Establishing and Sustaining a Preparing Future Faculty Program in Electrical and Computer Engineering and Computer Science

Carla Purdy
University of Cincinnati

Gary Lewandowski
Xavier University

James Hauser
Northern Kentucky University

Sarah Coppock
University of Cincinnati

The Preparing Future Faculty program we describe here was established in 1999 as part of the national PFF3 initiative. Originally based in one department in a college of engineering in a large midwestern state university, the program dramatically increased the number of students in our department opting for academic careers and has been expanded to serve students in all departments in the College of Engineering. Designed to be "lightweight" in terms of time and other resource needs, the format is easily exportable to similar departments and institutions. The program can also serve as the focal point for many other initiatives aimed at better mentoring Ph.D. students.

Introduction

Our university has been an active participant in the national Preparing Future Faculty (PFF) initiative since 1993. It was one of the original doctoral institutions chosen to participate in the PFF1 program established by the Association of American Colleges and Universities and the Council of Graduate Schools, with assistance from the Pew Charitable Trusts. Our departmental program in Electrical and Computer Engineering and Computer Science was

funded in 1999, with support from the National Science Foundation, as part of the PFF3 initiative in the sciences and mathematics. In this phase of PFF development, discipline-specific programs were administered through a discipline-specific society. For our program, this society was the Association for Computing Machinery's Special Interest Group on Computer Science Education (SIGCSE). Students from electrical and computer engineering were also included in our program because these disciplines are housed in the same department as computer science (Electrical and Computer Engineering and Computer Science, or ECECS) and student and faculty interests often span more than one of the three disciplines. One consequence of this structure is that the computer science PFF program was established in the College of Engineering. Our program was one of only two programs in computer science funded nationally and the only one in a college of engineering.

Many Ph.D. students in our ECECS Department as well as in the other departments in the college spend their entire time at the university as research assistants and thus have little or no opportunity to learn teaching skills. With this heavy concentration on research, it is probably not surprising that few of our department's Ph.D. graduates opted for academic careers in the past. For example, between 1993/94 and 1998-99, 75 students graduated from the ECECS Department with a Ph.D., but only three chose to pursue an academic career. Not surprisingly, none of the ECECS Ph.D. students was active in the university-wide PFF programs. Thus there was considerable motivation to try a discipline-focused PFF3 program as a way of increasing the number of our graduates who did opt for academia. In addition, the PFF3 program was seen as one way to help fill the national need for more computer science faculty in the 1990's.

Designed to be two years long, the program has from the beginning been very positively received and has since been expanded and made available to our entire College of Engineering.

Currently it is required for all recipients of our college-level Rindsberg Teaching Fellowships for advanced Ph.D. students planning to enter the professoriate (about ten per year) and also attracts many other students. Originally offered only once every two years, the program now is being offered every year, and thus is attracting about twice as many students as it did originally. Many program graduates are now in academic positions at a variety of institutions, and some are nearing tenure decisions. Current and past participants, college faculty, and employers continue to provide enthusiastic support for the program.

In this paper we give a brief outline of the program, and we describe benefits participants see from the program, reasons why it seems to flourish in engineering, outcomes, and future plans. In its present form, the program is quite stable, even though funding ended in 2002. The program can also serve as the focal point for many other initiatives aimed at better mentoring Ph.D. students.

Designed to be "lightweight" in terms of time and other resource needs, our program format could easily be exported to similar departments or colleges. To assist others who may be interested in establishing similar programs, we offer a list of questions which will assist potential PFF coordinators in setting up their own programs. We also propose some candidate answers, some based on our own experience and some collected from audience participants at the Lilly-North 2002 Conference held in Big Rapids, MI in September 2002.

