching strategies and incorporating them in the classroom. Participation in such programs improves faculty teaching, increases their satisfaction with teaching, and increases student learning (McShannon & Hynes, 2005; McShannon et al., 2006). In particular, *disciplinary* teaching and learning centers can play a key role in faculty professional development since they use the language of the faculty member's discipline (McShannon & Hynes, 2005). Disciplinary cultures strongly influence faculty behaviors (Alpert, 1985; Henderson, 2007). In fact, the norms and connections to a discipline tend to shape faculty behavior more than the norms and connections to their institution (Fairweather, 1996). Therefore, the teaching experience and the development of a support system for new faculty members need to be explored within a disciplinary context.

The growing trend for faculty to participate in disciplinary-based communities with discipline-specific curriculum and teaching strategies demonstrates the important role of disciplinary cultures in education reform (Henderson, 2007; Marbach-Ad et al., 2007). Faculty learning communities (FLCs) represent an active, collaborative, continuous process of learning and reflection that is supported by colleagues (Cox, 2004). These communities provide many types of support for faculty, including regular opportunities to discuss classroom issues, individual mentoring in teaching, a supportive environment for obtaining ideas and feedback, and the opportunity to collaborate on large-scale initiatives that might be daunting to a faculty member working alone. FLCs provide the presence of supportive colleagues and a positive atmosphere for scholarship and teaching, factors known to contribute to the job satisfaction of new faculty members (Sorcinelli, 1988).

Evidence suggests that FLCs have positive effects on instructors (Akerson, Cullen, & Hanson, 2009; Demir & Abell, 2010; Fazio, 2009; Lakshamanan, Heath, Perlmutter, & Elder, 2011; Pomeroy, 2010; Vescio, Ross, & Adams, 2008) and improve student and faculty learning (Cox, 2004; Dawkins, 2006; Layne & Froyd, 2006; Silverthorn, Thorn, & Svinicki, 2006; Sirum, Madigan, & Klionsky, 2009). For instance, Cox (2004) found that FLC participants reported better classroom atmosphere and engage-

ment, more positive student evaluations, and improved student ability to synthesize and integrate information. Silverthorn et al. (2006) found that faculty members who participated in an FLC began changing their teaching practices by including more classroom activities, rethinking their teaching content, and administering assessments. The faculty reported that these changes added opportunities for students to reflect on their understanding and develop the ability to self-assess.

The effectiveness of disciplinary TLCs and FLCs stems from their ability to leverage pedagogical content knowledge (PCK), the idea that pedagogy is inextricably linked with the disciplinary content taught in the classroom (Shulman, 1986, 1993; van Driel et al., 2001). In particular, PCK involves knowledge of teaching strategies specific to subject matter and understanding of learning difficulties and student conceptions within that subject (van Driel et al., 2001). PCK is important for instructors because it helps them determine how to communicate specific science content in a way that allows students to develop a deep conceptual understanding (Major & Palmer, 2006; Roth et al., 2011; Shulman, 1986).

Research Questions

To evaluate the challenges, needs, and teaching philosophies of the new faculty members and learn how a disciplinary TLC could ease their transition to their new positions, we asked the following four research questions:

1. What were new faculty members' concerns?
2. What teaching and learning resources did new faculty members use in adjusting to their new positions, and what did they feel was missing?
3. Did the new faculty members' teaching philosophy change over time, and, if so, how did it affect their reported teaching practices?
4. Can we identify different patterns for participation in professional development activities that could help us implement better support programs?

Methods

Context of the Study

At the time of this study, our university enrolled 25,590 undergraduate and 9,742 graduate students in 111 undergraduate and 96 graduate programs. Within the College of Chemical and Life Sciences, there were 150 faculty members, about 2,200 undergraduates pursuing majors in the biological sciences, and about 400 undergraduates pursuing majors in biochemistry and chemistry.

During the summer of 2005, the College underwent an external review of its Howard Hughes Medical Institute (HHMI) Undergraduate Science Education programs. A major theme that emerged from the external review was that faculty and graduate teaching assistants were often unaware of national STEM education reform efforts that were complementary to the goals of their curriculum projects. Based on the recommendations of the external review committee, the College administration, in coordination with the campus Center for Teaching Excellence (CTE), decided to create more structured opportunities for both faculty and graduate students to learn about innovative teaching approaches and trends in STEM education.

In previous years, faculty members from our college rarely participated in the campus CTE activities, mainly because they felt that the activities offered were too broad and were difficult to apply to science classes. Faculty often shared their desire to learn about innovative pedagogies, but in the context of their content and from role models or experts that were from their own research area. Therefore, it was decided to create a disciplinary TLC to serve the chemistry and biology departments. The disciplinary focus of the teaching and learning center and its staff, who hold both science and science education expertise, was intended to provide the pedagogical content knowledge that specifically applies to the biology and chemistry faculty (Fairweather, 1996; McShannon & Hynes, 2005).

The College TLC, established in 2006, provides professional development activities and individual assistance that is tailored specifically to the chemical and life science disciplines. One initiative of the TLC is to support new faculty in their transition to their new position. The TLC holds workshops twice a year for all new College instructors, where the TLC director provides advice, resources, and information on TLC services. In addition, all new faculty receive a welcome packet that includes books (e.g., *McKeachie's Teaching Tips* [McKeachie & Svinicki, 2006]), the latest national reports on science teaching (e.g., *Vision and Change: A Call to Action* [AAAS, 2009]; *Bio2010: Transforming Undergraduate Education*

for Future Research Biologists [NRC, 2003], *Scientific Foundations for Future Physicians* [AAMC-HHMI Committee, 2009]), and recent journal articles about teaching and learning (e.g., Caldwell, 2007; Freeman et al., 2007). The TLC staff also offers a menu of workshops, seminars, and individual consultation for all faculty members in the College, as well as on-going support for the College FLCs. Currently, our disciplinary TLC supports six FLCs organized around research areas, gateway courses, and interdisciplinary approaches to teaching (more about the TLC's and FLCs' activities can be found on the TLC website http://cmns-tlc.umd.edu/teachingandlearningcenter).

