Preparing Future Engineering Faculty: Initial Outcomes of an Innovative Teaching Portfolio Program

Angela Linse, Jennifer Turns, Jessica M. H. Yellin, Tammy VanDeGrift

University of Washington

Abstract
Engineering graduate students have few opportunities to explore and develop scholarly approaches to teaching compared to graduates in other fields. As part of an NSF funded teaching and learning center, we have developed the Engineering Teaching Portfolio Program (ETPP). Our initial step has been to design the program and conduct a formal study of how two independent groups experienced the program. We are currently using the data to gain insight on the impact of the program and learn how to improve it. We demonstrate the experiences of participants and the impacts of the program through case studies of participants.

Introduction
Engineering graduate students have few opportunities explore and develop scholarly approaches to teaching compared to graduates in other fields. There are at least two reasons to support this population in getting more preparation on teaching. First, graduate students represent the future faculty in engineering education. Thus, helping these students become more effective educators provides one means of promoting effective teaching in engineering (a widely accepted national goal). Second, teaching is an important aspect of the faculty career. Providing engineering graduate students with opportunities to focus on teaching is one way to prepare future faculty for their faculty career (also a widely accepted national goal). In this paper, we focus on a program we have created that addresses these two observations.

This program, the Engineering Teaching Portfolio Program, is devoted to helping engineering graduate students advance their teaching ability. The Engineering Teaching Portfolio Program (ETPP) is only one of many efforts of the National Science Foundation (NSF) Center for the Advancement of Engineering Education (CAEE). The ETPP is the primary program through which the CAEE achieves one of the primary goals of the National Science Foundation Centers for Learning and Teaching program: to provide “professional development for graduate and postdoctoral students in STEM disciplines to develop their skills as educators”[1]. The most important outcome for the graduate students who participate in the ETPP is creation of a complete draft of a teaching portfolio, which includes a teaching philosophy, a diversity statement, and 2-3 annotated artifacts. The program also provides a forum for participants to discuss teaching issues and an opportunity to develop a teaching-focused peer network.
Our initial step has been to design the program and conduct a formal study of how two independent groups experienced the program. We are currently using the data to gain insight on the impact of the program and learn how to improve it. In this paper, we will a) describe the program and concurrent research study, b) present case studies for a sample of the participants, with a focus on characterizing their experiences, and c) identify implications for continuous improvement.

**Background and Motivation for Focusing on Engineering Graduate Students**

There are strong reasons to focus on helping graduate students become more effective educators. Here we discuss two threads of reasoning that support this claim. In the next section, we describe the program we developed.

**Improving Engineering Student Learning by Addressing the Pipeline of Engineering Educators**

The national need for changes in the way that engineers are educated has been well established. One of the most common approaches to improving engineering student learning is by attempting to improve engineering teaching. Most engineering faculty receive little preparation for their teaching roles. The strategy of providing the next generation of engineering educators with the skills to improve engineering student learning is also widely accepted. Exemplars of this approach are the National Effective Teaching Institute (ASEE), the activities of the New Engineering Educators Division (ASEE), the NSF Engineering Education Scholars Workshops, and Stanford’s New Century Scholars program.

Despite considerable progress improving current engineering faculty teaching skills, preparation for the professorial teaching role has traditionally not been a high priority of U.S. engineering graduate programs. While doctoral graduates in engineering may be well prepared for industry or research careers, they are not equally well prepared for the teaching responsibilities of a faculty career. Engineering graduate students have few opportunities to explore and develop scholarly approaches to teaching compared with graduates in other fields.

Without the kind of opportunities provided by programs such as the ETPP, graduate students are likely to perpetuate what Felder calls “the consistent use of teaching techniques that have repeatedly been shown to be ineffective at promoting learning.” This claim is supported by educational research that indicates that graduate student teachers in STEM disciplines have a “strong attachment…to conservative teaching methods as a strong component of their preprofessional socialization”.

We know that the number of new engineering faculty entering the professoriate is significant. The ASEE reports that in the 1996-97 academic year approximately 30% of new PhDs in engineering joined the academy. Of those in the academy, 63.6% report teaching as their primary or secondary work activity. In 1999, the most recent year for which graduation rates are available, 5337 people received engineering PhDs. If the ASEE percentages are applied to 1999 graduates, over 1000 new engineering PhDs contributed to educating engineering students in the 1999-2000 academic year. The numbers would be larger if computer science PhDs were included in the calculations or if we included engineering PhDs employed in other sectors who report teaching as a secondary activity (self-employed [22.2%], nonprofit [10.7%], and government [3.9%]). The numbers could increase further due to increased enrollment in...
graduate programs that typically accompanies a weak economy because the “opportunity costs” decrease along with income and job prospects\textsuperscript{10}. These numbers suggest that even though focusing on future faculty may not affect the effectiveness of teaching in the near term (e.g., one week from now, one month from now), focusing on future faculty can have significant long term effects.

We also know that engineering graduate students are interested in gaining information and experience about faculty roles and responsibilities of faculty before they enter the academic job market. The results of the 2000 National Doctoral Program Survey\textsuperscript{11} (2001) indicate that only 42\% of engineering respondents felt that their teaching experience adequately prepares them for an academic/teaching career. Eighty-three percent of respondents to a recent doctoral survey indicated that teaching “is one of the most appealing aspects of faculty life, as well as its core undertaking”\textsuperscript{12,13}. In other words, graduate engineering students are open to focusing more emphasis on learning about teaching.