Program Overview

Program Format

Like all PFF programs, our PFF in ECECS program was designed with the three basic PFF components (PFF website, 2006):

- a *cluster* consisting of one doctoral institution, along with three partner schools was set up. Cluster partners had been active in previous university PFF programs, and so the cluster membership was easily determined. A project steering committee, consisting of faculty from these four partner schools, along with some of the participating Ph.D. students, was chosen. The cluster partners would provide a mix of academic environments for students to learn about and be mentored in. The program would allow students to explore all these diverse environments and to consider not only whether an academic career was a good personal choice but also what mix of research, scholarship, teaching, and service would best fit each individual's career plans. For many of the student participants, especially those whose baccalaureate education was not completed in the U.S., just learning about the existence of a range of departments with different viewpoints and missions was a rewarding experience. As is typical with engineering colleges today, the majority of our graduate students fall into this category. As our program has expanded to include students from many different engineering departments, we have continued to identify new partners and we also place some with mentors in the Ph.D.-granting institution's College of Engineering. The program continues to involve faculty from a broad range of institutions, not only as mentors but also as program advisors and as panel members for the many discussions in our seminars. Three of the original partner schools still remain active, while one, a four-year liberal arts college, is currently inactive due to the discontinuation of its computer science program and its lack of engineering programs (although one of our PFF participants, from bioengineering, has been hired by its biology department as an adjunct faculty member).
- sufficient activities involving partner schools and faculty that each student PFF participant would gain a good understanding of the specific *roles and responsibilities* at each partner

school. This is accomplished through an individualized schedule of visits and activities for each student participating. This mentoring phase, which can be spread out over an academic year to reduce demands on the student's time, is preceded by a required quarter-long seminar and enriched by two additional seminars, as described below. By participating in the seminars, faculty from the partner schools not only contribute their schools' perspective on the topics discussed but also begin to provide the third basic component,

- *multiple mentors*, along with feedback on teaching and service activities, as well as research. Program activities were originally designed to move the students from a possibly somewhat "passive" seminar attendance through more active seminar participation to actual teaching experience. Initially the program consisted of two seminars, the first on academic life and the job search, and the second on classroom management. After completing these seminars, students were matched with a mentor to gain at least ten hours of teaching experience. Based on feedback from students and mentors, the program has been revised, with the seminar on teaching expanded from one quarter to two, and with the seminar on the academic job search now following these teaching seminars. The first seminar on teaching is a requirement for participating in the mentoring component and the additional program activities. This arrangement better serves the students, especially those international students with no experience teaching in classrooms in the United States. Thus the current program consists of three one-hour seminars and a mentored teaching component:
    - Modern Teaching Techniques for Future Engineering Faculty ("PFF I") (Winter Quarter). Students discuss the basics of creating course content, managing a class, and interacting effectively with students. Each student creates a syllabus and related materials for a course they are likely to teach in the future. Weekly seminars are run

by students, with guidance from faculty facilitators. Emphasis is given to active learning styles, and thus each week two students are appointed to lead the discussion and to gain practice in facilitating more active learning activities. This course typically draws most material from (McKeachie & Svinicki, 2006) and also uses material from (Fowler & Markle, undated). Students begin construction of a Teaching Portfolio. The seminar begins with a discussion of learning styles. Participants assess their own learning style and discuss what techniques might be most effective for themselves and for those with differing learning styles. The discussion leaders also prepare a homework assignment which participants can work on and add to their portfolios. These activities range from describing your "best teacher" and why you chose this person to developing course goals and objectives to designing appropriate questions for testing particular levels of knowledge and skill. Active learning and discussion, rather than straightforward lectures, are the norm in this seminar, and students are encouraged to ask any teaching-related questions. In a recent seminar, for example, a lively impromptu discussion about take-home exams, initiated by a student question, took place.

- Advanced Teaching Techniques for Future Engineering Faculty ("PFF II") (Spring Quarter, prerequisite PFF I). This seminar continues the examination of issues addressed in PFF I. Additional topics covered include Bloom's Taxonomy, concept maps, effective mentoring, teaching evaluations, ABET accreditation, effective project and team management, mentoring skills, and preparing proposals and doing research in engineering education. The discussions are guided by faculty facilitators and by guest speakers with specific expertise in the various topics.

