The Engineering Education Scholars Program— Preparing a New Generation of Faculty

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Abstract

The Engineering Education Scholars Program (EESP) is a small but crucial endeavor in the National Science Foundation's (NSF) approach to stimulate a comprehensive reform of undergraduate engineering education. For two summers, EESP has invited diverse groups of several dozen, doctoral engineering students and junior faculty members to participate in a weeklong, hands-on workshop focused on teaching philosophy, classroom skills, and the essentials of the academic career. This paper outlines the background and scope of EESP, the benefits enjoyed by participants, and tips on establishing EESP at other institutions.

Participants testify to enjoying myriad benefits during and after EESP, especially in effective teaching and learning strategies, small group/cooperative learning, and professional development. Seven cases are presented to illustrate how participants have made substantial progress in their understanding of important areas of pedagogy. These cases also demonstrate how this learning has translated into confidence in implementing fresh—and often successful—approaches in the classroom. Participants additionally credit EESP with an early opportunity to "learn the ropes" of the academic career, including valuable insight into the hiring process, mentoring, promotion and tenure, and writing grant proposals. The positive impact of EESP has motivated NSF and others to spread EESP around the country to benefit larger numbers of future faculty members. Lessons learned over the past two years through an extensive evaluation process are shared to help other institutions implement EESP and similarly equip new faculty to become the necessary "change agents" in undergraduate engineering education.

Background and Scope of EESP

The Engineering Education Scholars Program (EESP) is a small but crucial endeavor in the National Science Foundation's (NSF) approach to stimulate a comprehensive reform of undergraduate engineering education[1, 2]. In 1996, organizers initiated EESP at the University of Wisconsin at Madison to encourage a cultural change in engineering education from traditional faculty-centered, individual teaching to student-centered, problem-based, team learning. To

reach this goal, EESP has invited diverse groups of several dozen doctoral engineering students and junior faculty members to participate in a weeklong, hands-on workshop focused on teaching philosophy, classroom skills, and the essentials of the academic career.

EESP ’97 enabled participants to achieve the following program objectives:

1. enhance their knowledge of teaching methods and the learning process
2. develop their understanding and appreciation of the diversity of undergraduate students related to learning styles, cultural background, age, gender, and interests
3. increase their capacity to embrace future responsibilities for leadership in engineering education
4. bolster their confidence in becoming “change agents” to create effective teaching and learning environments at their own institutions
5. strengthen their preparation as teachers of undergraduate students and, thereby, improve their skills for the competitive job market in higher education.

Many recognized experts in engineering education have conducted sessions aimed at fulfilling these objectives. Experts at EESP ’97 included Drs. Ken Heller (University of Minnesota), Paula Heron (University of Washington), Lillian McDermott (University of Washington), Elaine Seymour (University of Colorado), Karl Smith (University of Minnesota), Jim Stice (University of Texas at Austin), and Don Woods (McMaster University).

The highly interactive atmosphere during EESP also assisted participants in accomplishing the program objectives. The benefits of cooperative learning and mutuality were realized through many events that provided opportunities for small group and one-on-one exchanges, sometimes in the middle of larger formal sessions and, at other times, during meals or evening events (Figures 1 and 2). Through these activities, the thirty-seven doctoral engineering students and junior faculty (Figure 3) enjoyed valuable interaction and even developed meaningful long-term relationships. The participant feedback presented in the next section confirms that EESP objectives were indeed achieved.

Benefits of EESP

Participants testify to enjoying myriad benefits during and after EESP, especially in effective teaching and learning strategies, small group/cooperative learning, and professional development. Through personal “testimonials” this section reveals the primary benefits of EESP, as well as the activities through which participants received these benefits. Seven cases are presented to illustrate how participants have made substantial progress in their understanding of important areas of pedagogy, such as Bloom’s taxonomy, course design, effective classroom presentation styles, student assessment, and small group/cooperative learning. These cases also demonstrate how this learning has translated into confidence in implementing fresh—and often successful—approaches in the classroom. Participants additionally credit EESP with an early opportunity to “learn the ropes” of the academic career, including valuable insight into the hiring process, mentoring, promotion and tenure, and writing grant proposals.

