

Educating the Next Generation of Engineering Professors: Cornell University's Teaching Fellow Program

**Jennifer M. Jacobs, Elizabeth A. Eschenbach
Cornell University/Humboldt State University**

Abstract

Opportunities for future professoriate preparation exist at some engineering graduate schools. The Graduate Teaching Assistant Development Program for the College of Engineering at Cornell University is a program developed and facilitated by excellent graduate student instructors called Teaching Fellows (TFs). These Teaching Fellows participate in an intense 6-week summer program to prepare for facilitating the TA Development Program in the fall. The summer program is organized and facilitated by a Head Teaching Fellow (HTF) and the Assistant Director of the Office of Instructional Support. The authors of this paper have both served as HTFs for the TA Development Program.

The experience of serving as a TF or HTF provides significantly more preparation than attending an introductory TA development program or serving as a Teaching Assistant. Before facilitating workshops, the TFs must refine their teaching philosophy, explore novel teaching ideas and pedagogy, develop workshops for novice TAs, and critique each other's workshops. This intense experience provides a strong teaching foundation for individuals who plan to teach as a part of their careers.

Introduction

Many academics view Teaching Assistant development programs as one way to prepare the future professoriate. The College of Engineering at Cornell University, along with a number of other engineering institutions, offer or require Teaching Assistant training for novice engineering TAs.³ These programs are geared for novice teachers, and as such, can only provide rudimentary advice.

A unique feature of the Cornell TA Development Program is that it is designed and executed by top graduate student instructors called Teaching Fellows (TFs). While preparing to execute the TA Development Program, TFs create a teaching support network and through peer review, sharpen their teaching skills. TFs improve their presentation styles, use a variety of teaching



methods, and learn pedagogical theory. As Steffen Parratt, a former TF, mused, "I have probably learned more from this program than any of its participants. The program threw me in with some excellent teachers and forced me to work hard on my teaching skills."

Experienced TFs are a resource for all TAs in the College of Engineering. Most TFs continue to teach as graduate students and later as faculty members. The teaching skills and understanding TFs develop benefit their future students and colleagues. Sue Roberts, TF, found "once people knew I was involved in the program, they started to ask me questions and discuss with me their own teaching style. Also, I passed on interesting articles from my training to my fellow graduate students."

Over the past nine years, approximately 50 graduate students have served as TFs or HTFs. A significant number of these people have gone on to faculty positions. The experience of serving as Teaching Fellow or Head Teaching Fellow for the Cornell College of Engineering's Graduate Teaching Assistant Development Program significantly prepared these people for teaching as faculty. The purpose of this paper is to describe the 6-week TF training program and summarize how this experience has prepared TFs for faculty positions.

The Teaching Assistant Program

The TFs' goal is to develop a Graduate Teaching Assistant Development Program for the College of Engineering at Cornell University. The program prepares approximately 175 new engineering TAs for the classroom each year. The program seeks to improve the quality of undergraduate education by requiring all new TAs to participate in interactive workshops about teaching in the engineering classroom. TFs develop and present the TA Workshops to their peers.

The evolution and activities of Cornell's TA program is well documented.^{1,5} In brief, the Cornell College of Engineering's TA Development is a 1-credit mandatory program that includes a Dean's Welcome, four interactive workshops, a microteaching (videotaping) session, and follow-up activities. Programs and workshops continually evolve to reflect the current needs of novice TAs. The sessions offered in 1995 are briefly described below.

Introductory Meeting Novice TAs explore their teaching philosophy and establish teaching goals. The TFs provide practical hints for establishing credibility, maintaining productive professor-TA and TA-student relationships, and preparing for classes.

Teaching in a Diverse Community The workshop stimulates multicultural awareness in the engineering classroom. Participants develop skills for teaching in a diverse classroom.²



Teaching Topics Participants choose two different sessions from the following sessions: Teaching and Assisting in the Laboratory, Leading a Recitation, Grading, Tutoring and Office Hours, Writing as Learning Engineering, and Presentation Skills.

Microteaching Sessions A TF videotapes four TAs, while each TA teaches a short lesson and other TAs play the role of engineering students. The group reviews the video tape and the TF facilitates the ensuing discussion of teaching topics that are raised during the videotape review.

Teaching Fellow Development

The Teaching Fellows

The College of Engineering TFs are experienced, enthusiastic, and highly motivated engineering graduate students who play key roles in the TA Development Program. Each year the College of Engineering hires 9 or 10 Teaching Fellows (TF) and a Head Teaching Fellow (HTF). TFs are selected from current engineering TAs. Exemplary TAs are identified and recruited by former TFs and professors. In addition, exceptional TFs are encouraged to continue working with the program. The Assistant Director of the Office of Instructional Support (AD), an education specialist who works with the TA Development Program, and the HTF hire diverse TFs who are selected based on several factors including teaching ability, departmental affiliation, personality, gender, cultural background, and TA Development Program experience.