- Mentored Teaching Experience ("PFF III") (Spring Quarter, prerequisite PFF I). Each student in this course works directly with an assigned faculty mentor, either at the university, or at a nearby college or university, to develop their teaching skills. Students spend a minimum of 10 hours in classroom teaching and other appropriate activities, supervised by their mentor. Students may take more than one quarter to complete the required work, depending on their research commitments. As often as possible, these activities include not only classroom teaching and discussions about job responsibilities with faculty but also one-on-one mentoring with M.S. or undergraduate students. Participants are also encouraged to assist with graduate school recruitment through presentations to the ECECS undergraduates and to students at the partner schools. Some of our participants who are in large research labs have the opportunity to mentor their younger labmates, but for students who are in smaller labs the PFF program can provide otherwise unavailable opportunities for this type of mentoring.
- The Academic Profession ("PFF IV"). (Fall Quarter, prerequisite PFF II or PFF III). Students research opportunities for academic jobs in a variety of institutions, practice presentation skills, and prepare application materials, including a Teaching Portfolio. Each portfolio includes materials developed during previous PFF seminars. Issues important to junior faculty are also discussed. Several panel discussions, featuring both established and beginning faculty from nearby institutions, are held. Students also prepare "the first ten minutes" of a job interview talk. This is not an easy exercise for many of the participants, who are used to giving ten to twenty minute technical presentations at conferences. By focusing on the first ten minutes, which

should be understandable to everyone in the audience in a diverse department such as ECECS, students are also forced to think more about the challenges of teaching.

Supplemental Activities

The PFF3 funding enabled our program to include other activities in addition to the seminars and the individual mentoring. Thus we were able to send our participants to a university-sponsored workshop on effective proposal writing, which is of benefit both to those students going on to research institutions and to those who choose more teaching-oriented institutions. With the funding, we also sponsored a visiting speaker to discuss what a Teaching Portfolio ought to contain and how best to organize one. We also cosponsored, with the doctoral university's Women in Science and Engineering (WISE) Committee and with one partner school's Women's and Minorities' Studies Program, visits by several nationally prominent women professors of engineering who led discussion groups with PFF participants and gave public lectures on strategies for increasing diversity in science and engineering. PFF participants were also funded to attend several national conferences, including SIGCSE2001, SIGCSE2002, and the National PFF Conference held in Colorado Springs in June 2000. Presentations about our program were made at all of these conferences. In addition, preliminary results from our program were described in (Lewandowski & Purdy, 2001) and the expanded program was described in (Purdy, Bishop, Fried, Kukreti, & Lewandowdki, 2003).

While many of the above activities do require funding, others can be sustained even in lean budget times. For example, material on preparing a Teaching Portfolio and on effective proposal writing has been moved into one of the regular seminars. The program has also held extra seminars, with speakers from the partner schools, to address topics not covered in the regular seminars, and has invited PFF "graduates" to participate. In addition, the program has

held mentor workshops, based on the material in (Brainard, Harkus, & St. George, (1998)), to which both students and their mentors were invited. PFF participants have also participated in seminars on attending graduate school for our undergraduates and in review sessions for doctoral qualifying examinations. Recently our university's Graduate Office, university-level PFF program, and Center for Teaching and Learning have also begun to sponsor more campus-wide programs, including a recent visit from the University of Michigan's Center for Research on Teaching and Learning theater troop, whose presentations addressed issues of diversity for faculty and students. These programs are also valuable supplements to our college PFF activities.