Sample

Eleven new faculty members from the University of Maryland were followed over the course of their first three years at the University. The composition of the faculty was as follows: five females and six males; nine tenure-track faculty (with research and teaching responsibilities) and two non-tenure-track lecturers (with only teaching responsibilities). Further demographics are not provided to protect the identities of the faculty members who participated. All new faculty members reported that they had some previous teaching experience as a graduate student or postdoctoral fellow, such as supervising a lab or leading discussion sections. Four of them reported that they had no previous experience having primary responsibility for an undergraduate course, while three reported having taught graduate-level medical school courses. Two faculty members had taught high school, and two had previously co-taught an undergraduate course.

Instrumentation

Pre-Interview

In 2007, the TLC director and graduate assistant interviewed incoming faculty using a semi-structured interview protocol consisting of open-ended questions used previously in science education research (Marbach-Ad & Arviv-Elyashiv, 2005). The interviews took place in the offices of the new instructors. Department chairs, a science educator, and an outside evaluator adapted and validated the protocol for the study. Each interview lasted 40-100 minutes and was recorded and later transcribed.

Engagement in Professional Development Activities

During the three-year interval between interviews, the TLC staff documented faculty members' participation in professional development activities and science education conferences. A TLC staff member attended every community meeting and took minutes. TLC staff also provided the new faculty members with assistance in curriculum planning and syllabus development ($N = 4$). TLC staff conducted classroom observations and took field notes for new faculty members ($N = 6$) who requested individualized assistance. Through these varied forms of interaction, we were able to gather additional information on each of the new instructors to support the interview data.

Post-Interview

In 2010, we interviewed each of the new faculty members a second time using a semi-structured interview protocol based on the 2007 version, but modified to include questions on the faculty members' teaching experience and professional development (see Appendix A). The format of the interviews was the same as for the pre-interview.

Data Analysis

We used a qualitative case study approach to analyze the data collected from the interviews. Qualitative research provides insight into how individuals construct meaning and how they attribute meaning to their life experiences (Merriam, 2009). A case study is a form of qualitative research in which the researcher explores a process in depth for one or more individuals (Creswell, 2003). The case represents both the method of inquiry as well as the product of inquiry where the purpose is to provide a rich, detailed description of the case (Stake, 2008). Three researchers (the two who conducted interviews and an outside evaluator specializing in educational psychology) analyzed the transcribed data, using a cross-case synthesis to analyze multiple cases (Yin, 2003). Each researcher individually read the transcripts, looking especially for data pertaining to the main themes of teaching challenges, teaching and learning resources, teaching philosophy, and reported teaching practices. Researchers analyzed the participants' interviews separately and identified the themes, patterns, and contradictions to create a concise case study (see Appendix B). Each interviewee reviewed the case study to ensure accurate interpretation (all case studies are available from the authors upon request). Finally, we constructed figures (see Figures 1 and 2) with relevant themes by case

to enable cross-case comparisons within a uniform framework (Miles & Huberman, 1994; Yin, 2003). The data present no differences with respect to race, gender, or departmental affiliation. Pseudonyms are used to maintain confidentiality.

Results

We present the data according to our research questions (RQ).

RQ1. What Were New Faculty Members' Concerns?

Based on analysis of the interview transcripts, we identified six themes relating to concerns of new faculty members when they entered their new positions: balancing teaching and research, engaging students, developing a teaching style, dealing with procedural changes, writing assessment tools and grading, and feeling insecure about the topic (see Figure 1).

All of the nine faculty members with science research responsibilities were concerned about balancing teaching and research and being able to do well at both. Part of their concern stemmed from feeling that both teaching and research are important and require a great deal of time and energy. Some of them talked about weighing different time management strategies, such as focusing on research during the semesters that they do not teach or dividing each day between research and teaching. One faculty member, David, stated, ". . . the teaching will need a time commitment, my research and my grant applications will need a time commitment. I am going to have to resort to the methods I've always used, which is to make my day a 14-, 15-hour day, stop it, go, do my family thing and then when everybody goes to bed at 8:30 pm, go back and do another four hours."

Six faculty members described engaging their students as a concern and mostly related it to large class size. None of the faculty members who were teaching small classes or laboratories ($N = 4$) cited this as a concern. Faculty members were concerned about student engagement in large classes, in part, because they had no previous experience with large classes either as learners or teachers. The faculty described how they were unsure about what teaching strategies would work with large classes. Several faculty members reported that they already had difficulties getting students interested and willing to participate in the class. Susan noted, "I asked the class a question, there were 80 students in the class—nobody responded, nobody, so I just went on with the lecture."

Four of the faculty expressed concerns about developing and adapting their teaching style to fit the classes they were assigned to teach. David

Figure 1
Categorization of Faculty Member Concerns Based on the First Interview

Concerns	*Dana*	*Amber*	*Jenna*	*Ryan*	*Susan*	*Linda*	*Robert*	*John*	*Scott*	*David*	*Tim*
Balancing teaching and research (9)			X	X	X	X	X	X	X	X	X
Engaging students in the classroom (6)		X	X		X		X	X			X
Developing a teaching style that benefits the students and instructor (4)							X	X		X	X
Dealing with procedural challenges (4)	X					X	X	X			
Writing assessment tools and grading (4)		X		X		X				X	
Feeling insecure about the topic (2)		X						X			

described trying to deliver the material in a way that takes students' learning styles into account: "I really do not know what works very well. Would they [students] much rather have somebody who's writing slowly on the board, so they can write and take time for things to sink in?" The new faculty members also talked about the pros and cons of receiving class material from other faculty members or team-teaching with experienced faculty members who had a well-established teaching style. Tim spoke of how the benefit of receiving materials from the previous instructor of the class was tempered by their different styles of teaching: "I thought I had a set syllabus from the previous instructor, but a lot of his lectures weren't even complete PowerPoints. He didn't need a lot of slides, and I'm a very visual kind of person, so I have to prepare 30-40 extra slides."

