

1 + 1 = 3: Unanticipated Benefits of an Integrated Teacher Development Curriculum at Cornell

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Abstract

One of the strategic goals of the Office of Instructional & Research Support in the College of Engineering at Cornell University is to enhance the undergraduate experience through excellence in peer instruction. Through curriculum integration and expansion of existing teacher development programs, we have been able to construct a student community where teaching is discussed and valued. Since our establishment in 1997, we have focused on modifying components of a nationally recognized teaching development program, the College of Engineering TA Development Program, to strengthen a younger program, Undergraduate Cooperative Learning Facilitator Training.

Since its inception in 1987, the College of Engineering's TA Development Program has evolved into a mandatory, interactive training program. New graduate engineering teaching assistants are led by their more experienced peers, TA Fellows. The corresponding undergraduate program began in 1993 and focused on cooperative learning in math, physics, chemistry and engineering design. Trained undergraduate facilitators teach their peers in small team-based workshops. To streamline and augment training of both groups, we have incorporated the following components from the TA Development Program into the training for undergraduates:

- Diversity training
- Introduction to teaching and learning styles
- Video-taping in the classroom
- Implementation of a co-facilitation model at all levels of instruction
- A shared resource center to further encourage mentoring, communication and sharing

The immediate goals for integrating these two teaching programs were to 1) streamline training and 2) strengthen curriculum. We have observed the added benefits of professional development and mentoring. Motivated by the continuity and success of the Graduate TA Development Program, we have used the same structures within the Undergraduate Facilitator Training Program. Co-facilitation provides a safe, supported structure for students exploring teaching as a career. Using TA Fellows to deliver components of undergraduate training forges another link in a mentoring network, leading to future faculty in engineering. This paper describes the professional development of students through mentoring and teaching networks at Cornell

University's College of Engineering. It also highlights the value of co-facilitation which models the teamwork outcome so desired in ABET 2000.

Key to terminology as used in the College of Engineering at Cornell University:

- TA - graduate teaching assistant
- TA Fellow - experienced TA who trains new TAs and undergraduate facilitators
- Graduate TA Development Program - the program that prepares graduate students for their roles as TAs. Classroom component is ENGRG 678—*Teaching Seminar in Engineering*.
- Facilitator - undergraduate juniors and seniors who function as group leaders in cooperative learning workshops and are trained through a program adapted from the Graduate TA Development Program
- Undergraduate Facilitator Training - similar to the Graduate TA Development Program, but for undergraduates. Classroom component is ENGRG 470—*Peer Teaching in Engineering*.
- Co-facilitation - a model of cooperative team-teaching used in both Graduate TA Development and Undergraduate Facilitator training. Students are teamed to model diversity of gender, ethnicity, culture, and learning styles

Academic Excellence Workshops and the Undergraduate Facilitator Training Program

Program introduction

Established with seed money from the Sloan Foundation in the fall of 1993, the Cornell College of Engineering *Academic Excellence Workshops* (AEWs), were a response to the growing conviction that many students learn better within a cooperative learning environment. Based on the California State Polytechnic University, Pomona model¹, AEWs are alternative small-group active-learning sessions. They are conducted in conjunction with traditional large lecture courses, where students are expected to absorb information passively and demonstrate mastery on examinations. The workshops are growing in popularity among the entire undergraduate population in the College of Engineering.

The facilitators

AEWs are co-facilitated by engineering juniors and seniors who take Engineering 470, *Peer Teaching in Engineering*, a semester-long course for credit or pay, that provides on-going support and training during their first semester of teaching. In addition to the classroom component of Engineering 470, each student must teach at least one session of math, physics, chemistry, or Engineering Design during a fall or spring term as an AEW facilitator; many continue in subsequent semesters as paid facilitators.

One of the factors in retention of facilitators is the implementation of a co-facilitation model, which we also use in the Graduate TA Development Program. We have several different types of co-facilitation pairings:

1. Faculty/graduate TA/undergraduate teaching team (EE 303, *Electromagnetic Fields & Waves*, & CS 100, *Introduction to Computer Programming*)
2. Graduate TA/undergraduate teaching team (Physics 112, *Physics I: Mechanics*)

3. Undergraduate/undergraduate teaching team (Math, Chemistry, and Computer Science AEWs).

The motivations for using co-facilitation in cooperative learning workshops range from the practical to the pedagogical. First, effective co-facilitation demonstrates teamwork in an environment in which cooperative efforts are encouraged—workshop participants learn by example. In addition, two facilitators can provide different approaches to the material, allowing students in workshops to become more flexible learners. From the facilitators' perspective, co-facilitation makes their job easier and more fun—they share in the tasks of preparing for the workshops, answering questions, and enabling teamwork among their students. The isolation and stress associated with solo-facilitation was captured by a facilitator from the earlier model: “it was...hard because I felt that I was not getting the support I needed when I made a mistake or when I was having a hard week.” The co-facilitation model provides a safety net for first-time teachers, allowing them to try new techniques and get feedback on their teaching ideas from their peers.