Program Administration

To join the PFF program, each student is required to submit an application, signed by the research advisor, along with a statement of why they wish to participate. Obtaining the research advisor's agreement has not been difficult for any of the students who have expressed interest in our program. In fact, some of our most productive research faculty are among the strongest supporters of PFF in our department, because they see the program as helping them to encourage their students to remain in academia. In the first cycle of the program, any Ph.D. student was allowed to participate. However, it quickly became clear that first year students, who had not yet even passed their qualifying examinations, were not getting the maximum benefit from the PFF activities. Thus currently only students who have passed the doctoral qualifying exam are eligible to participate. Another change which we made in the second cycle was to offer PFF as a course, with one hour of Pass/Fail credit available for each of the seminars and for the completion of the individual mentoring activities. This allows participants to have a record on

their transcripts that they have participated in the program, and it also provides a way to factor the PFF supervision into the workload of the faculty organizers.

Benefits to Participants

The most obvious benefit of our PFF program so far, of course, is the increase in interest in academic careers among our Ph.D. students. Based on student comments, much of this increase is due to the existence of a forum in which questions about academic careers can be asked and answered and also to the existence of a secure environment in which students with little or no teaching experience or international students who would like to teach but need to gain English skills and self-confidence can practice their teaching techniques and discuss problems that might arise. However, there are many other benefits which come along with a successful PFF program. We list some of those here.

Benefits to Graduate Student Participants

Students in PFF learn up-to-date teaching techniques and receive individual coaching on their teaching, just as they are also receiving coaching on their research activities from their research advisor. Students also are developing a network of colleagues to whom they can go for advice on teaching and career questions, even after graduation. International students also learn about the very different U.S. educational system which they are hoping to teach in. Contrasting undergraduate experiences in their home countries with undergraduate experiences in the U.S. has made for several lively discussions in the seminars. Students who participate in the PFF program and then are hired into an academic position are better prepared to manage all the responsibilities of a beginning computer science or engineering faculty member. Students who choose industry or government jobs have learned such skills as the ability to make presentations to a diverse audience.

An additional benefit of the program is that it helps to identify other areas in which more mentoring and student support can be beneficial. For example, student discussion motivated us to organize a "qualifying exam workshop" for first year graduate students. Additional programs in future might include a job search seminar for Ph.D. students who are looking for industry positions or writing workshops for students who are struggling with writing up their results.

Benefits to Faculty Participants

For faculty in the cluster's research institution, the PFF program provides a forum for discussing teaching and updating teaching skills. Teaching activities may not always be discussed as thoroughly as is desirable in a research-intensive environment. The PFF program provides an impetus for looking more closely at teaching activities. For partner faculty, the PFF program provides regular contact with colleagues and students at the research institution, along with the opportunity to help mentor doctoral students. For all faculty participants, opportunities for teaching-centered activities are increased. For faculty at partner schools, participation in the program is a way to recruit new colleagues, if there is an open position at their school.

Benefits to the Research Department / College

For the research department or college in which the program is housed, producing more graduates who choose academic careers is a way to strengthen the academic reputation among peers. This was especially important for our Computer Science program, which was relatively new when the program began and produced its first graduate only in 1993. Providing increased teaching skills to those students who may be appointed to teaching assistantships also is a benefit to the department or college as a whole. In addition, the existence of a strong PFF program can serve as a recruiting tool to attract good graduate students into our programs. Also, the PFF program and its associated activities can introduce participating faculty to new developments in

pedagogy and can provide a department- or college-wide forum for the discussion of such topics as diversity and new teaching techniques.

Benefits to Partner Schools

Both students and faculty at partner schools can benefit from PFF programs in several ways. Students are able to interact with graduate students in the PFF program, through graduate student research presentations at the partner schools, discussions with the PFF students about graduate school options, and undergraduate research mentoring. Partner school faculty gain closer ties with research faculty, and are more likely to attend research seminars and participate in ongoing research projects. Partner schools also benefit from the opportunity to recruit PFF students into open faculty positions or into part-time or visiting positions while the PFF students are completing their dissertation work.

Benefits to Undergraduates

PFF participants in our program are encouraged to become involved in mentoring undergraduate researchers, both at the research school and at partner institutions. As young researchers themselves, they can be dynamic role models, helping their undergraduate mentees to complete successful projects and potentially influencing undergraduates to opt for graduate school themselves. This is one area in which our program has not yet developed as fully as it can, and one area we hope to improve in future program cycles.