Four faculty members were concerned about how to deal with procedural issues that might arise, such as student absences. Dana explained, "I would love if every lab at the College had the same policies on absences, unexcused, excused, illness, all that stuff, because for me that's a really big frustration." Robert expressed concern about dealing with problematic students: "What about undergraduate students who are very difficult to work with and are rude. How do you deal with this?" Faculty members also cited uncertainty about how much to interact with students outside of the classroom and how to maintain the student-instructor boundary, including how to balance being available to students without students abusing this access.

Four faculty members raised concerns about writing good questions for tests or quizzes. For instance, Amber noted, "I would say that my most difficult thing is tests. Just writing clear questions. It's very difficult." They also described how they sought to write questions that tested thought-processes and targeted conceptual understanding rather than memorization. David, in particular, was concerned about developing a grading system: "I still haven't decided what my grading scheme is going to be. Do you make your exams cumulative or not? How do you divide the grades between class and lab?"

Lastly, two faculty members reported that they were uncomfortable with their course assignment because they were required to teach outside of their area of expertise. They described how this made preparing for teaching more time consuming, and they also felt that it was unfair to the students. Amber stated, "I have to teach two classes in the spring, and I really don't want to teach [this class] because I think it's a disservice to the students. I'm not an expert in this topic; that's not what I should be teaching."

RQ2. What Teaching and Learning Resources Did Faculty Members Use in Adjusting to Their New Position, and What Did They Feel Was Missing?

What Resources Faculty Members Used

Based on faculty interviews, our observations, and records of attendance at teaching and learning programs, we identified four categories of resources that were used by faculty: individual assistance from departmental colleagues, workshops and seminars, individual assistance from the TLC staff, and joining a Faculty Learning Community (FLC). The interviews provided insight into the ways in which new faculty members benefited from each type of resource.

All of the instructors reported that they benefitted from assistance and mentoring from other faculty members within their home department. They described how they either talked to previous course instructors or those who had specific teaching expertise. Robert noted, "I think inside [the department] there's a lot of mentors, people who have been teaching the same course that I'm teaching for one or two decades, so I talked to them about it. . . . One of my colleagues showed me how to use clickers [a student response system]." Faculty members who had the opportunity to teach with an experienced instructor described how they benefitted from this interaction because it provided them with a model of how to teach. This modeling allowed them to learn new strategies for teaching, as David explained:

> . . . I gave lectures as part of [an experienced faculty member's] class . . . and I adapted the same format that the [experienced faculty member] had, so for example, every two weeks he gives five lectures and on the last Friday of the two weeks, the sixth lecture, he gives the students a paper and they discuss the paper. So I did the same thing.

Another faculty member, John, reported that he benefited from the peer-review system that the department had established for tenure-track faculty members. He mentioned that the faculty member who had observed his class gave him specific, constructive feedback that helped him to improve his teaching:

> I have a problem with [my] accent, so people find me difficult to understand sometimes. So first I learned to speak very slowly. Second, I'm writing a lot, or when I see that the material is difficult or I'm giving a lot of instructions, I ask one of the students to repeat what I said.

All of the new faculty members were required to attend a college teaching orientation workshop, where they met the TLC director and received teaching and learning resources. In addition to this workshop, new faculty members made use of the wide array of teaching seminars and workshops offered by the TLC and the campus CTE. Based on attendance records, nine of 11 new faculty members participated in at least two teaching and learning workshops offered by the TLC. In the interviews, they described how the workshops exposed them to nationally recommended STEM teaching strategies. They benefitted from learning about science education research as well as specific teaching techniques, such as how to use technology in the classroom. The faculty members also indicated that it was beneficial to have workshops specifically tailored to teaching science. They stressed how important it was for them to have a disciplinary teaching and learning center that provided workshops focused specifically on their own science discipline, directed by someone whom they could trust to guide them to the appropriate workshops and teaching resources. Dana noted,

> I'm glad that we have a disciplinary teaching and learning center. I did go to a lot of workshops offered by the campus Center for Teaching Excellence (CTE), but it was so skewed to humanities and not sciences, and labs are [a] totally different beast from discussion sections.

Six of the 11 instructors reported receiving individual assistance from the TLC staff, who have specific expertise in science education. This assistance involved personal guidance during one-on-one meetings in which TLC staff provided specific recommendations for course instruction. In some instances, TLC staff visited classes to observe and provide feedback. Additionally, one of the new faculty members received assistance from the TLC staff in writing the educational component of a large grant.

The TLC staff also referred faculty members to online or printed resources. Jenna described the helpfulness of the resources since teaching was not an intuitive process for her:

> I've read a couple of books and gotten information from a college mentoring session where experts came and spoke. So I've gathered information from many different sources. Teaching might seem intuitive, but I think it's something you need to think about and work at fairly hard to be effective.

In the post-interview, seven of the 11 faculty members reported that they were members of at least one of the college's FLCs, which meet regularly to discuss scientific teaching. All of the FLCs in the college are supported by TLC staff and discipline-based education researchers from the partici-

pating departments. Five of the faculty members joined an existing FLC centered on their scientific research area. This community consisted of about 20 individuals from all faculty ranks who met monthly to discuss teaching and learning initiatives in the nine courses within their area of expertise. One faculty member joined an interdisciplinary faculty teaching community that met weekly to discuss the development of courses at the interface of the physical and life sciences. Finally, one of the new faculty members founded a community centered on a course that serves as a gateway to an array of upper-level coursework. This group met several times over the course of the academic year to identify critical prerequisite knowledge for the upper-level courses and develop a concept inventory.