Facilitator training

Engineering 470 introduces facilitators to cooperative learning methods and pedagogical theory. The course itself is based on interactive, cooperative techniques that the students are expected to recreate in their own teaching assignments. In addition to practical tools for educational innovation, the course provides opportunities to gain professional skills and attitudes, such as appreciation of diversity in the classroom, awareness and understanding of group development and dynamics, and consciousness of their own approach to learning, teaching and teamwork. The course syllabus/training schedule for Fall 1999 follows:

Workshop/Training & Staff Meeting Schedule

8/28	What is Cooperative Learning? <i>(half-day front-end training for all new facilitators)</i>
9/2	Icebreaker Models with Cornell Outdoor Education Facilitators
9/9	Learning & Teaching Styles
9/16	Questioning Strategies
9/23	Teaching in a Diverse Classroom: Multicultural Awareness <i>(Midterm Feedback forms distributed)</i>
10/14	Midterm Feedback: Workshops & Training <i>(Individual consultations begin)</i>
10/28	<i>Myers-Briggs Type Indicator®</i> (MBTI) & Group Dynamics
11/11	Facilitator-created session/staff meeting
11/18	Staff meeting <i>(Final evaluations distributed)</i>
12/2	Semester-end feedback on workshops & training <i>(Celebration with facilitators!)</i>

An explanation of major training components follows:

Facilitator training begins with an all-day session a day or two before classes begin. In this component, new facilitators are introduced to the concept and practice of cooperative learning as a structured learning endeavor. It begins with case studies from teaching journals and a panel discussion led by former facilitators. Students then begin working in teams to create and critique worksheet problems. This first session sets up a dialog between returning and new facilitators that continues throughout the semester. As observed by one veteran facilitator, staff meetings and training workshops are structured to provide opportunities for us to “talk freely, offer advice and learn from each other.” Fostering this same relaxed environment in their workshops is one of the responsibilities of the facilitators. To prepare them for this task, as well as build community among the facilitators, we begin the semester by exposing them to interactive, creative icebreakers and activities.

In spring 1998, we adapted two workshops from the Graduate TA Development Program to facilitator training: *Learning & Teaching Styles* and *Teaching in a Diverse Classroom: Multicultural Awareness*. TA Fellows, experienced graduate trainers, led these workshops. The first of these workshops introduces facilitators to the Felder-Silverman Learning Style model³. Participants are encouraged to use awareness of their own learning style in teaching students who learn both the same as and differently than they do. The second workshop, *Teaching in a Diverse Classroom*, was implemented because effective facilitation requires an awareness of how cultural differences can affect both group dynamics and learning. As one facilitator-in-training acknowledged, “I really gained a sense of understanding of others working habits and learning differences. I also learned a lot about myself and my style of teaching.” Both workshops were well received (4.4/5.0 rating by participants), and are now a core part of the training program.

An introduction to the *Myers-Briggs Type Indicator*® (MBTI) & Group Dynamics was piloted in Fall 1999. This workshop lays the groundwork for a more in-depth investigation of how personality influences group dynamics. Facilitators examine their personality types, and how these types effect their approach to teamwork and learning. They become better observers of group dynamics. This skill transfers into their professional development, making them more effective managers, team players, and team builders. Strengthening the emphasis on teamwork, during the fall of 1999, we incorporated teambuilding activities developed and led by an Outdoor Education facilitator with a Ph.D. in Engineering². Many co-facilitation teams used an activity introduced in this workshop to set the tone in their first workshop. The response from participating students was favorable.

The midterm evaluation process is an integral component of cooperative learning workshops. Not only does the process provide administrators information on the success of the workshops, it is the most personal and direct feedback facilitators receive. Facilitators distribute evaluation forms to their workshops mid-semester and discuss the results in a consultation with a member of the training team. Facilitators are asked to reflect on strengths and weaknesses and identify goals for improving their teaching. Students taking the course for a grade formalize this exercise in a learning contract and reflection paper.

Throughout the semester-long training, facilitators are encouraged to present their ideas and experiences in front of their peers. Participants' comments reveal the class generates enthusiasm about teaching. One of the most exciting consequences of the facilitator experience is that the

students themselves are taking a greater responsibility, not only for their own learning and professional development, but for that of their peers as well. This phenomenon extends beyond the context of the individual workshops, and manifests itself in a more global, empowered approach to their (and their peers') education. Facilitators realize the value of cooperative learning, and are actively changing the way engineering is taught at Cornell through the following student-based initiatives:

1. The Chemistry 211 AEW was designed and piloted by an undergraduate facilitator, a former Chemistry 211 student. This workshop is now in its fourth semester, and building momentum.
2. Physics 112 facilitators successfully lobbied to increase their participation in the course to helping facilitate learning in laboratory sessions as well. Facilitators have also worked to strengthen their working relationship with graduate Physics TAs.
3. Based on the success of the Chemistry 211 AEW, another facilitator is working on developing a pilot AEW for ORIE 270, *Basic Engineering Probability and Statistics*. She is working closely with the instructor for the course and the Office of Instructional & Research Support to gauge student interest and need, and to design a structure and materials for a workshop to be offered in Fall 2000.
4. Cooperative learning workshops in Physics 213, *Physics II: Heat/Electromagnetism*, are being considered, after a group of current facilitators brought their desire to extend the model throughout the Physics sequence to the attention of department faculty.