Lessons on Effective Teaching and Learning Strategies, including Small Groups

A Three-Pronged Attack for an Effective Lecture Class— small group problem-solving, relevance, and student presentations

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One of the major EESP topics was cooperative learning techniques in the classroom. As explained to us, the general idea is to make the classroom experience more of a discussion and less of a one-way lecture. Reflecting on the classes I had taken as both an undergraduate and a graduate student, I realized that, with very few exceptions, they unfortunately fell into the latter category. All too often, it seemed the role of the professor was to present as much material as possible, and the role of the student was to dutifully record it for later processing. These "hand-cramping" sessions did little to foster discussion and understanding of the material, however.

I am fortunate to have a perspective from the other side of the classroom as well, as I spent two semesters lecturing at San Francisco State University while I was a graduate student. The evaluations I received in both instances were quite positive and gave me self-confidence in my choice to pursue a career as a professor. In light of what I learned at this summer's meeting, however, I now realize that I was guilty of falling into the patterns of teaching which we were being urged to avoid. I lectured at a single pace, failed to prompt my students for questions, and did not succeed in demonstrating the relevance of the material to their lives.

At the conclusion of EESP, I was determined that my next teaching experience would be different. I was scheduled to lecture at the University of California at Berkeley for the fall semester and decided that I would try to implement some modest changes to my teaching style in the Elementary Fluid Mechanics class. As it is a rigorous and highly structured course, I realized that I had only a limited amount of room within which to work. Nonetheless, I set three goals for the semester.

First, I decided that, once a week, I would break the class up into small groups to solve an example that, in past semesters, I would have solved myself at the blackboard. The second tine of my three-pronged attack was to make these problems more relevant and timely than what is usually found at the back of a textbook. As an example, during discussion of the linear momentum equation, I used the ongoing supersonic car competition in the Black Rock Desert as an effective exercise. Finally, I concluded these sessions by having a student present his or her solution at the blackboard, instead of me presenting a solution.

The student response to these periodic exercises was overwhelmingly positive. The students generally enjoyed the small group exercises, citing that they served to alter the pace of the class. The use of small problem-solving groups was successful at making class more fun for both my students and myself and at making the exchange of information more efficient. They also gave favorable reviews to the examples that I had culled from the news or from issues of local interest. Finally, having students work out solutions for the class went over very well, attributable to the fact that students are often able to explain a concept to their classmates in a way more "approachable" than, or merely different from, that of the instructor. I have discovered that a

small effort on the part of the instructor can go a very long way in the eyes of undergraduate students. As instructors, just because we stand at the front of the classroom doesn't mean that we are done learning; I for one look forward to a career of learning how to better help my students to learn.

Closing the Gap between Teaching and Learning—
student learning and feedback through small group problem-solving

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One of the most effective teaching and learning strategies I gained through EESP was presented by Lillian McDermott and Paula Heron during the workshop entitled, "Closing the Gap Between What We Teach and What Students Learn." This workshop demonstrated a new approach used to teach introductory physics, not in the traditional lecture format, but by conducting sessions in which students work in small groups to solve problems strategically designed to lead them to a personal discovery—and ultimately to a deeper understanding—of the core concepts being taught. During the workshop, we participants were divided into small groups and given a physics worksheet to complete while Lillian and Paula roamed around the room "eavesdropping" on groups to monitor the progress and direction of each solution. Upon discovering a group heading off-track, they succeeded in redirecting the group's progress by asking critical questions intended to help the group members discover their own answers. This was much more effective than lecturing or even providing answers to direct questions. Because I experienced first-hand the effectiveness of this technique as a classroom tool, I had high hope that it would be worth an attempt.

The opportunity to find out came the during the fall semester after EESP when I was assigned to teach the introductory mechanics course. I designed the schedule with extra time after each core concept to "try out" this new technique. After I had presented a particularly important topic, the students would enter the following class to find the tables covered with blank newsprint, a problem statement in the center of each table, and several markers scattered about. I asked the students as they entered to form groups of 3 or 4 and begin working with their group to solve the problem directly on the newsprint. The solution typically required the use of several different concepts, rather than focusing on just one, making the problem more complex than examples previously solved for the students during lecture. The first time the students were asked to solve one of these problems, most acted as if the problem was beyond their capability. And even after beginning their solution, many were quite frustrated when I would not simply tell then how to proceed. However, once they realized that they had to work it out themselves, the discussions that followed proved to be extremely rewarding to both the students *and* myself.