What Resources Faculty Members Felt Were Missing

In the second interview, we asked the faculty members what they felt would help them in teaching beyond what was already available to them. They suggested the following:

1. **Offer training in teaching for new faculty in the early phases of their career, e.g., graduate school and postdoctoral appointments.** They described how most tenure-track faculty members are coming with very little or no training or experience in teaching, since teaching is not typically a part of postdoctoral training. As Robert put it, "Teaching for the first time can be a very daunting process. So in a way the first class becomes an experimental class. . . . so maybe there should be some training [for postdocs]."

2. **Provide more examples and models of good practices in teaching science.** Faculty members describe how they wanted to learn and receive guidance from the best instructors in their department, as well as nationally renowned scholars. Dana commented on how helpful it was for her to meet with a visiting science education expert and explained how she wanted more of these opportunities.

3. **Provide topical seminars and mentoring.** Faculty members asked for workshops on certain topics in order to learn these areas in more depth. For example, they wanted workshops on concept maps and using technology in the classroom. Not only did they want to

learn how to use these techniques, but they also wanted to see evidence that these approaches were effective in science classes similar to theirs.

4. **Have mechanisms for learning what students were taught in previous courses.** Faculty felt that it was important to understand the prior knowledge that students bring with them to the classroom in order to know what material to cover in their own classes. Faculty suggested they could do this by sitting in on prerequisite classes, talking to the faculty members who teach the prerequisite classes, and using pre-tests at the beginning of the semester.

5. **Receive feedback from experienced faculty.** Faculty members asserted it would be helpful to have someone come and observe their classrooms or give them constructive feedback. John stated, "I think it's good that people come to the lecture. I have no problem if someone said we're assessing your lecture." Susan was also interested in receiving feedback, but she emphasized that it was important that the feedback be separate from the tenure and promotion process: "Maybe have somebody attend a lecture and give you feedback . . . not a written critique that goes in your record."

6. **Receive more human resource assistance for the course.** Faculty felt that having a teaching assistant could help them reduce the amount of time and effort they put into preparing for and managing their classes, especially for those who taught large classes in which they were trying to incorporate innovative teaching approaches (e.g., group work, writing assignments, and case studies). Linda stated that she used to incorporate innovative teaching techniques in her large class, including group work, and written projects, but when she lost the help of her teaching assistant due to budget cuts, she was no longer able to do this.

RQ3. Did the New Faculty Members' Teaching Philosophy Change Over Time, and If So, How Did It Affect Their Reported Teaching Practices?

At the time of the first interview, only one of the faculty members had thought about and written a formal teaching philosophy. The others reported that they had not thought much about their teaching philosophy and were never required to prepare one. Representative statements of these faculty include, "I don't know that I've developed one yet," "I'm not sure I have a [laughs] a philosophy *per se*," "I think when you come from a research background you don't necessarily think a lot about teaching philosophy." After three years, the faculty members had developed more formal teaching philosophies that incorporated a variety of goals and objectives, many of which were in alignment with nationally recommended STEM teaching practices. We categorized these into four themes: teaching for understanding instead of memorization, interacting with and engaging students, relating to student diversity (e.g., learning style, prior knowledge, different background), and relating to everyday life and scientific research. We linked these themes to the faculty members' reported teaching practices (see Figure 2).

Teaching for Understanding Instead of Memorization

Over the course of their first three years, the new faculty members developed a greater appreciation for the importance of teaching to achieve understanding rather than memorization. Three faculty members mentioned this theme in the first interview, while eight (including the original three) referred to this in the second interview. John described in both interviews how he "tried to make the students think, try to actually get them to put things together . . . and not just to memorize facts." David discussed how he realized after three years of teaching that he needed to cover less material in class in order to facilitate deep understanding of a more limited number of topics: "My teaching philosophy has been evolving since I came here. I think it's a clichéd one, but I think my philosophy right now is 'less is more.'" David also described how this philosophy was embodied in the classroom:

> . . . my first year, when I first taught, I taught a lot of concepts. And the final exam time was really depressing because I realized how little they had learned. And I realized I was throwing too much at them and not realizing how much they were not learning. Now I think I have reduced maybe 20-25% of the ma-

Figure 2
Categorization of Pre- and Post-Teaching Philosophies

Teaching Philosophy		*Dana*	*Amber*	*Jenna*	*Ryan*	*Susan*	*Linda*	*Robert*	*John*	*Scott*	*David*	*Tim*
(I) Teaching for Understanding Instead of Memorization	Pre	*							*		*	
	Post	+			+	+		+	+	+	+	+
(II) Interacting With and Engaging Students	Pre		*	*								*
	Post		+	+		+	+				+	+

Figure 2 (*continued*)
Categorization of Pre- and Post-Teaching Philosophies

Teaching Philosophy		*Dana*	*Amber*	*Jenna*	*Ryan*	*Susan*	*Linda*	*Robert*	*John*	*Scott*	*David*	*Tim*
(III) Relating to Student Diversity	Pre							*				
	Post	+				+	+	+				
(IV) Relating to Everyday Life and Science Research	Pre											*
	Post			+				+			+	+

> terial I cover. . . . I've been illustrating things more . . . the class participates quite a bit more. I really try to engage them, and I succeed in doing that, actually.

Some faculty explained that they tried to enact this teaching philosophy by teaching with clarity in the classroom and actively trying to understand which concepts students found confusing.