TF duties include: (a) working with Cornell's Office of Instructional Support to develop and present workshops in the TA Development Program offered to all new TAs during the first three weeks of the semester, (b) leading small group discussions on selected topics such as teaching, grading, teaching labs, and leading recitations, (c) conducting microteaching sessions with small groups of TAs, which entails videotaping their teaching and facilitating feedback sessions, and (d) providing support to new TAs on an individual basis, through consultation, in-class visitations, and videotaping TAs in the classroom.

Head Teaching Fellow

Engineering graduate students who serve as Head Teaching Fellows probably learn the most from the TA development program. The HTF gains administrative experience by working closely with the staff of the Associate Dean's Office and the AD on the program budget and schedule. The HTF and the AD develop the summer TF program. Interacting with an education expert exposes the HTF to diverse teaching pedagogies and expands his/her knowledge of recent developments in Engineering Education. In addition, the HTF gains leadership skills. It is crucial that the TFs work as a team by the end of the summer. As the TF team leader, the HTF models excellent teaching and professionalism, facilitates team dynamics, and motivates the TFs. The HTF learns to clearly communicate expectations to the TFs, monitor individual TF progress, and provide feedback to the



TFs. During the first three weeks of each semester, the HTF oversees the TA Development Program, including tracking attendance, giving the opening welcome, and analyzing evaluations. During the semester, the HTF reviews TA attendance, awards certificates, and administers midterm evaluations.

The new Head Teaching Fellow (HTF) is selected in the spring. The HTF is selected by the resigning HTF and the AD from a pool of approximately 10 former TFs. The HTF is selected based on experience, demonstrated interest, and vision. Internal candidates are able to quickly take charge of the program by drawing on their skills and experiences from previous years.

Summer Preparation

For 6 weeks each summer, the HTF, TFs, and the AD meet twice a week to design and organize the fall Graduate TA Development Program for the College of Engineering. A sample summer schedule appears in Table 1. The goal of the summer work is to prepare a fall program with excellent materials presented by well-prepared teachers. In order to achieve this goal, TFs work on team-building, workshop development, multicultural training, and practice teaching. At each meeting, a different pair of TFs co-facilitate a model fall program workshop. The other TFs participate in the workshop, while simultaneously evaluating it. After the two hour model workshop, the group critiques the form and content of the workshop. The TFs analyze each exercise and discuss whether the workshop meets the overall TA Development Program goals. The participants critique the facilitators on their teaching and presentation style.

Date	Activity
June 1	Retreat and Planning Meeting
July 18	First session Demonstration and Discussion, Model
July 19	Microteaching 1st Session with First Session Material
July 25	Multicultural Training
July 26	Multicultural run through and Discussion
August 1	Microteaching 2nd Session with Multicultural Material
August 2	Practice Teaching Topic - Recitation
August 8	Practice Teaching Topic - Teaching in a Laboratory
August 9	Practice Teaching Topic - Presentation Skills
August 15	Practice Teaching Topic - Office Hours and Tutoring
August 16	Practice Teaching Topic - Grading
August 22	Practice First Session
August 23	Practice New Sessions

Table 1: Teaching Fellow Summer Schedule



Programs and workshops continually evolve. Each year TFs are empowered to completely revise the materials from previous years. This process ensures that the workshops are relevant to the current needs of novice TAs. In addition, it helps TFs "own" the workshops. The facilitators have complete freedom when developing workshop material. The peer review process for new workshop material encourages creativity and provides a supportive test environment. In addition, the program's latitude offers TFs the opportunity to refine their teaching philosophy and verbalize it.

Summer Meetings

Summer meetings are held in one of the following four formats: (a) New Teaching Fellow Retreat, (b) Demonstration and Feedback of a Fall Program session, (c) Microteaching Practice, or (d) Multicultural Training. Meetings are held in a classroom arranged to facilitate the meeting format. The sessions are all co-facilitated. In addition to attending regularly scheduled meetings, TFs read relevant education materials (see Appendix).

New Teaching Fellow Retreat The retreat is the first meeting in which the new TFs meet and begin building the team. In preparation for the meeting, the TFs are asked to read papers that review the program's background,^{1,2} write about their personal teaching philosophy, and review Cornell's *TA Handbook*. During the retreat, TFs share their philosophies, describe the ideal TA, and address how, in light of their philosophies and goals, the TA Development Program can help meet those goals. The latter part of the workshop is spent negotiating responsibilities, elective assignments, and the summer and fall schedules.