Collectively, these observations provide support for a proposition that one way to enhance the effectiveness of engineering teaching is by addressing the pipeline (i.e., focusing on engineering graduate students). The observations also suggest some implications for the design of a teaching program focused on graduate students. For example, the program would need to take into account the likely variety of prior teaching experiences, including the minimal teaching experiences of many of the participants. Additionally, a focus on the faculty pipeline suggests that the program might provide support for students as they transition from their graduate education to jobs with teaching responsibilities. For example, activities that concurrently help graduate students find jobs and focus on teaching may be particularly well received. Ideally, the program should also help graduate students anticipate the wide variety of teaching responsibilities they might undertake in their future jobs and identify strategies for addressing such issues. The important issue here is that unlike faculty who have already committed to a specific institution and may need help understanding how to work within the institutions, graduate students will likely move to a different institution. It would be important for lessons about teaching to transfer to the students’ new contexts.

Professional Development for Future Faculty: A National Need

The national need for changes in the way graduate students are prepared for faculty careers is also well established. While a faculty career involves a complex array of responsibilities including not only research but also teaching and service, much of graduate education focuses on research preparation while neglecting preparation for teaching, service, and generally understanding the academy.

The leading organization in this movement is the national Preparing Future Faculty (PFF) program\textsuperscript{14}. Mentoring and preparation for the teaching role are key characteristics of most PFF programs nationwide.

PFF programs are posited to have many benefits for participants, the departments and institutions in which the participants receive their graduate education, and the departments and institutions that hire PFF graduates. For example, PFF programs may also improve placement and success rates of graduates by forging relationships and creating a feedback loop between institutions that
train future faculty and those that hire them. If alumni who become faculty attribute their success to quality preparation, it can be used to demonstrate success during program evaluation. Finally, these programs can also be used to demonstrate to the public that states’ needs for higher education faculty are being met. The justifications for PFF outlined by Lee provide insight into additional benefits that might accrue as a result of participation in a program like ETPP. Lee suggests that PFF programs affect the quality of graduate programs because departments can use them to recruit graduate students, which may make departments more competitive.

Recent research has provided evidence for the beneficial impacts of PFF programs. For example, PFF evaluation data indicate that PFF participants are better prepared for their faculty careers. National experiences with PFF programs have also illustrated the challenges. For example, institutionalization of the programs is a challenge once national funding expires.

The above observations about PFF programs suggest some implications for the design of a program to support graduate students learning more about effective engineering teaching. Such a program would be consistent with the PFF focus on teaching and mentoring, and thus could be complementary to PFF/teaching activities on various campuses. In the case of the our program (ETPP), many professional development activities are already available on the campuses of the core CAEE institutions of (as indicated above the CAEE is the umbrella organization within which the ETPP was developed. For example, Howard University has participated in all four phases of PFF, the University of Minnesota was involved in PFF 1 and PFF 2, and the University of Washington in PFF 1, PFF 2, and PFF 3 (see the PFF website, noted above, for descriptions of the different phases). These three institutions, along with the other core institutions (Colorado School of Mines and Stanford University) all have campus teaching centers, seminars, and/or workshops that provide information and resources for graduate students interested in faculty careers.

Ideally, the program would be designed to mesh with the realities of the graduate education in which the students are currently engaged. A teaching program that has unrealistic expectations of the students, such as requiring significant time investment, would likely fail. Additionally, design of a program for engineering graduate students should attempt to address the challenges of institutionalization and reflect realistic hypotheses about how institutionalization could occur over time. For example, if possible, the program should be designed to be self-sustaining and to stand apart from specific university administrative or managerial units.

The Engineering Teaching Portfolio Program: Description and Design

In this section, we first describe the primary characteristics of the ETPP, including our program objectives, the major topics, program structure, and program format. We then describe the major design principles on which the program is founded. The ETPP stands apart from other programs because of three characteristics. It is customized for engineers, peer-focused, and includes a diversity element. ETPP participants a) create a draft teaching portfolio, b) develop a network of fellow graduate students interested in teaching, c) discuss teaching issues with colleagues, d) envisage teaching as decision making, and e) explore the teaching responsibilities of a faculty career.
Engineering Teaching Portfolio Program Description

We designed the ETPP with engineering graduate students in mind. The objectives listed below guided all aspects of the program.

1. Create a draft of a teaching portfolio (teaching philosophy statement, diversity statement, 2-3 supporting artifacts).
2. Develop a network of fellow graduate students, early career postdocs, and other people on campus that share an interest in teaching and the scholarship of teaching.
3. Discuss teaching issues with colleagues. Research suggests that making this a habit helps new faculty succeed.\(^\text{17}\)
4. Develop the practice of considering teaching as decision-making and considering the impact of teaching decisions on students and learning.
5. Familiarize participants with the varied responsibilities associated with a faculty career.

Participants were asked to make the following commitments:

- persistence—agree to meet for 1.5 hrs per week for 8 weeks,
- interaction—regularly receive feedback from and provide feedback to your peers,
- participation—take part in group work that you can later use with your own students,
- collaboration—provide researchers with feedback about the program.

Program Topics, Format, and Structure

This program was structured around the following individual topics; note that there are nine topics because each of the eight sessions included two topics.