Interacting With and Engaging Students

Three faculty members mentioned in the first interview and six mentioned in the second interview that their philosophy is to engage students in the learning process, keep them interested, and promote more interaction during class. In the second interview particularly, faculty members provide examples that were specific of the ways in which they engaged students. Methods for increasing interaction included encouraging students to ask more questions in class, student-instructor discussions, student-student discussions, and team projects. For example, in the second interview Jenna described how she was trying to engage students through class research projects:

> I like to engage students in interesting questions and teach them, give them tools so hopefully they can explore areas that they're interested in. So most of my classes . . . I teach them to do [process] analysis and pull genes out of genomes, and then we do a class project together where every student contributes a different piece that we then put together as a class, and hopefully then by doing that the whole class has done some research on a topic that I pick, and then they can go off and do their own project for the second half of the class.

Relating to Student Diversity (Learning Style, Prior Knowledge, Different Backgrounds)

Initially, faculty members displayed little awareness of the differing backgrounds of students in the classroom. In the first interview, only one faculty member mentioned attempting to relate to the diversity in students' learning styles within his class. In the second interview, four faculty members voiced this theme. Faculty members such as Linda described how students have different learning styles and explained the strategies they use to cater to the different styles:

> I've been using a lot of different modalities of learning at the same time because it's become obvious to me that people learn

> differently. So we have different ways of teaching, in my course, . . . I try to have a broadened understanding with students' individual talents and foster that.

Susan discussed the importance of understanding the prior knowledge that students bring with them to the classroom because they may come with different levels of understanding.

Relating to Everyday Life and Scientific Research

In the first interview, Tim included in his teaching philosophy the importance of making "the teaching relevant to everyday life and teaching students the applications in order to grab their attention." In the second interview, four instructors expressed this teaching goal. Tim described in the second interview how he "tries to relate the material [in lower level classes] to the real world or, in the upper-level classes, to the research world." Similarly, David emphasized how he used current media to connect classroom material to everyday life:

> I've shown movies about certain processes that I get from the web. Every once in a while I hear a news report that's very relevant to our classroom. I bring it to the class. So we start with what I heard on NPR an hour ago. They like that component because it shows them that what they're doing is real, it's happening out there, it's not just a hypothetical or theoretical. People are using these technologies today. What I succeed certainly in conveying is what they're learning is very important today and at the leading edge of scientific research today.

Jenna described how she believed that it was important to teach in an interdisciplinary manner in order to prepare students for research in science.

RQ4. Can We Identify Different Patterns for Participation in Professional Development Activities That Could Help Us Implement Better Support Programs?

Based on our analysis of the interviews, we identified two different groups in terms of the types of resources that faculty used to meet their teaching needs and the frequency with which they used these resources. One group consisted of faculty who were seeking intensive on-going support, mainly through joining an FLC. The other group consisted of faculty who were seeking more intermittent, usually individualized support. Below, using faculty case studies, we provide examples to represent each group.

Faculty Who Were Seeking Intensive On-Going Support

Seven faculty members were grouped under this category. All of them had joined FLCs. Five faculty members (Tim, Amber, Susan, Ryan, and David) joined an FLC that focused on undergraduate instruction within their research area. The FLC consisted of both lecturers and tenure-track faculty. Tim and Susan were tenured and tenure-track faculty members, respectively, who had active science research labs. Amber was a non-tenure-track lecturer who had expertise in science education. Tim and Amber described how they benefitted from their complementary expertise. This interaction ultimately resulted in the collaborative development of learning activities based on Tim's current research. Tim also described how he benefitted from the opportunity to collaborate with more senior faculty members in the FLC. Team-teaching with an experienced faculty member helped him learn new techniques and gave him access to additional instructional materials. David joined the same FLC, even though it was only peripherally related to his research and teaching. As a result of his participation in the community, he shifted the emphasis of his course to better align with the community objectives so that he could benefit from the community's resources.

Dana provides an example of a faculty member who needed to be more active in finding an FLC that suited her needs. She taught a multi-section gateway course and felt isolated from the other instructors who taught the same course. As a result, she took the initiative to start a community based on the course, and she invited each of the other course instructors to participate. Jenna joined an existing interdisciplinary community on the campus that fit with the interdisciplinary focus of her research and teaching assignment. This allowed her to benefit from the different perspectives of faculty members from outside her department.

Over the course of the three years, all of the faculty members in this group developed more sophisticated teaching philosophies as well as innovative teaching practices that reflected themes discussed in their communities. For instance, David's initial teaching philosophy focused on content coverage and what he wanted students to gain from the class (e.g., enjoy the class, work hard, and develop skills), but did not include how he planned to accomplish this. Over time, the community influenced his view of how to teach in that he no longer emphasized breadth of content coverage, but rather focused on increasing the depth of student understanding. He also used teaching strategies that would help him attain this goal, such as student engagement and connecting course content to everyday life. These teaching strategies were specifically discussed in the community.

From our observations and the interviews, we identified three main themes regarding the support that the new faculty members received from participating in FLCs: (a) individual mentoring in teaching, (b) regular opportunities to discuss classroom issues, obtain ideas, and receive feedback, and (c) opportunities to collaborate on large-scale initiatives.

Individual mentoring in teaching. Faculty members received individual mentoring from other members of the community in the form of team-teaching, modeling of best practices, and receiving course design ideas and materials from previous instructors. Tim explained how stepping into an existing, innovative course made it easier for him to adopt new teaching approaches because he had the assistance of the community members who had originally collaborated in developing the course:

> . . . It's a very structured class, because you have to coordinate three components of the course: lecture, lab, and an on-line unit. I don't claim to take credit for that, [other members of the community] have done that over time. So I just plugged in, but as somebody coming from the outside, it was extremely helpful to plug into a situation where there were very clear expectations of what you needed to cover.

