

A Model Preparing Future Faculty Program for Engineering

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Abstract

To address the need for more qualified faculty in engineering programs and to improve the overall educational environment, the University of Cincinnati College of Engineering has established a college-wide Preparing Future Faculty program. The program maintains strong ties with a well-established university-level program but is specifically focused on engineering and computer science disciplines. It is based on the best practices of two previously existing departmental programs, in Chemical and Materials Engineering and in Electrical & Computer Engineering & Computer Science. The new program retains the flexibility of the departmental programs, while providing a solid common core of knowledge and practice for student participants. It is organized into easily exportable modules which can be used as is or modified to fit the needs of other institutions and which cover elementary teaching skills, advanced teaching skills, proposal writing, time management, and preparation for the job search process. There is also a mentored teaching component, which is individually structured for each student. Requirements for participation are set by each department. The program prepares students for the full range of academic positions, at research-intensive or more teaching-oriented schools. It also offers a forum for faculty to update their teaching skills and for the discussion of issues of diversity, learning styles, and differences in culture between instructor and students. In addition, an associated yearly lecture on educational issues by a distinguished engineering educator helps to facilitate both faculty and student involvement. Overall, this program provides a richer, more supportive environment for graduate students, with opportunities for mentoring by multiple mentors, and thus increases the chance of retention.

1. Introduction

Preparing Future Faculty (PFF)¹ is a ten-year-old national initiative designed to improve the graduate educational experience, to encourage more Ph.D. students to consider academic careers, and to better prepare the next generation of college and university professors to meet their many responsibilities. A PFF program has three main features:

- a *cluster* of schools, including one anchor Ph.D.-granting institution which collaborates with neighboring institutions of higher learning to give students from the anchor school an introduction to the broad range of possible academic positions;
- emphasis on the full spectrum of *faculty roles and responsibilities*, including research, teaching, and service, and information on how these roles and responsibilities may differ at different types of academic institutions;
- *multiple mentors* who can provide feedback to participating doctoral students on teaching and service activities as well as on research activities.

Currently 43 doctoral institutions and 295 partner schools are involved in PFF, and many other doctoral institutions have established programs with activities and goals similar to those of PFF¹. All these programs are designed to improve the doctoral educational experience and to address many of the student concerns raised, for example, in the study conducted by Golde and Dore for the Pew Charitable Trusts².

The University of Cincinnati (UC) has been active in the PFF movement since its beginning, with a university-wide program started in 1993 and several cooperating departmental programs, including two in the College of Engineering, in Chemical and Materials Engineering (CME) and in Electrical & Computer Engineering & Computer Science (ECECS). The ECECS program^{3,4} was one of only two programs in computer science funded nationally in the "PFF 3" initiative¹ and the only one in a college of engineering. The CME program was started earlier, in 1997, as part of the institutionalization phase of the university-wide program. Both the CME and ECECS programs have been very favorably received by students and faculty. In addition, while the ECECS program has been in existence, the number of ECECS Ph.D. graduates taking academic positions has 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 present, with four of these 12 going to Research-Extensive universities). With these two successful programs as a basis, we are currently expanding the PFF initiative to the Engineering College as a whole. Here we describe this college-level program, the resources required to sustain it, and why such a program is a valuable addition to doctoral training in engineering.

2. Format of the PFF in Engineering Program

The UC PFF in Engineering program consists of three 1-credit seminars and a mentored teaching experience. In addition each year a distinguished speaker is invited to address the College on a topic related to teaching. The program is arranged as follows:

Effective Classroom Teaching, offered in the Winter Quarter, provides an introduction to teaching for engineering and computer science. Topics include presentation skills, classroom management⁵, student assessment, Kolb learning styles⁶, and managing diversity in the classroom.

Advanced Teaching Techniques, offered in the Spring Quarter, builds on the material in the first seminar. This seminar focuses on discussion and practice of effective pedagogical techniques⁷, with emphasis on teaching of technical subjects.

The Academic Profession, offered in the following Fall Quarter, focuses on preparation for the academic job search and time management skills and also includes a proposal writing workshop.

Finally, the Mentored Internship, for which a student may earn up to 9 credits, provides a mentored teaching experience. Activities and appropriate credit are determined individually by contract with the student's assigned teaching mentor. Individual mentors for the student participants may come from partner schools in the UC cluster or may be Engineering College faculty, but all students are exposed to the broad range of teaching opportunities through interaction with partner faculty in the seminar series. The internship may be scheduled as an intensive one-quarter project or may be spread over a full academic year, depending on the research commitments of the individual student.

Students participating in the seminars, as well as students who have completed the seminar series, are also encouraged to attend quarterly presentations with previous PFF students. In Fall 2002, for example, current and former PFF in Electrical & Computer Engineering & Computer Science participants led a lively discussion on grading practices for current PFF in Engineering students. In Winter 2003 all PFF students were invited to a presentation on accreditation for engineering programs. In addition, a panel discussion on evaluating teaching, with the Dean of Engineering, departments heads from UC and Northern Kentucky University (one of our partner schools), and a recently tenured UC faculty member was held. Another valuable supplemental activity, a Mentoring Workshop, will be held in Spring 2003.

In each of the seminars, the emphasis is placed on active participation by all members. In the teaching seminars, students take turns presenting the material for each week and designing appropriate accompanying exercises to be done by their peers and the faculty seminar participants. In the seminar on the Academic Profession, students focus on such activities as preparing "The First Ten Minutes" of their interview talk, which needs to be comprehensible and intriguing to a broad audience, not just to the specialists in their field. Faculty from partner schools, members of departmental search committees, and new faculty hires are also invited to participate in discussions in this seminar.