1. Program & Teaching Portfolios Introduction
2. Teaching Portfolio Design Specifications (participants were asked to look at a number of portfolios and identify critical elements and organization criteria)
3. Teaching Philosophy Statements–1st Draft (participants wrote teaching philosophy statements, agreed on feedback criteria, provided feedback, discussed the process and challenges)
4. Teaching Philosophy–2nd Draft (participants wrote 2\(^{\text{nd}}\) draft, revisited feedback criteria, provided and received feedback, discussed the revision process and challenges)
5. Teaching Artifacts I–Scavenger Hunt (participants identified activities that count as teaching, identified types of evidence associated with those activities, created lists of specific teaching artifacts, located at number of artifacts and identified reasons for inclusion in the portfolio, discussed the artifacts and rationale for inclusion with peers)
6. Teaching Artifacts II–Artifact Explanation/Annotation (participants identified example teaching artifacts, articulated how each demonstrates excellence in teaching and supports their teaching philosophy, wrote annotations for 1-2 artifacts, provided and received feedback)
7. Diversity Statements (participants read, thought and wrote about, and discussed issues of diversity in engineering, received and provided feedback)
8. Portfolio Completion (participants created a plan for expanding and revising their portfolios, and developed a complete, if not polished, portfolio)
9. Professional Development Plan (participants created plans for gaining teaching experience and/or skills, future documentation of teaching, learning about career options, and becoming competitive candidates)

Each topic was discussed in two separate sessions. This occasionally caused confusion for some participants, but it makes the program more flexible because topics can be reordered to suit the
experience and interests of different groups. Each topic was introduced in one session, participants worked on an assignment between sessions, and then concluded the topic at the beginning of the subsequent session.

Each topic had an identical organization and the topic worksheets included the following segments.

**TOPIC TITLE**

**Topic Objectives**

**This Session**
- Handouts/Links
- Introduction
- Activities
- Before you leave today’s session
- What you should bring to the next session

**Between Sessions**
- “Assignment”

**Next Session**
- Status Update

The role of group-facilitator rotated among the participants for each meeting session. During the first session, group members volunteered to lead one or two sessions. Each week’s facilitator was responsible for:

1. Reviewing topic objectives at the beginning of the new topic and revisiting them at the conclusion of the topic.
2. Time management.
3. Ensuring that all group members have an opportunity to participate.
4. Completion of weekly anonymous feedback forms in the last 5 minutes of meeting. The questions they answered were “What went well in today’s session?” “What could have gone better?” and “What could be changed?” Both groups created email lists and provided electronic feedback summaries to group participants.
5. Bringing additional resources for the topic (optional).

**Major Design Principles of ETPP**

In the sections below, we describe the major design principles behind the ETPP program: customization for engineers, the focus on peer interaction, and inclusion of a diversity element.

**Customized to Engineering**

We have limited participation to graduate students in departments associated with the colleges or schools of engineering, which permits us to tailor the activities specifically to the interests and values of engineers. More than simply limiting the program to engineers, we created the program so that the outcomes, materials format, language, and examples were relevant for engineers.

The design metaphor provides a framework for the program. For example, we describe the process of creating a teaching portfolio using design terms with which engineers are familiar, such as “code review” and “product review.” We also used the metaphor of “deliverable” to
ensure that the program was product oriented. All program activities are centered around development of a single product—the teaching portfolio.

Resources and information about creating teaching portfolios are widely available in print and electronic form. However, in the authors’ experiences, engineers tend to have strong negative reactions to these materials because they include “soft,” “touchy-feely,” or unfamiliar terminology. We adapted those materials for our audience. For example, the term “reflection” appears frequently in materials about teaching development. While the process of reflection is extremely familiar, the terminology is not. Instead of “reflecting,” engineers “close the loop,” “debrief”, “iterate”, or take a “retrospective” approach to product design and development.

The printed materials were also designed specifically for engineers. Many of the widely used teaching portfolio materials are narrative, or otherwise text heavy. We again adapted the materials for engineers. Text was brief, concise, and to the point. We frequently used bulleted or numbered lists. All activities were concrete and task oriented, with an emphasis on deliverables.

Our selection of examples was deliberate. For example, we asked participants to review a number of published teaching portfolios authored by engineering faculty. During group discussions, participants showed a clear preference for teaching statements that were similar to research statements. One of the objectives of the program is to provide engineering graduate students with a forum to explore the unfamiliar world of teaching. That is, we want to encourage some out-of-the-box thinking, but we found it important to provide participants with examples that resonate with them.

The importance of the customization was highlighted for us in their reaction to some “ice breaker” activities suggested for the first group meeting. Use of such activities is standard practice in classrooms where instructors want students to engage in collaborative and cooperative learning because they help break down barriers to communication between strangers. The language and terminology had been modified for use by science and engineering faculty (from originals used in other disciplines), yet some engineering graduate students still reacted negatively. In the first group, several participants questioned the value of the icebreaking activity because they had never experienced this kind of activity as students. Participants in the second group were more familiar with icebreaker activities, acknowledged their value, and did them without question. However, several of them submitted written feedback suggesting ways to make the icebreaking activities more relevant to the ETPP’s program goals. As a result of this feedback, we are designing new icebreaker activities that de-emphasize what some engineers refer to as “soft skills” and instead focus on discussion of what kinds of activities constitute “teaching.”