Regular opportunities to discuss classroom issues, obtain ideas, and receive feedback. Faculty members learned innovative techniques for the classroom and received encouragement to engage in professional development activities from the other community members. Amber explained,

> So basically the [community] has been huge. When I came in, even though I have an education background . . . they encouraged me to go to the case study workshop. And I learned about clickers. . . . You have the support for doing innovation, for doing things differently. Also giving me ideas for doing things, like concept maps. . . . I think more [important] is the support. It's having that meeting once a month and knowing that there are people that think that what you're doing is important.

Susan described how the community gave her a venue to discuss topics related to teaching: "Well, I mean, obviously the [community] is really the main resource that I use to try to understand more about how the undergraduates think and how you can actually communicate with them and effectively get them to understand."

Opportunities to collaborate on large-scale initiatives. Through the research-oriented community, six new faculty members were involved in writing a National Science Foundation (NSF) grant in support of undergraduate instruction. After receiving the grant, each of the six faculty members

implemented innovative teaching techniques and assessment strategies. This work resulted in eight peer-reviewed publications and multiple conference presentations.

Dana, the new faculty member who initiated the gateway course FLC, coordinated the development and implementation of a concept inventory that was used to measure students' prior knowledge. With assistance from the FLC and the TLC director, she also developed several innovative teaching methods, which she subsequently disseminated through conference presentations and a peer-reviewed publication:

> . . . [the director of the TLC] guided us with writing the questions and coming up with concepts, which is really hard to do. And giving us examples from what other people have done. . . . I've gone to science education meetings and learned a lot. I've also gone to present data at other national meetings.

The faculty member who joined the interdisciplinary teaching community, Jenna, described how she benefitted from helping to writing science education grant proposals. These proposals helped her to develop her own interdisciplinary course and write a successful NSF Faculty Early Career Development grant. One tenure-track faculty member, Tim, particularly valued the opportunity to collaborate with a lecturer to develop a case study for the lecturer's course. The synergy of his science research expertise and her science education expertise enabled them to use one of his recent research papers to build a teaching case study, which brought authentic scientific research into the classroom.

Faculty Who Were Seeking Intermittent, Individualized Support

Four new faculty members were categorized in this group. Rather than joining a community to seek support, these faculty members sought occasional help from colleagues or other resources, usually for very specific reasons. Robert, a tenure-track faculty member, began seeking assistance for teaching when he learned that he was assigned to teach a large course. He was concerned about how to engage all of the students while taking into account the diversity of the class. He learned that another faculty member in the department who taught the same course used clickers (student response systems), and as a result he asked this faculty member for help specifically with the logistics of implementing clickers. In addition, he went to one workshop on clickers. Aside from these resources, he didn't feel the need for any other assistance. Linda, a tenure-track faculty member, sought the help of the TLC director to learn how to implement group work in her large class. She attended one meeting of the gateway

course FLC (described above), but she stopped participating because she felt the need to spend more time on her research. Scott, who began at the University of Maryland as a tenured faculty member, came with a very clear vision of how he wanted to teach his class. He acknowledged that he did not need much assistance because his course was a small, upper-level class in his research area: "I think I'm the one who ultimately has to prepare the course, and when I taught it for the first time there were certain areas where I thought, okay, I will have to do this differently next time or explain this differently next time, but I'm not sure anybody outside could help me with that." He did prepare for teaching by speaking to faculty members in his department who had previously taught the class he was assigned to teach to learn which aspects of the course the students found difficult.

The teaching philosophies that these four faculty members developed reflect the specific issues for which they sought assistance. For example, Robert and Linda sought techniques to engage students in large classes, and both had teaching philosophies that revolved around engaging students, especially in terms of relating to student diversity in the classroom. The only assistance that Scott sought was related to student understanding, and his teaching philosophy reflected his desire to be clear in his teaching and to know what students found confusing.

It is noteworthy that two new faculty members, one from each group, felt that after three years, they were still struggling to feel confident in their teaching. In the post-interview, they expressed frustration with the students' attitudes and level of understanding. Although the other new faculty members also spoke in the post interview of experiencing some difficulties, they also expressed satisfaction with their teaching. Conversely, these two faculty members appeared to experience not only difficulties, but also some dissatisfaction with their teaching. Ryan used many resources, such as communities, to help him in his teaching. While he felt supported by the community and implemented innovative teaching techniques, he felt that he did not achieve the productive connection with students that he wanted to have. John's difficulties stemmed largely from his experience co-teaching with an experienced faculty member. He indicated that students always compared him to the experienced instructor and complained about his teaching style and grading. In addition, he described his difficulties in developing his own teaching style. This illustrates that new faculty members can face barriers even when they make use of available professional development opportunities, such as participating in communities or team-teaching. Both faculty members mentioned only one theme in their post-interview teaching philosophy:

teaching for understanding instead of memorization. The singular focus of their teaching philosophy may reflect the difficulties they experienced in trying to increase student comprehension.

Discussion

This research was motivated by the need to better understand how faculty members develop their teaching philosophies and practices, as a first step in creating professional development strategies to improve undergraduate education. The study is unique in that it utilized longitudinal data to explore the teaching experience of 11 new science faculty members over the course of their first three years.

Analysis of the pre-interviews revealed that our new faculty came to their new positions with little or no experience in teaching. Most of them experienced teaching as GTAs, but this was usually limited to facilitating laboratories or discussion sessions. Most reported that as graduate students they did not have experience in facilitating large classes, and they did not receive any intensive preparation for teaching. These findings were in accord with the large body of literature that shows that in most research-intensive universities, there is almost no training for graduate teaching assistants (Cox, 1995; Golde & Dore, 2001; Handelsman et al., 2007; Luft et al., 2004).