In reply to this student energy, we find faculty responding enthusiastically to the concept of incorporating peer cooperative learning workshops into their courses. For example, this spring semester, the computer science department, in conjunction with our office, is piloting two AEWs for CS 100, *Introduction to Computer Programming*. This departmental commitment will open the door to more faculty involvement and increase opportunities for faculty-undergraduate mentoring. As we have recognized, departmental participation is key to the expansion and continued success of the program. Another key is maintaining a solid base of passionate facilitators.

Engineering 470 is generating excitement within the college, and we anticipate more juniors and seniors will become part of the AEW enterprise. The notable growth in our facilitator population during academic year 1998-99 (from 27 during AY 1997-98, to 50) has positioned us for further expansion. The program has come full circle. We note that many of the current facilitators are former participants in AEWs. As this quiet revolution takes hold, the concepts of active cooperative learning will become a natural complement to the traditional engineering curriculum, allowing students many pathways to learning, and to success. We hope that many of those who complete the program will choose teaching as a career and become innovative teachers who pass the torch to a new generation of learners.

Program participation

Currently, we reach about one thousand undergraduate students through the AEW/cooperative learning experience each academic year and the numbers are growing. Enrollment data shows the development over the past three years:

Undergraduate population in ENG supported by a cooperative learning experience

Academic Year	1997-1998	1998-1999	1999-2000
Total UG participation	977	1,115	673*
Math AEWs	316	323	212*
Chemistry AEWs	18	29	30*
Computer Science AEWs	0	0	0*
(Spring 2000 pilot)			
Physics cooperative sessions	643	653	302*
ENG design cooperative sessions	0	110	129*
Undergraduate facilitators	27	50	38*

*Fall 1999 numbers only

We have maintained a strong student-to-facilitator ratio as we have grown. Workshop enrollment varies from eight students in an AEW section of Math 192 (introductory calculus) to 20 students in each of the physics AEWs. In the latter situation, a Graduate TA supports the AEW facilitator so the ratio of students-to-instructor does not exceed 10:1. To support this co-facilitation of Physics AEWs, a team from the Office of Instructional & Research Support in Engineering developed a training workshop, *Cooperative Learning in the Classroom*, specifically for Graduate TA Training in the Physics Department, (part of the College of Arts and Sciences, not the College of Engineering).

The costs

Funding for the program is provided by the College of Engineering, in a partnership with the Teagle, Noyes, General Electric and Corning Incorporated Foundations.

The 1999-2000 Budget:

Program Coordinator	\$18,500	(1/3 Time Salary/Benefits)
Head TA Fellow/Trainer	12,000	(1/3 Time Tuition/Stipend)
Facilitators	24,500	(Paid UG Facilitators, 70 x \$350/avg)
Trainers/Consultants	5,000	(Part-time departmental liaisons, TA Fellows & topical experts, i.e., outdoor ed.)
Supplies/Copying	1,500	
Instructional Materials	1,000	(Videos, software, reference text, etc.)
Misc./Refreshments	<u>1,500</u>	(for training and workshops)
	\$64,000	(~1,260 students during AY: \$50/participant)

Toward a continuum of Teaching Excellence

We have successfully adapted Cal Poly's Academic Excellence Workshop model to the culture of engineering education at Cornell University. By creatively using existing resources—hiring TA Fellows as facilitator trainers, centralizing the program and staffing structure, and incorporating the co-facilitation model in workshops—we have been able to expand cooperative learning efforts without significantly affecting faculty workloads.

The mentoring structures we have adopted, which vary from course to course, allow the facilitators to explore teaching in a safe and supported environment, without imposing a rigid “that’s the way we do things” philosophy. Through training modules, these highly motivated students are encouraged to find the teaching methods that work best for them and their students. The co-facilitation model provides support on the peer level—students mentor each other, share ideas, tasks, and experiences, and supply an internal quality check for each workshop. Facilitators feel that they are part of a larger teaching community and have a sense of ownership of the program. This balance of autonomy and guidance breeds enthusiasm, confidence, empowerment, and a sense of responsibility for changing the culture of engineering education. These intangibles of professional development offer unexpected benefits to both the facilitators and the college.

On a college level, the power of an informed student voice concerned with the quality of education for themselves and their peers is slowly changing the curriculum. The program’s growth has drawn attention and provided more notice and involvement from faculty and central administrators.

We have seen, over the past five semesters, that we can share training methods and structures for two different audiences, graduate TAs and undergraduate facilitators. The impetus for this cross-pollination was to provide quality support for undergraduate facilitators of cooperative learning efforts in the face of program expansion and competing demands for faculty time. Taken as a whole, streamlining these two programs has created a culture in which peers help and support each other, graduates mentor undergraduates, and faculty members guide both graduates and undergraduates. In doing so, we have created economies of scale, and simplified training. In a larger sense, we are creating a teaching continuum characterized by a cooperative work ethic, and a unified teaching philosophy.

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