Demonstration and Feedback During the summer, the TFs model all the fall Workshops and receive feedback. The workshops are prepared and practiced outside the scheduled meetings, presented to the TFs, and evaluated. The *First Class Hints Workshop* is modeled by the HTF and AD. The *Multicultural Workshop* is modeled by the HTF and a TF. Each of the 5 teaching topics workshops are co-facilitated by a different pair of TFs. Each pair receives a folder of workshop materials from previous years. They prepare a workshop by drawing from existing material and developing new material. In addition, they determine each facilitator's role for the workshop components.

Microteaching A microteaching session includes introducing microteaching, videotaping TAs teaching a brief lesson, introducing the video recall session, and facilitating discussion during the video recall. Practice microteaching sessions are modeled by 4 TFs as TAs and one TF as the facilitator. The remaining TFs and AD observe the session and provide feedback to the facilitator after the session. Marian Silberstein, a former TF, commented that facilitating microteaching sessions "develops sensitivity and confidence-building techniques" as well as developing "skill in holding a discussion section, mediating class debates, and listening."



Multicultural Training During the summer, TFs receive multicultural training. The training sessions, prepared by the HTF and AD, prepare TFs to facilitate a workshop on diversity in the classroom. The sessions encourage TFs to be comfortable talking about diversity, to value diversity as an issue in teaching, and to develop personal objectives for the multicultural workshop. TFs lead the *Teaching in a Diverse Community Workshop* for the new TAs.

From these summer program activities, TFs learn advanced teaching skills. Chris Achong, TF, explains that "Being a Teaching Fellow has given me a laboratory in which to grapple with the notions that I have learned." Achong feels that the most important program benefit for the TFs is the "practical application of pedagogical theories."

Institutional Support

The Associate Dean of Undergraduate Programs, Office of Undergraduate Engineering, provides administrative support and program funding. The fiscal year 1995-96 program budget is \$45,620. The budget funds the summer TF training and execution of fall and spring TA Development Programs. The budget includes TF salaries (\$10,620), graduate tuition (\$20,000), supplies and materials (\$9,000), and food (\$6,000). Food is included in the program in order to create community among the new TAs. A full Teaching Assistantship is available for the graduate student HTF who co-coordinates the program and has a 20 hours per week commitment for one year. The TFs have a part-time commitment of eight hours per week from mid-July to the end of October. The full-time Teaching Assistant position accounts for a large proportion of the budget. The 0.2 FTE of professional staff time from the Office of Instructional Support does not come out of this budget. The operating cost excluding salaries and tuition is \$15,000. The Dean's Office provides financial and administrative support, but the staff selection, preparation, and delivery of the workshops are performed independently of the Dean's Office.

Program Accomplishments

Recently, an administrator from a leading research university visited the Office of Instructional Support to learn more about the TA Development Program. This administrator bemoaned the fact that Ph.D. graduates of her institution were not being considered for positions at teaching institutions. Engineering graduates from Cornell receive job offers from teaching institutions at least partly because these graduates are able to demonstrate that they are prepared to teach. TFs offer potential employers experience, a breadth of teaching skills, and the ability to continuously improve their teaching. Offering graduate students the opportunities to improve teaching not only makes an institution's graduates more competitive for faculty positions, it also strengthens the institution's teaching resources.



Experience The TF program develops well-trained, experienced TAs who are educational leaders. Matthew Evans, a TF, stated "I was appointed *Head TA* of the class I am working in right now. I feel I can speak from a broader and deeper experience." Teaching experience comes from increased knowledge and practice. The TF's growth is accelerated by self and peer evaluation during workshop demonstrations and microteaching practice sessions.

Breadth and Understanding After the TF leaves the University, he or she continues to be an educational leader. Eschenbach was exposed to novel teaching approaches and learned about ASEE as a TF at Cornell University. She now shares these ideas with her colleagues at Humboldt State University. As a new member of the faculty, Eschenbach has been able to suggest approaches to teaching and learning that her colleagues had not considered. The students and faculty seem to appreciate these new ideas.

Eschenbach is currently in her second year of teaching at Humboldt State University. She was hired along with another new faculty with limited teaching experience. Eschenbach was able to refer to materials and ideas developed for the TF 6-week training program. The other faculty member felt she was at a disadvantage in terms of preparation for teaching as compared to Eschenbach.

Improved Teaching Menges⁴ identifies four steps for improving teaching: (a) look for new ideas, (b) keep a clear goal, (c) take the plunge, and (d) persist. This plan is used each year as new TFs develop the fall TA Development Program. TFs learn new teaching ideas from peers and through relevant readings. TFs establish objectives for TA Development Program as a whole, and then for each workshop, and each workshop exercise. New ideas are first tried in a safe environment with the TF peer group before interacting with new TAs. Often TFs return to teach the program on multiple occasions, thus refining new techniques, and reinforcing new behaviors. Dr. Marty Taylor, former AD, noted that this process "changes how TFs think of teaching and helps them develop both personal goals and goals for their students."