Often group members developed strong, conflicting ideas about how the solution should proceed. In attempting to convince group members of the validity of their approach, they would naturally find flaws in their own logic. While most students were confident about many course concepts, through the solution process students began to individually notice weaknesses in their understanding. As one student commented, "I can see right away what I really understand and what I don't. Working in groups helps to work out the 'kinks' of what I don't understand before

it becomes a problem." Working in groups also makes each student aware that she or he is not the only one struggling to learn the material. This has made the students much more willing to discuss the material with each other throughout the semester. Once the students "conquer" the problem or at least feel they are well on their way, they begin to realize that they are indeed learning something from the class and that they have the capability to solve quite complex problems. And by using large sheets of newsprint rather than notebook paper, students can easily explore a variety of approaches and can clearly see an entire solution without having to shuffle papers.

The primary benefit I received from these "newsprint problems" was unexpected, but in retrospect, very desirable. While "eavesdropping," I began to notice subtle but unanimous misconceptions students had somehow received from my previous lectures. As a result, during the following lecture, I was able to clear up these misconceptions before they blossomed into major problems. I have since altered my lecture notes to avoid the misconceptions entirely in the future. Another benefit is actually watching the learning take place. There is nothing better in a classroom than to see that look of understanding and accomplishment flood across a student's face when she or he finally "gets it." I truly appreciate EESP for providing this innovative instructional tool as well as many others that I plan to use in the future. But above all the tools and techniques I learned, EESP left me with a sense that we are the future of engineering education, and it's up to us to make a difference.

Practical Strategies for the Classroom—
ombuds "people", name cards, and instructional objectives

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Early into EESP, the message was conveyed to the participants of the importance of the faculty role in helping retain undergraduate engineering students. The necessity to relate course material both to real world applications and to other disciplines was discussed. The coherence of course material was also emphasized. Among the most effective strategies, the importance of clearly communicating course goals and objectives, sharing enthusiasm about the course material with students, and getting student feedback to assess their learning were unanimous. Many techniques aimed at implementing these strategies were demonstrated during EESP, including the following: 1) the use of "ombuds" people (class representatives) for student feedback; 2) the use of name cards to enhance student interaction and class participation; and 3) preparation of course goals and instructional objectives for students. Before EESP was over, I was already determined to apply these new techniques in my classroom.

The semester following EESP I was assigned to teach an undergraduate course I had previously taught. I started by completely revising the syllabus to include a course outline giving detailed information for each instructional block, homework and grading policies, and classroom activities. In this way, the students knew up-front what I expected of them. In addition, I prepared a separate handout containing one-page of instructional objectives for each block, which I distributed during lecture. The classroom activities section in the course syllabus demonstrated the new emphasis on active student learning by informing students of the new

policies, namely, the use of name cards, ombuds people, and incentives for student classroom participation. On the first day of class, students were given name cards with their full name printed on one side and were asked to write their first name (or nickname) on the other side and to bring this card to every class. Two volunteers were selected among the students to serve in the classroom as the ombuds people, and their telephone numbers and e-mail addresses were given to the rest of the students. These ombuds people were assigned to periodically provide me with student feedback on how to improve the classroom environment. In addition, a survey form with a few short questions was distributed to assess from the start what students expected to learn in this course and how they could relate the course topics to real-life problems.

From the first day of class, students responded positively to the new policies. This made me feel good about student participation and classroom dialogue. I earned their trust from the start because I had assured them that the new techniques would improve the classroom environment and that I cared about their learning. For example, students realized that name cards not only helped me identify each student but also aided the students themselves in getting to know each other. The two ombuds people regularly brought in anonymous student feedback on ways to improve the class. Typical comments included “Could you please write in bigger letters on the board?”, “Could you also give us handouts of the transparencies shown in class?”, and “Could you give us a practice session for the upcoming exam?” Many times not one student but a group of students showed up in my office to ask about a homework problem. Compared to previous classes, these students were genuinely interested in the course material and in classroom discussions as well. They often brought up course-related problems/issues at the beginning of the lecture hour.

The excellent experience and dialogue I had this semester with undergraduate students proved that EESP was highly effective in improving my teaching and the classroom learning environment. I plan to continue implementing these and other useful EESP program tips and strategies in future classes. After all, I believe that students are very capable of independent thought, deserve opportunity for expressing their own opinions, and have the full right to my best effort as an instructor.