Need For PFF in Engineering Programs

Our university-level PFF program has a structure very similar to our college-level program. Currently the university-level program offers two two-credit seminars, along with occasional workshops. Students can also arrange for a 40-hour mentored teaching component, for which they earn a university certificate. Thus it might seem that a departmental- or college-

level program is not needed. However, we believe that such programs can be very valuable. Here we list some of the reasons why it makes sense to have PFF activities specifically focused on the needs of students in engineering and computer science and why such programs may be particularly welcome in engineering departments or colleges.

Pedagogical Issues in Engineering

Currently there is increased emphasis throughout the engineering field on encouraging more active learning activities in the classroom. In addition, current ABET (Accreditation Board for Engineering and Technology) evaluation criteria (ABET 2006), which are essentially universally used by undergraduate engineering programs, place more responsibility on engineering faculty to become involved in course development and evaluation. In an engineering PFF program, these trends in engineering education can be addressed more thoroughly than in a general university-wide program. Other current trends, such as a focus on introducing engineering to K-12 students and requirements to include a teaching component in many federally funded research projects, can also be addressed in the PFF in engineering program. In addition, it is known that many undergraduates "give up" on engineering degrees early in their programs, often because the level of teaching in introductory courses is not what they expected (Seymour & Hewitt, 1994) and that there is a need for providing more training to engineering graduate students who are assigned teaching duties (Torvi, 1994). These issues can be effectively addressed in the PFF teaching seminars. These seminars are especially valuable for the large number of international students typically found in engineering graduate programs who may have little experience with concepts such as active learning or with the wide range of cultural and academic backgrounds which may be found in a typical freshman engineering class in the United States. Recently our program has also begun attracting students and post-docs

from areas such as mathematics and chemistry, who find that our more focused program is a better fit than the university-wide program.

Student Diversity

While most undergraduates in engineering programs are domestic students, many Ph.D. students are foreign nationals. For example, in 2000 7.9% of B.S. in Engineering degrees and 49.9% of Ph.D.'s in Engineering were awarded to foreign nationals; in 2001 these percentages were 7.4% and 45% respectively (Computing Research Association, 2006). In 2004 7.6% of B.S. in Engineering degrees and 57.9% of Ph.D.'s in Engineering were awarded to foreign nationals (Engineering Workforce Commission, 2004). Thus in the fields of computer science and engineering it is especially valuable to have a forum for discussing cultural differences and respect for diversity. The quarter-long teaching seminar on Effective Classroom Teaching Techniques, based on (Fowler & Markle, undated) is an especially valuable tool for getting students to interact informally and to mentor one another in interpersonal and management skills. Issues of diversity and underrepresentation also arise naturally during the discussion of Kolb learning styles (Kolb, 1981).

The PFF program can also stimulate discussion and educate participants about efforts, particularly those related to teaching, to diversify the engineering workforce in the United States. The September 2000 Report of the Congressional Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology Development (CAWMSET, 2000) states "If we are to compete effectively in the global marketplace, we must advance the full and equitable participation of all Americans in science, engineering, and technology fields." With respect to women in particular, as noted in (Macdonell-Laeser, Moskal, Knecht, and Lasich, 2001), "There are compelling economic reasons to seek to increase the number of women in

engineering. For example, a recent report by the National Science Foundation has raised concerns that there has been an overall decrease in graduate enrollment in engineering. They have warned that this decrease is likely to have a negative impact on the economy in the United States. … One manner in which to increase the overall pool of trained engineers is to increase the participation of women in these fields." Yet the proportion of women and minorities entering engineering fields remains low. For example, in 2004, women, African Americans, Hispanics, and Native Americans, respectively, earned 20.1%, 4.9%, 6.3%, and 0.5% of the B.S. in Engineering degrees awarded in the United States. But in the 2000 United States Census, these groups accounted for, respectively, 50.9%, 12.3%, 12.5%, and 0.9% of the total population. While these percentages are not directly comparable, they do suggest that these groups are underrepresented in the engineering workforce. In recent years a great deal of effort has gone into trying to understand the reasons for this underrepresentation and to broaden the participation in engineering programs. Many of the successful teaching strategies identified have been found to be more effective for all engineering students than traditional methods. Two good sources of information about these efforts, for example, are (NAMEPA, 2006) and (WEPAN, 2006). A comprehensive description of one successful effort, aimed at increasing the number of women in computer science at Carnegie Mellon University, is provided in (Margolis and Fisher, 2002). The PFF program can provide a forum for discussing these strategies.