While participating in the seminars, students also create a teaching portfolio, which documents their teaching philosophy, seminar activities, and plans for teaching after graduation. An essential component of the portfolio is the statement of teaching philosophy and goals which will accompany each student's vita and statement of research goals during the actual job application process.

All students must obtain their research advisor's written permission to enroll in the PFF program. Additional requirements are set by each department. For example, in some departments students are allowed to join the program after passing the Ph.D. qualifying examination (typically after one year of study), while other departments prefer to require two years of study before the PFF activities are undertaken. At present the program is required only for a few groups of students, including the UC College of Engineering Rindsberg Teaching Fellows, who are chosen through a competitive college-wide application process, and the Department of Civil and Environmental Engineering's GAANN (U.S. Department of Education Graduate Assistance in Areas of National Need) Fellows, whose program contains a required teaching component.

3. Special Features of PFF in Engineering

As mentioned above, UC has a well-established university-level PFF program, which some of our engineering doctoral students participate in. Both the College of Engineering program and the university level program have the same basic components: a one-quarter seminar on the job search, one or two one-quarter seminars on teaching techniques, and an individual mentored teaching experience. It is expected that students may choose to participate in seminars from either program, depending on their schedules and seminar availability. However, there are many reasons why it makes sense to have activities specifically focused on the needs of students in engineering and computer science:

- **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. Without both programs, it would often be necessary to turn away interested and qualified students.
- **Flexibility.** Engineering students may have especially heavy course or research loads in some quarters. With additional opportunities for completing the PFF seminars, more students will be able to finish all the PFF activities and move on to being mentored.
- **Pedagogical issues in engineering.** Currently there is increased emphasis throughout the engineering field on encouraging more active learning activities in the classroom. In addition, new ABET evaluation criteria⁸ 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, can also be addressed in the PFF in engineering program. In addition, it is known that many undergraduates abandon engineering degrees early in their programs, often because the level of teaching in introductory courses is not what they expected⁹ and that there is a need for providing more training to engineering graduate students who are assigned teaching duties¹⁰. These issues can be effectively addressed in the PFF teaching seminars.
- **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% respectively¹¹. Thus in the engineering field it is especially valuable to have a forum for discussing cultural differences and respect for diversity. The quarter-long seminar on Effective Classroom Teaching Techniques⁷ 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 styles⁵.
- **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 also often needs to take this lack of previous teaching experience into account. While not a part of UC's program, the PFF program could also be used to provide mentored teaching for beginning faculty, who also may have little or no actual teaching experience.

- Specifics about the job search. Clearly, in the job search seminar, having a more homogeneous group of student participants and faculty presenters makes it easier for students to obtain advice and guidance relevant to their specific situations.
- 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.

4. Program Sustainability

While the PFF in Engineering program described here is quite new, the programs on which it is based, in CME and in ECECS, have been in existence for a number of years and have been supported enthusiastically by both students and faculty. Thus prospects for sustaining the new PFF in Engineering program are excellent. But it is important to clearly identify what resources are needed for such a program, and where they will come from. For example, both the CME and ECECS programs were initially supported by specific grant funding, which is no longer available. Below we describe the resources necessary for this program and how we have sustained them after the initial grant funding ended.

- Student participants: as noted above, student enthusiasm for the program is high, with previous participants expressing continuing support for the program and also reporting favorable reactions to their participation during job interviews. The PFF training seems to be a definite plus for job candidates, especially in areas such as Computer Science, where many job seekers have little or no classroom experience. The positive experiences of previous participants and the flexibility of the PFF program scheduling also contribute to the program's acceptance by the majority of research advisors.
- Seminar coordinators: faculty seminar leaders currently receive teaching credit which applies to their college workload. The effort required to set up and run one of the seminars is similar to that required to run one of the standard graduate research seminars, and many faculty enjoy the opportunity to refine their teaching skills through seminar participation. It is important to continue to identify faculty who can take a turn at the seminar coordination, both to prevent burnout of a few faculty and to keep the PFF activities well integrated into departmental graduate programs.

- Partner faculty and teaching mentors: identifying participating faculty at partner schools and faculty at the doctoral institution who are willing to serve as teaching mentors is crucial to the success of a PFF program. For example, graduates of the program who are now faculty at neighboring institutions are glad to help with mentoring potential new colleagues. Additional interested faculty can also be identified through the university-level program.
- Support for outside speakers: currently some funds for outside speakers, which were previously provided by specific PFF grants, are available from departmental and college colloquium funds. It is hoped that specifically designated funds for an annual lectureship can eventually be identified.
- Administrative support: once the program is organized, administrative needs are relatively simple. These can easily be provided by one graduate assistant allocated to the program at the college level.

5. Program Assessment and Conclusions

Currently an independent assessment of the national PFF initiative is being conducted. The results of this assessment are not yet available. However, both anecdotal evidence and the local statistics given above show that the programs which have been established in UC's College of Engineering are having a significant positive impact on doctoral education and on placement of graduates into academic positions at a wide range of institutions. Thus the prospects for sustaining a healthy college-level PFF program are bright. Based on the UC experience and on the analysis of resources needed, it should be straightforward to establish similar programs at other institutions. Such programs could be one component in an overall plan to improve the quality of the graduate educational experience and to better prepare graduate students, at both the M.S. and Ph.D. level, for the many challenges and opportunities they will face in their careers.

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