The Impact of EESP at the High School Level

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During the opening session of EESP, I learned that a disproportionate number of highly-qualified, undergraduate women and students of color switch from engineering to non-science disciplines due to poor teaching by the faculty as well as poor student preparation and career counseling at the high school level. I initially felt overwhelmed by this revelation, because it illuminated the enormous responsibility that faced me as a future faculty member. By the end of the week of workshops and small group activities, however, I felt confident and prepared to successfully meet the challenges of academia and "teaching with retention in mind." My initial apprehension subsided during the week, because I had learned how to plan for a successful academic career, how to design courses from start to finish, and how to employ effective teaching practices, such as active and cooperative learning.

This insight along with the initial revelation empowered and motivated me to volunteer my time to design and teach a Career Planning and Professional Development for Future Engineers (CPPD) course to a group of African-American, high-school women. With the mission of helping these women to understand the field of engineering as well as preparing them to be successful future engineers, I proceeded to design the CPPD course by: 1) analyzing the subject area to determine a list of topics; 2) determining objectives for each topic with each objective based on Bloom's Taxonomy of Cognitive Objects; 3) adjusting my topics and objectives according to the ability and background of my students; and 4) completing the remaining steps of the course design process, including developing my syllabus and conceptual map of the topics. Throughout this design process, I leveraged knowledge and experience gained during the EESP course design workshops facilitated by Jim Stice as well as small group activities. I also relied upon the teaching philosophy that I had outlined during the diversity and learning styles workshop.

The CPPD syllabus incorporated a wide range of topics that I felt were consistent with my mission and teaching philosophy. Topics varied from developing a positive self-image and attitude, time management, developing a career plan and successful career management to problem solving, analysis, technical writing, and interpersonal skills. I also identified both traditional and non-traditional activities to accompany my lesson units, such as journal writing, role-playing and solving logic problems. The course culminated with a final project for which students had to prepare and present a very detailed career plan in order to demonstrate synthesis of topics covered throughout the entire course. The career plan also required students to perform self-assessment and independent research, as well as short-term and long-term goal setting.

While designing the course content and activities, I also devised a teaching plan for each lesson unit. Each plan outlined the following: objectives of the unit; specific teaching practices that I would employ to meet these objectives; and a breakdown of classroom time for all discussions and activities determined for the unit. Guided by these teaching plans in the classroom, I was able to rely heavily on the active and cooperative learning practices and minimize the amount of lecturing. For example, I would begin a class by asking students about a particular concept and allow them to discuss it among themselves. Then I would tailor my discussion based on their responses. I also extended the cooperative learning approach outside of the classroom by allowing students to choose partners to work with on all assignments, except the final project.

Another aspect of my teaching plan that was beneficial to the students and myself was designating a portion of classroom time for course assessment. I provided students with the opportunity to give feedback on course topics, activities, assignments and my teaching approach via weekly surveys. Students' responses to all aspects of the course and my teaching approach were very positive and encouraging. In fact, the students expressed a sincere appreciation of the teaching approach and contrasted it to that of their other teachers. I was also able to assess the benefits of the course design and teaching approach by their classroom participation, completed assignments, and ultimately by their outstanding career plans presented at the end of the course.

The message that remained with me after EESP that proved most beneficial in the outcome of the CPPD course was the five P's—prior planning prevents poor performance. By expending a lot of initial effort in course design and developing a teaching philosophy and plan, I was able to teach

a very successful course. This success was reflected in the students' enthusiasm and performance, as well as personal and professional growth. Its success was also evident in the personal and professional growth that I experienced. In fact, teaching the course provided me with the opportunity to finish the career plan that I started at EESP as well as to cultivate effective teaching techniques. Teaching the course also allowed me to see first-hand the deficiencies in high school teaching and realize that high school students truly suffer from the same frustration as undergraduates, which is indicated by high school dropout statistics. I believe that programs like EESP can have a major impact at the high school level and ultimately result in better retention at the undergraduate level.