Opportunities for Graduate Teaching

In many disciplines outside engineering, such as English, biology, and mathematics, almost all graduate students have ample opportunity to gain teaching experience through graduate assistantships. In engineering, in contrast, many students serve only as research assistants, with few opportunities to teach. The PFF program may thus serve as the student's

only exposure to actual teaching. Thus it is important to be able to focus on even very elementary questions and concerns about the educational process. This is more easily accomplished in the engineering program PFF seminars. The mentored teaching experience for each student will also often need to take this lack of previous teaching experience into account. The PFF program could also involve beginning faculty, who also may have little or no actual teaching experience, if appropriate.

Opportunities for Recruitment and Mentoring

With a national need for more graduate students in many fields of engineering, recruiting of undergraduates into graduate programs is an important activity. PFF participants can be effective recruiters both at specific recruiting events and during their mentored teaching activities at partner schools. PFF students can also serve as effective mentors to undergraduate researchers in their research labs, in senior projects, and in special summer undergraduate research programs.

Flexibility for Students

While the university-level PFF program can be completed in one year, our engineering PFF program stretches over two years. This gives participants with heavy research commitments plenty of time to complete the program without neglecting their research responsibilities. Housing the program in the department also makes efficient use of student and faculty time, since seminars are easily accessible and can be scheduled to be convenient for the participants.

Seminar Size

To ensure active participation by all seminar attendees, it is best if the seminars enroll 10-20 students. Fewer than 10 students may not provide a broad enough range of backgrounds and career goals, while more than 20 students gives too large a group for equal participation by all attendees, especially as we attempt to foster the ability to lead and participate in lively

discussions. Without both programs, it would often be necessary to turn away interested and qualified students. Currently our program in engineering enrolls 16-22 students in the first seminar each year, and the university-level program has similar levels of participation.

Specifics about the Job Search

Clearly, in the job search seminar, having a more homogeneous group of student participants and faculty presenters will make it easier for students to obtain advice and guidance relevant to their specific situations. Faculty speakers in this seminar, such as newly hired assistant professors who can share their job search experiences, and hiring committee members who can present their perspectives, can also give more specifically useful advice to students in the same or related disciplines.

Similar Programs at Other Institutions

Another indication that department- or college-specific programs are valuable is the existence of similar initiatives elsewhere. One example is the Science, Technology, Engineering, and Mathematics Education Scholars (STEMES) Program run by Howard University for new and prospective faculty members (STEMES, 2006). Many other programs which address the preparation of future engineering faculty have been described at the annual conference of the American Society for Engineering Education. Descriptions can be found by going to the ASEE conference database (ASEE, 2006) and searching on the keywords "future faculty", for example.

Program Outcomes

In December 2002, both our university program and our departmental program participated in a site visit as part of a formal evaluation of all PFF programs nationwide. The results of that evaluation are not externally available. Furthermore, since the end of our formal

funding, we have not had resources to assess our program as completely as we would like. But informal assessments indicate that the program is doing very well.