Positive reactions to materials that are heavily modified for engineers lead us to surmise that lack of customization could be one reason why engineering educators are sometimes labeled as resistant to educational reform activities. Engineering educators may be reacting to the language, framing, and presentation style, rather than concepts and content.
Peer-Focused
The program activities are designed to be enacted by a group of engineering graduate student peers. Note that the focus on graduate student peers does not mean that the program was designed and implemented solely by graduate students, without external knowledge or support. The program materials were designed by professionals familiar with graduate education, the challenges of preparing future faculty for a variety of faculty careers, and the differential responsibilities of faculty at institutions other than those at which most future faculty receive their degrees (i.e. Doctoral/Research Universities—Extensive\textsuperscript{18}).

Faculty members at research institutions might be concerned that their graduate students would not have sufficient knowledge and experience, or access to appropriate resources, to successfully manage the portfolio program. We provide ETPP participants with enough program materials and information to introduce a topic and get participants started. The program relies, in part on, participants using their advanced research skills to gather additional information and move forward on the selected topics. Participants are asked to seek additional information between meetings from their own support networks, from faculty at their own or other institutions, and from existing professional development and teaching resources on their campus. They then have an opportunity to share this information with their peers in the next meeting session.

Note that the program materials serve as guidelines for activity and discussion of the topic. The group is not required or constrained to use the program materials exactly as written. Groups that are more experienced may choose to begin with one activity and let the discussion evolve.

The phrase “peer-focused” incorporates three important facets of the program: leadership, feedback, and sustainability.

Leadership. The role of group-facilitator rotates among the participants for each meeting session. This structure fosters program ownership among the participants and provides each group member with the opportunity to practice leadership and facilitation skills. The absence of a leader of higher academic rank requires that the group take responsibility for effective group function and program continuation. It also provides them with the opportunity to create a peer-mentoring network in which participants: a) recognize their peers’ experience and expertise and b) demonstrate and draw on each member’s information network.

While the graduate student participants will inevitably vary in their teaching and facilitating skills, we found that in both pilot ETPP groups, the more experienced facilitators not only respected what each member brought to the group, but they also helped the less experienced facilitate without over-emphasizing any of the participant’s experience or lack thereof.

Feedback. Another unique aspect of the program was the extensive use of the peer review process. The integration of peer review utilizes a communication structure familiar to and valued by most members of the academic community. It also leverages the cumulative knowledge and experience of participants in PFF programs\textsuperscript{16}—that interaction among peers is beneficial to participants. We designed the program so that nearly every meeting involves peer review of individual work.
As most faculty members who have implemented cooperative learning in their courses know, groups with good rapport and cohesion sometimes evolve into peer mentoring groups. The ETPP program fosters peer mentoring by encouraging participants to calibrate their views on teaching and learning. Each participant learns about others’ philosophies of teaching and learning and has the opportunity to present their own perspective. This exchange of ideas encourages expansion and revision of individual views.

The goal of the peer review was for participants to receive feedback from people with potentially different perspectives. Thus, in each peer review session every participant received feedback from at least two other people. Participants were asked to consider what kinds of feedback other participants could best provide, what could be ignored, and what would be most useful. The group created an initial list of the kinds of feedback that would be most useful for improvement and then discussed how to structure the peer review so that everyone received the most constructive feedback. Participants were asked to reconsider their feedback process and criteria each time a session involved peer review. This reconsideration was intended to foster a process of continuous improvement through formative assessment and reflection.

Sustainability. The program was designed to mitigate the problem faced by many PFF programs—that without extra funding, faculty members and staff are not available to run the program. We specifically chose a structure that can stand on its own. The ETPP does not require a staff or administrator be assigned to manage the program. Instead, all that is required to begin an iteration of the ETPP is a group of motivated and committed graduate students.

That the program does not require overt faculty or administration involvement, but this in no way precludes a department or college from encouraging their students to implement the program. In fact, the success of the program would probably be enhanced if faculty and other campus leaders promoted graduate students’ participation and made it clear they were willing to provide external support.

Diversity Component
To our knowledge, no other teaching portfolio program in the nation asks participants to develop a diversity philosophy statement. The reason we include this in our program is that engineering faces a persistent challenge of low enrollment and retention rates for women and minority students. Predicted demographic changes have the potential to compound the problem if it is not addressed.

Academic and industry leaders are well aware that the lack of diversity in engineering is a critical issue. However, engineering faculty are rarely asked to articulate their approach to the issue, despite the significant impacts they can have on underrepresented students’ educational experiences. Today, few engineering educators can afford to avoid the subject because faculty job postings increasingly mention diverse student populations and funding agencies are requiring researchers to specify what roles they play in addressing this challenge.

The primary purpose of the Diversity Statement was to provide graduate students with a forum for thinking about issues of diversity in engineering. Some engineering graduate students are unaware that they are expected to address the issue and few have the opportunity to confront these issues before joining the ranks of the professoriate.
Diversity statements are so rare that they are difficult to describe. A participant might choose to discuss the importance of a diverse engineering community or describe how s/he interacts with students and colleagues with different backgrounds and experiences. At the very least, a diversity statement provides future faculty with the opportunity to demonstrate that they have given serious thought to the issue. Discussing diversity issues and inclusive teaching practices with your peers provides a good foundation for the topic comes up in more formal settings, such as a campus interview or proposal review.