Conclusion

During the past nine years, the TF preparation has evolved into an intensive and advanced program that prepares the future professoriate. An important benefit of the TF program is that it allows a self-selected group of future teachers to explore novel teaching ideas, develop these ideas, and communicate them to novice TAs. This preparation is a unique opportunity for engineering graduate students to focus on pedagogy and to apply their knowledge in context. Through this unique experience, Cornell University's TFs and HTFs are well prepared to be faculty members and consequently are stronger candidates for academic teaching positions.



Appendix Teaching Fellow Readings

Eschenbach, E. A., M. R. Taylor, and G. Rehkugler, "Implementing a Teaching Assistant Program with Continuous Improvement," *In Proceedings of the 1993 Annual Conference of the American Society for Engineering Education*, University of Illinois at Urbana-Champaign, 1993, pages 1955-1963.

Eschenbach, E. A., M. R. Taylor, and R. Parrott, "Teaching in a Diverse: Multicultural Awareness," *In Proceedings of the 1994 Annual Conference of the American Society for Engineering Education*, Edmonton, Alberta, Canada, 1994, pages 1807-1811.

Felder, R. M., "We Never Said It Would Be Easy," *Chemical Engineering Education*, 29(1), 1995, pages 32-33.

Felder, R. M., G. N. Felder, M. Mauney, C. E. Hamrin, Jr., and E. J. Dietz, "A Longitudinal Study of Engineering Student Performance and Retention. III. Gender Differences in Student Performance," *J. Engr. Education*, 84(4), 1995, pages 151-163.

Felder, R. M., and L. K. Silverman, "Learning and Teaching Styles in Engineering Education" *Engr. Education*, 78(7), 1988, pages 674-1981.

Henes, R., "Creating Gender Equity in Your Teaching," College of Engineering, University of California, Davis, 1994.

Miller, G.V., and P. G. Wilson, "Co-Training: a Synergistic Outcome," *Training and Development Journal*, September, 1982, pages 94-100.

Streett, W. B., "The Military Influence on American Engineering Education," *Cornell Engineering Quarterly*, 27(2), 1993, pages 3-10.

Taylor, M. R., and Eschenbach, E. A., "An Engineering TA Development Program - Developed and Facilitated by Graduate Students with Centralized Institutional Support," Report of the Office of Instructional Support, Cornell University, 1994.

Tobias, S., *They're Not Dumb, They're Different: Stalking the Second Tier*, Tucson, AZ, Research Corporation, 1990.

Widnall, S. E., "AAAS Presidential Lecture: Voices from the Pipeline," *Science*, 241, 1988, pages 1740-1745.



References

- [1] Eschenbach, E. A., M. R. Taylor, and G. Rehkugler, "Implementing a Teaching Assistant Program with Continuous Improvement," *In Proceedings of the 1993 Annual Conference of the American Society for Engineering Education*, University of Illinois at Urbana-Champaign, 1993, pages 1955-1963.
- [2] Eschenbach, E. A., M. R. Taylor, and R. Parrott, "Teaching in a Diverse Community: Multicultural Awareness," *In Proceedings of the 1994 Annual Conference of the American Society for Engineering Education*, Edmonton, Alberta, Canada, June 26-29 1994, pages 1807-1811.
- [3] Fitzgerald, N., "Showing TAs the Ropes," *ASEE Prism*, Vol. 5, No. 2, 1995, pages 26-29.
- [4] Menges, R. J., "Improving Your Teaching," *In Teaching Tips*, 9th ed., Ed. W. J. McKeachie, Lexington, MA, D.C. Heath and Company, 1994, pages 297-312.
- [5] Taylor, M. R. and E. A. Eschenbach, "An Engineering TA Development Program - Developed and Facilitated by Graduate Students with Centralized Institutional Support," Report of the Office of Instructional Support, Cornell University, 1994.

Biography

JENNIFER M. JACOBS

Jennifer M. Jacobs is a Ph.D. candidate in Civil Engineering at Cornell University and the Head Teaching Fellow of the College of Engineering. In 1987, she received a Sc.B. in Electrical Engineering from Brown University. She worked as an environmental consultant until 1993. In 1993, she received her M.S. in Water Resources Engineering from Tufts University. She is presently working on her dissertation entitled, "Regional Scale Land-Atmosphere Interactions in the Southern Great Plains."

ELIZABETH A. ESCHENBACH Elizabeth A. Eschenbach is an Assistant Professor in Environmental Resources Engineering at Humboldt State University. She received a B.A. in mathematics and psychology, with honors in mathematics from the University of California Santa Cruz in 1985. She received both her M.S. and Ph.D. from Cornell University in Environmental Systems Engineering. While at Cornell, she served as Head Teaching Fellow of the College of Engineering.