Student Participation

Our original program, offered once every two years, had three cycles: 1999-2001, 2001-2003, and 2003-2005. In 1999-2001, the program's initial year, 13 ECECS students, 11 men and 2 women, participated in the program. Currently 9 of these, including both women, are in academic positions. One of these just began his academic career in Fall 2005, after working with a small start-up company. In 2001-2003, 14 students, 12 from ECECS and two from Chemical Engineering, participated. By Fall 2004, three of these had obtained faculty positions, and several more were in the process of applying for positions for Fall 2005. In 2003-2005, 26 students, 25 from ECECS and one from Industrial Engineering, participated. About 15 students from throughout the Engineering College also participated in "transition" one-year programs beginning in Winter 2003 and Winter 2004. Currently we are in the second cycle of seminars since the program was expanded to the entire Engineering College and reorganized. In the Winter-Spring-Fall 2005 seminars, 22 students, from five of the six departments in the Engineering College, participated. In the current cycle, 16 students, twelve from five departments in the Engineering College, one from the Department of Mathematics, and one post-doc from the Chemistry Department, are participating. So overall the program has served about 106 students, 104 from the six college departments, and two from departments in the College of Arts and Sciences. Since we are now offering the program every year instead of once every two years, it is attracting about twice as many students as it did originally.

Students Entering Academic Careers

We do not have extensive data on the positions currently held by many graduates of our program. We do know that in the first few years of the program the number of ECECS Ph.D. graduates taking academic positions increased dramatically, from 3 out of 75 graduates between 1993/94 and 1998/99 to 12 out of 44 graduates between 1999/2000 and the 2001/2002, with four of these 12 going to Research-Entensive universities. As noted above, at least 12 participants from the first two cycles of our program chose academic jobs, at a range of institutions. Surveying the graduates of the program to see how many altogether have taken academic positions and also to see how many choose to remain in academic positions is an objective of futre work on this project.

Student and Faculty Satisfaction

Based on informal opinion surveys, we believe that student satisfaction with the program remains high. Students who have undertaken job searches continue to report that they are much better prepared for this task and much better able to focus their searches on institutions that will be a good match for them. In addition, they report that interviewers at hiring institutions are positive about their PFF participation and the head start this will give them in their faculty teaching responsibilities.

Some specific student comments obtained from an email survey of present and past participants include:

"I think it's well worth while"--from a current participant;

"I am now teaching an operating systems lab session. I found the courses very helpful"--also from a current participant;

"PFF provided a solid framework for improving one's teaching skills with time. For many students, there is simply not enough time during graduate work to make significant strides

in becoming a better teacher. . . . The only changes I would recommend are the natural ones that occur as the program evolves."--from a participant in the first cycle of the program.

Another measure of the acceptance of our program is the number of research faculty whose students participate in it. By 2001, the list of participants' advisors already included 14 of the 45 faculty in our department. The number of advisors continues to grow, especially since the program has been expanded to the entire Engineering College. More faculty are also beginning to take a more active role in the program, participating in seminars on specific topics such at accreditation, teaching evaluations, and proposal writing, in addition to participating in discussion related directly to the job search and hiring procedures. As noted above, faculty from three of the original partner schools in the PFF cluster continue to participate in the program. Faculty from two additional nearby schools are also participating.

Setting Up Similar Programs

To assist others in setting up similar programs, we have developed a list of seven questions which will help potential organizers to decide what will work at their institutions and to share our techniques for dealing with common problems, such as conflicts between research and teaching, which PFF programs may face. Some common problems include lack of funding, lack of student time to commit to PFF, gaining acceptance from research faculty, and providing rewards to partner faculty. We present our list of questions here, along with our suggested answers and also (in italics) suggestions collected through discussions at the Lilly-North 2002 Conference (Purdy, Lewandowski, Hauser, & Coppock, 2002). We make no claim to completeness here, but we hope that this material will at least serve as a useful guide and a way to initiate discussions about starting such a program.