The design principles above are founded on a variety of theoretical perspectives about learning, teaching, and design. While there are many views of what it means to teach, our approach is consistent with current educational research on human learning\textsuperscript{23,24} and social learning theory\textsuperscript{25}, and effective instructional development practices\textsuperscript{26,27}. Some of the assumptions implicit in our design principles include that effective teaching is a learned behavior, that teachers evolve (i.e. change through time), that the rate of change is accelerated in cooperative groups, and that expert teachers seek to continuously improve through review and/or reflection. Readers familiar with “user-centered design” research\textsuperscript{28} will also recognize that approach in the discussions of our design principles above. For example, we made explicit design choices based on knowledge of our intended audience.

**Design of the Research Study**

During the implementation of the first iteration of the program, we simultaneously conducted research on the program. The purpose of this research was twofold, to understand how well the program would work and to gather formative data that would support redesign efforts. Concerning the first goal, our interests included issues such as whether the participants would stay in the program, what types of impacts the program would have on participants, and whether the program would be effective for participants with little teaching experience, as well as those with significant teaching experience. Concerning the second goal, we were interested in the sections of the program that were most helpful (aspects we should definitely keep) as well as most challenging (issues for our redesign), as well as any insights on our major design principles.

Our study involved participants committing to participating in the entire eight-week program. We recruited through two information sessions and via a college wide email list. Ultimately, we signed up fifteen [originally, 7 in the first group, 8 in the second group] volunteers. Because of the high level of interest, we were able to form two participant groups with staggered starting points. By having the second group start two weeks after the first group, we were able to include an iteration cycle within our study design. We used feedback from the participants in the first group to refine how some of the topics were introduced and revise some of the activities for the second group.

The data collection for the study was extensive. We collected a large portion of our data in field notes through the ethnographic method of direct observation\textsuperscript{29,30}. Specifically, we paid two graduate students (co-authors of this paper) to participate in one group and observe the other group. We chose to have graduate students collect the data so that we remained consistent with the peer-led design principle. When the graduate students observed, they used a computer to type, in real time, a record of participant contributions. Participants were assigned codes to
designate their contributions. Both graduate students reported that the task was demanding, but feasible. The field note/transcription data were supplemented with a focus group interview that included all of the members of each group present at the final meeting. Participants also completed an individual written exit survey, and the graduate student observers conducted individual exit interviews with each participant after the conclusion of the program. Prior to any data collection, we submitted appropriate forms to the University of Washington Human Subjects Review Committee, received approval, and all participants signed consent forms agreeing to participate in the study.

We are currently in the midst of analyzing this large body of data. In this paper, we focus on the data from two sources. The primary sources of the information used here are the individual exit interviews and the observation field notes. The data from four exit interviews were used to learn more about the participants, the process by which they created the portfolio, how they experienced the program, and the impact of the program on them. The field notes served as a secondary source of information about participants’ processes and challenges. We have included four case studies in this paper in order to illustrate participants’ variability along a number of dimensions including the participant’s gender, proximity to graduation, prior teaching experience, and the type of academic institution they would like to join after graduating. Our sample includes three participants who completed the program and one participant who did not.

In the next section, we present these case studies. In the subsequent discussion session, we use the information in the case studies and some information from the study more broadly in order to revisit the study purposes identified above.

**Results – Case Studies of Four Participants**

These individuals were chosen to highlight the following features of the program: completing a teaching portfolio, changing perceptions about teaching, learning what constitutes teaching, community building, providing a forum to discuss teaching, and awareness of decision making in teaching. In later sections, we will also discuss the challenges that participants faced in completing this program, program features that participants found most helpful, and unanticipated impacts of this pilot study.

**Case Study 1: “Marcy”**

**Background**

Marcy was a graduate student in the Civil and Environmental Engineering department. She was entering her seventh year in the PhD program. Her teaching experience included giving guest lectures, developing homework assignments and exams, and developing and teaching the laboratory component of a course. Marcy intended to search for faculty positions at institutions with graduate students soon after the program terminated. Marcy also had four years of consulting experience in industry, which made her unique among the participants in the pilot offering of the program.

**Process**

Marcy had not experienced writing a teaching statement before participating in the ETPP. She often questioned the utility of activities provided on the topic sheets, but usually completed the weekly writing tasks. Marcy also felt she had little teaching experience when she started the
program, and through talking with her peers, realized that she did have artifacts to share with others. The program also provided the first formal place for Marcy to talk about and think about her own teaching practices. Marcy also sought models and examples for her portfolio components. She even stated in her exit interview that her biggest challenge was finding appropriate examples and models. For example, when first writing her teaching philosophy statement, she searched the Internet to find teaching philosophy statements that she liked in format and content. Marcy’s next largest challenge was creating statements that would not offend the search committee, in terms of teaching practices and diversity related issues. Even though Marcy faced several challenges in the program, she successfully completed her teaching philosophy statement and two artifact annotations. The group structure with peer feedback gave her a “forced timeline” to get her portfolio done.

**Impact**

Through the process of talking about teaching, Marcy started thinking about teaching as a scholarly activity. She also realized that she did have teaching experience through the collection of artifacts. She changed her teaching philosophy. At first, she thought she would teach with traditional lecturing, but through discussions with her peers, she realized that group work and writing were important, too. She started reading the Tomorrow’s ProfessorSM Listserv31 to gain more insight into current teaching practices. Overall, the main impact for Marcy was having a forum to develop her ideas about teaching.