The lack of previous experience and training in teaching at the graduate and postdoctoral levels (Abell, Park Rogers, Hanuscin, Lee, & Gagnon, 2009) could explain most of the concerns that were raised by the new faculty members. We identified three major types of concerns: (a) concerns that were related to instruction, such as engaging students in the classroom, adopting a teaching style that benefits both the students and the instructor, developing creative assignments and assessment tools, and dealing with procedural challenges; (b) concerns that were related to curriculum, such as insecurity about the topic that they were assigned to teach; and (c) concerns about time management, such as finding a balance between teaching and research or other responsibilities. This last concern has been discussed broadly in the literature (Boice, 1991). Faculty in research-intensive universities are expected to do well in all of their roles (teaching, research, advising, and service); however, success in research is more richly rewarded and appreciated than success in teaching (Austin & McDaniels, 2006; Bouwma-Gearhart & Schmid, 2012; Boyer Commission on Undergraduates in the Research Universities, 1998).

In response to the new faculty concerns about instruction, our TLC offered a variety of professional development activities. In the post-

interviews, it was encouraging to find that faculty not only sought advice from peers, but also participated in TLC activities and sought individual assistance from the TLC staff. Faculty members emphasized how they benefited from activities that were connected to their discipline. They highlighted the advantage of participating in workshops that focused on innovative approaches for science teaching and seminars that were led by scientists who were recognized for scholarship both in scientific research and science education.

Following the first three years of this study, almost all new faculty members reported that they felt comfortable with their teaching, and, accordingly, we found that their teaching philosophies were more developed and were more closely aligned with best teaching practices as articulated by recent STEM education reports (American Association for Advancement in Science [AAAS], 2009; AAMC-HHMI Committee, 2009). The two faculty members who reported that they still faced challenges in teaching had much more limited teaching philosophies that did not change appreciably over the three-year study period. From the interviews and our observations, we identified two groups in terms of the faculty members' use of resources and the extent to which they were using these resources to meet their teaching needs. One group consisted of faculty who were seeking intensive on-going support, while the other group consisted of faculty who were seeking more intermittent, focused, and individualized support.

Implications

This study suggests that faculty members have different ways of adjusting to their new positions, and they use different resources to build their experience and gain confidence in teaching. Therefore, it is important for universities to offer a variety of professional development opportunities for new faculty members. We describe several strategies that universities can implement to improve teaching based on feedback from new faculty.

Better Preparation for Teaching in Graduate Degree Programs

Most new faculty reported coming to their positions with little prior experience teaching full undergraduate courses. It appeared that some of the new faculty members' concerns stemmed from this lack of experience. When asked what resources were missing, new faculty reported that they would have benefited from more teaching preparation in earlier stages of their careers (e.g., graduate school, postdoctoral training). Implementing

rigorous graduate teaching preparation programs can help future faculty become aware of recommended teaching practices before less effective practices become entrenched. In our university, we initiated a 6-week course for all new graduate teaching assistants in the chemical and biological sciences (Marbach-Ad et al., 2010, 2012). In addition, we offer more substantial training in the form of a University Teaching and Learning certificate program that graduate students can complete concurrently with M.S. and Ph.D. degree programs. These students are required to participate in teaching and learning workshops, complete a science pedagogy course, observe classes and be observed teaching, prepare a teaching portfolio, and carry out a science teaching project. This enhances the credentials of graduate students who aim for positions with a teaching component and helps them develop a more sophisticated teaching philosophy.

Faculty Learning Communities

Given the numerous benefits that new faculty reported gaining from their participation in communities, we recommend that universities support the formation of faculty learning communities and encourage their faculty to participate. The success of FLCs, however, depends on faculty having a shared enterprise and incentives (Wenger, 1998). In some cases, these emerge from interactions within the group, but if they are not present, the group may be unsustainable. Mentoring systems can also provide support for new faculty members and may be more feasible to initiate at the departmental or college level. We found that all of the new faculty members sought advice from experienced faculty members, which indicates the high level of need for this type of interaction.

Workshops and Seminars

The new faculty in this study described how they benefitted from attending the TLC teaching and learning workshops and seminars. These types of workshops can focus on specific topics (e.g., implementing a particular teaching approach) or broader educational topics (e.g., science education theories). We feel that it is also important to expose instructors to national leaders in science education; therefore, we initiated a visiting teacher/scholar series in which respected faculty members come to the university to meet with faculty and share their experiences with teaching and research. Because balancing teaching and research is a common concern, this can also provide an opportunity to model how this balance can be achieved.

Individual Assistance From the Teaching and Learning Center Staff

The disciplinary TLC on our campus offers a comprehensive menu of professional development activities. The new faculty members in this study described how they benefitted from both individual consultation with the TLC staff and from the TLC's involvement in faculty learning community initiatives. The advantage of disciplinary teaching and learning centers is that they can address the specific needs of faculty within the discipline (Alpert, 1985; Fairweather, 1996; Henderson, 2007; McShannon & Hynes, 2005).

Conclusions

The interviews revealed that there is no one correct model for supporting new faculty during this transition, because what helps one faculty member (e.g., team-teaching) could hinder another. Therefore, there is a need for institutions to be flexible and offer a menu of professional development and opportunities from which faculty members can choose. These resources facilitate new faculty members' adjustment to their new position and, moreover, help prepare them to become change agents within their new institution by taking leadership roles in departmental cultural change.

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Appendix A
Post-Interview for New Instructors

1. How many semesters have you taught here?
2. What type of classes did you teach (major, non-major, introductory, upper-level, small, large, etc.)?
3. What is your teaching philosophy?
4. What should chemical and life science majors acquire in their undergraduate studies? What are you doing to make sure that you're giving students the opportunity to acquire these?