1. What concrete, measurable results and benefits would you like from a PFF program?

- more students choosing academic careers
- students who are more competitive for higher tier academic jobs
- recruiting tool
- students who can make informed decisions
- enriched environment, networking among students
- *recruitment of graduate students*
- *better retention of graduate students*
- *increased faculty involvement in graduate education*
- *increased student satisfaction, both short- and long-term*
- *increased satisfaction for mentors*

2. What information or skills do you want students to gain from a PFF program?

- appreciation for the wide range of academic jobs
- teaching skills
- presentation skills
- a portfolio of teaching work, research statement, etc.
- job application skills
- proposal writing skills
- mentoring skills
- *better understanding for students of the different aspects of the faculty role*
- *help for students in articulating research goals and building a professional portfolio*
- *experience for students in committee work*
- *ability for students to "read between the lines" in advertised job descriptions*

3. What attributes should your program have in order to be accepted by your fellow faculty and/or the administration?

- should be cheap to run
- should be flexible because of research
- should not be too time-consuming
- should show tangible results
- should generate conference presentations
- should have faculty involvement and feedback
- *should not interfere with students' degree progress and work productivity*
- *should not benefit just a few select people but should have broad potential impact*
- *should be simple and streamlined with no budgetary concerns*
- *should start small*
- *should require research advisors' okay*

4. What activities already in place at your institution would be useful for students?

- proposal writing workshop (university-wide, primarily for faculty)
- other PFF courses and activities at the university
- teaching manual (Fowler & Markle, undated)
- speakers in career center
- human resources staff to discuss benefits, etc.
- faculty development activities
- course materials

5. What high-impact activities can you do with sustainable effort?

- seminars with teaching credit for faculty leader and participation by PFF "graduates"

- job search seminar with faculty participation
- graduate school recruitment and mentoring
- lecturers on education with support from department seminar funds
- *listserv and/or webpage*
- *brownbag seminars*
- *undergraduate research conference for graduate student and partner faculty recruiting*

6. What schools or organizations do you need to cooperate with to implement the program?

- current PFF "partners"
- other departments in the partner schools and at the university
- other PFF programs on campus
- *Center for Teaching and Learning*
- *student organizations*
- *Center for Diversity*
- *Disability Services*

7. How will students apply to the program and how will you motivate them to complete the activities?

- application: pass qualifying exam, write a statement of purpose, get research advisor's permission
- completion: credit for seminars, success stories from previous participants, stories from job interviewees, opportunities for part-time teaching positions
- *application: completion of M.S.; support of advisor or chair or graduate studies coordinator*
- *completion: certificate to include in job application materials; food*

Conclusions and Future Plans

The program we have described here has been designed to have modest resource requirements and to be sustainable over the long term. It has benefited from our institution's university-wide PFF program and has so far achieved excellent results. For long-term viability, the program requires continued efforts by research and partner-school faculty. A modest budget, to support yearly speakers, for example, is desirable. Assigning course credit for our seminars and mentor supervision allows participating research faculty to factor this activity into their workload. By placing program graduates at the partner schools, which we have begun to do, we should also increase the number of partner faculty who want to participate, and thus reduce the workload on any one faculty member. Support for speakers can be obtained from standard colloquium budgets and can be magnified by sharing support among all cluster schools and interested groups such as the diversity programs at the cluster schools. Spreading the program over two years, instead of requiring students to complete it in year, reduces the amount of resources needed and seems to be about right in terms of the number of students who wish to participate.

We continue to refine our program to better serve all participants. Short-term plans include adding more specific information in the final seminar about how to achieve tenure, continuing to improve coordination with the university-level PFF program, and continuing to increase the number of research institution faculty who actively participate in the program seminars. We are also looking at ways to improve communication among current and past participants, to provide more thorough ongoing assessments of the program, and to fund more outside speakers.

Our program has been in existence since Fall 1999 and has grown over the years. The prospects for continuing to sustain our program at its present level of activity are good. We believe such a program could also be sustainable at the many institutions similar to ours and would be of great benefit both to the students and faculty at those institutions and to engineering and computer science education in general. Organizing our program at the college level instead of the department level (Purdy, Bishop, Fried, Kukreti, & Lewandowdki, 2003) might be a useful strategy for smaller schools or those which have fewer resources to devote to such a program.

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