**Case Study 2: “William”**

**Background**

William is a PhD student in the Department of Electrical Engineering. He was finishing the 3rd year in his PhD program during the time of the study, and he plans to graduate in 2-3 years. Although he wants to work in industry first, William stated several times during his exit interview that his primary motivation for pursuing a PhD was because he wants to teach at the college level eventually, in the USA, Europe, or in his home country in Africa. He stated that he wanted to participate in this program in order to start preparing for an academic career and learn more about teaching resources on campus. A friend and mentor who went from industry to academia had strongly advised William to start thinking about teaching while he was still in graduate school. Therefore, William was looking for something like the ETPP and was starting to apply for TA positions in order to gain teaching experience. His previous teaching experience was limited to tutoring and working as a grader. William did not complete the program, but he was a very involved participant during the first 4 sessions. He was able to complete a teaching philosophy statement and begin an artifact search. During his exit interview, William said that he had enjoyed the time that he was able to spend in the program and regretted that family and research obligations got in the way of his attending the last 4 sessions.

**Process**

William found writing his teaching philosophy statement and finding teaching artifacts to be very challenging because he did not have much formal teaching experience. He started the process of writing his statement by reviewing the program materials. From the website, he found teaching philosophy statements that he liked, and then analyzed why he liked them. He also used an exercise from one of the program handouts, in which he drew on his own experiences as a student and thought about what he liked and disliked about his instructors. Of all the teaching
philosophy examples, William particularly liked one that focused on what the writer had done in her classes and the process by which she implemented the features. Although William did not use this same structure, he revised his teaching philosophy statement and tried to include more supporting evidence for his ideas. He felt that the group discussions about the program material helped his understanding, and that the peer feedback would improve future iterations of his teaching philosophy statement.

Impact
During his exit interview, William stated that through discussions with program participants who had more teaching experience, he gained a greater awareness of what activities count as teaching, how to improve student learning, and how different teaching decisions can affect students. William also said that because of this program, his viewpoint has changed from being very passive about following directions as a TA or grader to being more proactive about his teaching decisions. Before, he would have never considered changing anything about a class format unless he was prompted to do so by the instructor. Now, he would be more likely to think about his teaching in advance and consider different ideas about how to format his class and present course material. He also found it reassuring to know that many other engineering graduate students are interested in teaching and have the same concerns about finding teaching resources and training as he did.

Case Study 3: “Kathy”

Background
Kathy was a postdoc in the Civil and Environmental Engineering department. She obtained her PhD from a different institution than the University of Washington. Her teaching background includes high school biology and chemistry, teaching as a lecturer at a university, and four years of serving as a Teaching Assistant. Kathy intended to search for faculty positions at small, teaching schools immediately after finishing the ETPP. One feature that made Kathy unique from other participants in the program was that she had already written drafts of her teaching statement and diversity statement for previous job searches.

Process
Even though Kathy had many teaching experiences before starting the program, she had not intentionally collected teaching artifacts for a teaching portfolio. The ETPP gave her the opportunity to reflect on her past teaching practices and previous drafts of her teaching philosophy statement. Her biggest challenge was creating a teaching philosophy statement that sounded sincere. Throughout the program, Kathy was willing to participate in activities, attended the weekly sessions regularly, and offered advice to her peers based on her previous experiences as a teacher and as a job applicant. During the exit interview, Kathy stated that her goal in participating in the ETPP was to refine her teaching philosophy statement. For her, having the additional components to the portfolio was “bonus” material. Kathy also found the program a refreshing environment for talking about teaching practices.

Impact
Kathy’s main impact, as stated by her, was getting a solid version of her teaching philosophy statement finished. She felt the process of peer reviewing the portfolio components was valuable for improving her portfolio. She also found the program itself to be helpful for networking with
other students who were interested in teaching. For Kathy, this was incredibly valuable, since she worries that people in the academy are not interested in teaching.

Case Study 4: “Tom”

Background
Tom was a PhD student in the Department of Computer Science and Engineering and his dissertation research focuses on computer science education with an emphasis on diversity. He was in the sixth year of his program and expected to start looking for teaching positions in 2-2½ years. His considerable teaching experience included being the sole instructor for a two-quarter introduction to CS class, which was a large lecture class. Tom also worked as a TA multiple times, was a head TA for an introductory sophomore/junior level major course in computer science, and has done 1-day outreach programs multiple times in addition to tutoring for 2-3 years. Tom intends to start searching for teaching positions at small, teaching-focused institutions, and he plans to include community college positions in his job search. His undergraduate experience was at a small, teaching-focused liberal arts school and he stated that this experience influenced his career trajectory. His industry experience was mostly through summer internships and some freelance work, for a total of approximately 1-year of industry experience.

Process
Although Tom had considerable teaching experience and was very reflective about his teaching, he found the exercise of writing a teaching philosophy statement to be very challenging. He struggled with the idea of philosophy with a lowercase ‘p’, and was very intimidated by setting down ‘the way teaching should be according to Tom’. He found the pre-writing suggestions from the one-page handout with suggestions for how to get started helpful, and tried 2-3 of these exercises. The ‘teaching decisions’ exercise on this handout was particularly helpful. He listed some of his teaching decisions, then stepped back and was able to see natural groupings or themes. From there, he thought about concrete examples from his teaching and decided on a theme for his teaching philosophy statement that was general enough to match his teaching decisions, but not so general as to be vacuous—he settled on understanding student perspectives. In his exit interview, he stated that having the components peer reviewed was especially valuable. He felt that the two most important things for him were that the schedule got the components done, and the peer review ensured quality.