   Pay attention to the following aspects:

   a. Content knowledge
   b. Laboratory skills
   c. Scientific writing and reading
   d. Understanding the dynamic nature of science
   e. Understanding the applicability of science to everyday life
   f. Understanding of what scientists do
   g. Historical views
   h. Increasing students' motivation to continue in the field
5. Are you using the following in your teaching? If yes, how are you using them?
   a. Case studies and/or problem-based-learning
   b. In-class discussions
   c. Out-of-class discussions (virtual chat, bulletin board)
   d. Critical writings (reflective journals, summaries, essays, critiques)
   e. Group work
   f. Visual-based instruction (streamed video or CD)
   g. Games and simulations
   h. Problem solving
   i. Role-play
   j. Directed research
   k. Other
6. How do you interact with your students outside of class time?

7. How do you plan your class sessions? (e.g., review of the last session in the first 10 minutes, time for questions, etc.)
8. How do you build your syllabi? Do you use the online course management system?
9. How do you create the course assessments? Do you use any alternative assessments?
10. How do you learn about your students' background knowledge so that you can relate to the diversity in the class?
11. How do you feel about teaching?
12. Did you use any resources inside or outside of the university to learn skills to enhance your teaching? Explain.
13. Are you using an interdisciplinary teaching approach?
14. Do you belong to any community focused on teaching, either in the university or outside of the university?
15. How do you divide your time between research and teaching? Are you concerned about being able to do a good job at both?

Appendix B
Example of a Case Study That Was Built for Each Interviewee

Brian (pseudonym) is a male who started at the university of Maryland as an Associate Professor in a tenure-track position. He came with some experience teaching small classes as a postdoctoral fellow. In his first interview he had a teaching philosophy that included several themes, such as wanting students to enjoy the class and helping them develop skills that would allow them to work on their own:

I want the students to enjoy the class as much as possible . . . and I do want to push them to work hard. I want them to feel that . . . they're really working on developing, beginning to develop some really important skills. For example, the lab component we're working on right now for our class, the philosophy is to use all kinds of tools that will be available to them once they leave this class and the University. . . . I can't teach them everything about [the course topic] so, but I do want them to feel that they can actually go and do it on their own. They can either through purchasing books and continuing their training or going to other labs and being able to develop things on their own. . . .

In the first interview, Brian expressed his enthusiasm for teaching: "Oh, I like it, I like it. I think I enjoy it, I put a lot of energy into it, I'm definitely committed to it, and I will enjoy it." *When he was asked what would help him in his teaching, he replied that he would like to get advice about the best method to present information to the students, and he reported that he sought advice from other faculty:*

What have been the formats that are most successful, because this is something I did actually talk to many people about. Do I use chalk on the board? Powerpoint? And I've gotten all kinds of answers from faculty members, some that I like and some that I do not like. It seems writing and really slowing down lecture, to me it seems like really an ineffective way of delivering material and I would really much rather focus on delivering material and making it a full learning experience.

In the second interview, Brian described how he joined a community and benefitted from the interaction with other faculty members and the director of the TLC:

…The [name of community] has been fantastic. Because I had not taught before coming to campus. I had taught in small workshops, a couple of lectures. I had taught to graduate students, I had taught medical students… and I had not taught undergraduate students. I think our [community] has been great. And our interactions with the director of the TLC.

Brian also reported that he participated in almost all TLC activities: "I learned a lot actually. The 'less is more' is definitely something I've learned from workshops and from experience. . . . I've been wanting to build a concept list, real clear concept list for my class." *He reported that in his classes he is using case studies, problem-solving, class discussions, group work, visual-based instruction, and occasionally directed research. In the second interview, Brian had a teaching philosophy that included the themes of teaching fewer concepts in more depth, using many types of active learning, and emphasizing how the course material is linked to everyday life and the current scientific research:*

My team-teaching philosophy has been evolving since I came here. I think it's a cliché one, but I think my philosophy right now is "less is more" . . . my first year when I first taught I taught a lot of concepts. And the final exam time was really depressing because I realized how little they had learned. And I realized I was throwing too much at them and not realizing how much they were not learning. So the year after I reduced the concepts I wanted to cover by about 10% I would say. And I still have the same difficulty. Now I think I have reduced maybe 20-25% of the material I cover. . . . I've been illustrating things more . . . the class participates quite a bit more. I really try to engage them, and I succeed in doing that actually . . . [I use] illustration as much as I can on the board. I use PowerPoint, the board. I illustrate with things that I brought to the class actually, and they really like that. I've shown movies about certain processes that I get from the web. Every once in a while I hear a news report that's very relevant to our classroom. I bring it to the class. So we start with what I heard on NPR an hour ago. They like that component because it shows them that what they're doing is real, it's happening out there, it's not just a hypothetical or theoretical. People are using these technologies today. What I succeed certainly in conveying is what they're learning is very important today and at the leading edge of research today.

In the second interview, Brian again reported that he liked teaching, but he acknowledged that it was demanding and involved procedural challenges:

I like it. Not when I'm doing it, I like it later. It takes a lot of time. I like to do it well and it's very demanding. I like it when they learn, when they provide nice answers, when they come back a year later and say you've changed my life, my career, my scientific career . . . I like that. The part I really don't like is when two of them miss the midterm. The day-to-day dealing with the undergrad students and their various issues. This year I have one student dealing with severe mental health problem. Another one is dealing with severe substance abuse problem and they're missing classes and I spend a lot of time trying to reschedule their exams. . . . I mean these are things that you don't get trained to do. . . .

Appendix B (*continued*)
Example of a Case Study
That Was Built for Each Interviewee

When Brian was asked about his concerns, he responded that he was concerned about balancing research and teaching:

Oh, I'm always concerned. Yeah, I can do a better job at teaching, and I still think that I don't have time to do enough. And I could do a better job at research . . . it's very difficult to balance both. We are expected to be very good teachers. We are expected to bring in a lot of grants. I'm sure you'll hear this from everyone. . . .