Impact
In Tom’s department, a small but strong network of students interested in teaching already existed. His department also sponsors seminar classes geared towards computer science and engineering education. Because of this, Tom already had access to a network of students who were interested in the scholarship of teaching, even though he stated that values in his department were more conventional. His group stabilized to only one member outside of computer science and engineering. This didn’t lead to a substantially wider network for him, however he was very aware that other departments within the college of engineering did not have a core group of people interested in teaching. Because he already had a strong background in the scholarship of teaching and his dissertation research was on a topic related to engineering education, he did not feel that this program influenced his teaching decisions much. The main impacts of the program for Tom were the peer reviews, which he thought were the most eye-
opening and engaging part of the experience, and the structure of the program. The structure of this program helped him to put together a mostly complete portfolio that he planned to use as a formative tool in the short term and for job searches longer term.

Discussion

Through our study, and the case studies of participants in the previous section, we have gained insight into participants’ experiences in the program and impacts of the program. In this section, we summarize and discuss what the case studies suggest about each of the major questions driving the research study.

General Themes and Outcomes

First, we will discuss general themes and outcomes determined from the case studies presented here and data collected from other participants in the program.

Did the program motivate participants to complete their portfolios?
The primary objective of the program was to give participants a forum to complete components of a teaching portfolio. We defined the program as successful if participants completed one or more portfolio components. All four people featured in our case studies successfully completed a written teaching philosophy statement. Tom, Kathy, and Marcy also completed additional portfolio components such as the diversity statement and teaching artifact annotations.

Another dimension on which to assess the program’s success is simply whether or not participants continued with the program. The ETPP was a voluntary commitment by the participants; no credit or grade was associated with the completion of the program. As noted in the case study, William did not complete the program, but left for research and family obligations. The other three participants featured in our case studies finished the program. In total, 10 of 15 participants completed the voluntary program. This retention rate suggests the program was worth the time for these participants.

Did participants change their perspectives about teaching?
When designing the program, we anticipated several impacts of the program. These included thinking about teaching as a scholarly activity and building a community of peers and a place to discuss teaching. In particular, William and Marcy had a greater awareness of what constitutes teaching through participating in the program. In their exit interviews, William and Marcy said that they found the discussions about teaching issues very valuable, and that these discussions increased their awareness about the effect of their teaching decisions. All four participants featured in the case studies viewed teaching as decision-making at the end of the program. The program helped participants view teaching as scholarly activity and gave them a place to talk about teaching decisions.

Did participants benefit from the network of peers interested in teaching?
William and Kathy greatly benefited from having a network of peers with which to discuss teaching. During their exit interviews, William and Kathy said that developing a network of people interested in teaching was especially important to them because they had not yet found a network like this in their home departments of civil engineering and electrical engineering. Other
participants in the program also rated highly the program feature of discussing teaching with a network of peers.

Did the program work for participants with relatively little teaching experience?

We intentionally chose two participants for the case studies who had little teaching experience. William had tutored and worked as a grader before participating in the program. Even with his limited experience, the program helped him become a more proactive teacher, whose decisions have an impact on students. He successfully completed his teaching philosophy statement and started the artifact search before leaving the program. Our second example is Marcy. When Marcy started the program, she thought she had very little teaching experience. Through talking with her peers and locating artifacts, she realized she had more teaching experience than she initially thought. She also participated in peer reviews and group discussions throughout the program. The program worked for these students with little teaching experience.

What was most challenging for participants?

As with any group, each person experienced a unique set of challenges throughout the program. Several participants struggled with writing the teaching philosophy statement, as did all four people in our case studies. What is interesting is that they struggled for different reasons. William had little teaching experience and found it difficult to incorporate concrete examples to support his claims. Tom struggled with building an encompassing philosophy for his teaching practices, a theme that would center his statement. Kathy struggled in making her statement sound sincere, while Marcy struggled with getting ideas on paper. Marcy struggled with the statement’s freedom in content and structure and greatly desired an example statement. In fact, Marcy relied heavily on examples to write her first draft, copying ideas from the examples that she liked and then completely revising later drafts of her teaching philosophy statement to make it her own.

Other participants not profiled here also struggled with writing the teaching philosophy statement. Two participants, however, found writing the teaching philosophy statement to be a straightforward assignment. Instead, these two participants struggled with the diversity statement with respect to its function, form, and content. Writing a diversity statement was not a major challenge for the participants profiled in the case studies. However, some of the other participants did find writing this statement to be very challenging, struggling with how personal to make the statement, how to avoid offending search committees who might read the statement, and how to write about a topic with which they felt they had little experience.

At the introduction of the program, many participants worried about the time commitment to complete the program and finish their portfolios. However, most participants were able to complete their portfolio components within the time that they had allocated to spend on the program.

What was most helpful for participants?

Participants generally agreed that the peer review process and the structure of the program were most helpful. Everyone thought the comments and support from their peers were helpful in creating better teaching portfolios. The peer review also generated conversations about teaching practices, which helped participants gain more tools and resources for their own teaching.
Participants also agreed that the peer review helped to create more solid drafts of their portfolio components.

A second major source of support was the structure of the program. The structure included weekly deliverables, which some participants referred to as a “forcing function” to help get their drafts done. The participants knew that if they did not bring a draft for the session, the opportunity for valuable peer review would be lost. For each session, most participants brought drafts to share with the group. The focus on deliverables in the program structure was helpful for the participants to get their drafts completed.

Did the program have unanticipated impacts?
The program also generated unanticipated impacts. For example, in Tom’s department, several of the graduating students gathered to work on their research statements for faculty job applications. Three of the graduating students in Tom’s department had participated in the ETPP, and they suggested using the same structure as the ETPP. The larger group of graduating students in Tom’s department incorporated several of the ETPP’s features into their independent research statement support group.

One of the graduating students in Tom’s department who participated in the ETPP (not profiled here) submitted his teaching portfolio as part of a faculty job application. The search committee chair told him that his teaching philosophy statement and supporting material were the strongest package that the committee had ever seen.

What Did We Learn about the Major Design Principles?
In the following section, we will discuss and evaluate what we learned about the effectiveness of the major design principles of the program based on evidence gained from this pilot study.

Customized to Engineering
When designing the program, we customized the program to graduate students in engineering who are interested in faculty careers. Although we cannot isolate the successes of the program to our customized features, we do have confirmation that some of our design principles enabled our target audience to be successful. For example, the language for creating the teaching portfolio was more in the domain of design, a term and process familiar to engineers. Some participants, such as Marcy and William, were model-driven, in that they searched for examples of portfolio components. We included examples of engineering teaching portfolios during the second session of the program to show how other engineers designed their portfolios. As discussed above, the deliverable feature of the program was helpful to participants. The peer review structure is similar to “code reviews” and “product reviews” in engineering, as well as peer reviewed conference papers and journal articles in engineering academia.

Peer-Focused
We also designed the program to be peer-led, so that it can scale across campus and to other campuses without prohibitive resources, such as a paid facilitator for the program. This peer-led structure gave participants more ownership of the program, allowing them to decide which activities to do and where they wanted to spend their time. During many of the sessions, the participants agreed that the most valuable use of time was in peer review, so they had the freedom to bypass some of the session activities. Besides being scalable, another benefit of the
peer-led structure is that it gave participants an opportunity to “teach” as a discussion leader and time manager.

The peer-focused design principle includes a commitment to extensive use of peer review throughout the program. As discussed earlier, participants found this to be the most helpful feature of the program. In his exit interview, Tom alluded specifically to how valuable he found the peer review, stating that “the schedule got the components done, and the peer review ensured quality.” The process of peer reviewing seemed to help participants build trust among their colleagues and become a cohesive and collegial group. In the later program sessions, many participants were willing to bring in very unpolished drafts to get feedback from peers about basic ideas and structure before coming back to the following session with very polished portfolio components that they revised using the peer feedback that they had received. In the last session for both the first and second pilot offering, all of the participants discussed keeping in touch so that they could have a network of people who would be willing to review additional drafts and other supporting material for faculty job applications, such as research statements.

Diversity Component
This program is unique in that we included a diversity statement as a portfolio component. Very little literature is presently available about the form, content, and structure of diversity statements, although many teaching institutions with diverse student populations, such as community colleges, are increasingly requiring diversity statements as part of faculty job applications. Therefore, the materials that we developed to guide the participants through the process of writing diversity statements are a unique feature of our program.
The inclusion of the diversity statement created the most tension in the first of our pilot offerings of the program. Two of the five participants questioned the function of such a statement and resisted writing such a statement. During our second pilot offering, we modified the activities to have participants discuss how to teach a diverse body of students. Our second set of participants did not resist writing the diversity statement. We are currently writing a paper that provides a more detailed report about the inclusion of the diversity statement.

Moving Forward
In this paper, we have described our Engineering Teaching Portfolio Program and a recent study exploring its effectiveness and feasibility. We have also presented case studies of four participants and used the information from the case studies to address specific questions related to the program’s effectiveness and feasibility. As we move forward, we will focus on three threads of activity. In the short term, we will complete our analysis of the study data we have collected and use the insights from the analysis to improve the program even further. Subsequently, we will focus on expanding the program to other institutions and understanding how to help the program function successfully in varied institutional contexts. We will also focus on assessing the program’s impact on its participants more formally. At this point, we are very encouraged by the success of our first iteration and keen to move on to the next steps of the work.

Links to the program may be accessed through the Center for the Advancement of Engineering Education website <http://www.engr.washington.edu/caee/activity.html>.
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References Cited


33. The Engineering Teaching Portfolio Program is part of the CAEE’s Scholarship on Teaching element, which is currently described under the “Activities” link at the CAEE website <http://www.engr.washington.edu/caee/activity.html>. As of March 17, 2004, the ETPP website is still under construction.

Biographical Information

Angela R. Linse is the Assistant Director for Faculty Development at the University of Washington Center for Engineering Learning and Teaching (CELT). She was the principal designer of the ETPP. She has been involved in the UW PFF program since 1999 and has taught a graduate course on the Faculty Career for program since 1999.

Jennifer Turns is an Assistant Professor in the Department of Technical Communication, College of Engineering, University of Washington. She leads the Scholarship on Teaching element of the CAEE. She is also a Faculty Affiliate with CELT and the Program for Educational Transformation through Technology. She is the principal designer of the ETPP research study.

Jessica M. H. Yellin is a graduate student in the Department of Mechanical Engineering at the University of Washington and a Research Assistant for the Center for the Advancement of Engineering Education. She is a codesigner of the ETPP. She will defend her dissertation research on structural vibration and damping of acoustic noise this year.

Tammy VanDeGrift is a graduate student in the Department of Computer Science and Engineering at the University of Washington and a member of the Educational Technology Research Group. She helped design the ETPP and is a member of the ETPP research team. She has published works in in engineering education, educational technology, and learning sciences.