In-Class Participation and Connecting with Students—
small group discussions and "ombuds" people

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After EESP I had the opportunity to teach a summer laboratory capstone course for graduating seniors in which students are divided into six-person groups to conduct a series of formal experiments. I thought this was an ideal opportunity to turn the traditional "lecture" part of the course before lab work into a participatory environment where the students could discuss the theory related to their experiments. I notified each group the day before the lab that we would be discussing the material as a class instead of having a traditional lecture, so that they would not feel that an unpleasant surprise had been sprung on them. Most of the groups were willing and able to discuss the applicable theory without significant prompting. One of my major roles was to provide counterpoint ideas and ask "What if?", "Are you sure?", or "Does anyone have another viewpoint?" The students would typically go too far in assuming the terms they could neglect in a mechanical energy balance, and I would remind them that they could neglect the terms in question only after they checked the experimental data.

Response from the student groups to the participatory discussion varied considerably. Some of the students came prepared with the applicable equations neatly written on a page. I would usually ask these students to give their classmates a chance to think about the theory before coming out with the answer. Certain groups displayed nearly equal participation from all members, while other groups needed considerable prompting to move through the material.

I tried this technique a second time in a fall junior-level laboratory course. This time I provided no warning that we were going to try something new in place of the usual lab preview lecture. I was pleased that the students readily volunteered to discuss the important processes that needed to be considered in the lab and that most students participated in the discussion without hesitation.

I also tried to apply the lessons I learned during EESP as I taught my first "traditional lecture course" this fall. Because this was my first experience teaching a lecture class, I followed the traditional lecture format familiar to myself and my students. I recalled what Don Woods shared during EESP about attitude and tried to make sure that I connected with the students in my class. I asked for volunteers the first day to serve as student representatives (ombuds people) for the

class to give me feedback on how I was doing. I met with the student representatives regularly at the beginning of the semester to ensure the class was not having problems related to my inexperience as an instructor. In retrospect, I believe it would have been more profitable if I had continued to meet with them consistently. I also used another approach to connect with my students. Early in the semester I celebrated my birthday and brought homemade cookies to class to celebrate. I think this really served to let the students get to know me (I even told them how old I was) because the semester ended with a very open class in which students commonly asked questions during lecture. In addition, students readily came to my office hours to discuss lecture material, homework problems, and, in one case, the pros and cons of two summer job offers.

EESP has been one of the most useful training programs I have ever attended. I left the program with increased confidence in my ability to teach and the courage to try new ideas that I believe can improve the classroom environment and help students learn better. But even more important than the specific techniques that were presented, EESP made all the participants aware of the vast resources available for us to continue learning about the field of learning and teaching. The most important idea I left the conference with was expressed by one of the assistant professors who shared her perspectives on the early years of a career in academia: be yourself, and be true to yourself.

Engaging Students in Lecture—20-minute lecture blocks and in-class problem solving

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EESP was especially helpful because we were exposed to a wide variety of teaching styles. Whether participants were explicitly discussing teaching and learning strategies or not, exposure to various teaching styles during a time when we were acutely aware of differences in such styles was enlightening. Some of the presenters were outgoing and energetic; some focused heavily on style; others focused on substance at the expense of style; a few seemed to reach an ideal balance. An important point for young researchers to keep in mind is that although we all want to be well-respected and well-liked instructors, not all off us have the personality to put on a show in the classroom. We need to find the teaching style that works best for us as individuals, and the exposure to a diverse set of examples was helpful in this regard.

I tried some of the teaching and learning strategies that I was exposed to during EESP with mixed results. One suggestion was to have 20-minute lectures broken up by class activities or at least by a shift in the presentation style or lecture focus. I tried several ways to break things up in my Introduction to Computer Methods course. After introducing a programming problem, I asked the students to take 5-10 minutes to write a section of code either alone or with one or more other students. These exercises almost always fell flat. Students were not engaged in the material enough to do the exercises by themselves and, as often as not, they were unwilling to work with their neighbors.

I will try this method again with the same class next year, but using a different approach. First, the problems will be better defined. I will take very small problems and break them up into solvable parts. Then, I will hand out copies of the problems in class and have students fill in the

blanks. I also plan to teach in 70-minute blocks rather than 50-minute blocks and to use these exercises once a week after about 50 minutes (two segments) of lecture.

I did have limited success with breaking the lectures into 20-minute blocks. Some of the breaks occurred without conscious intervention at all. When I covered more than one subtopic, I usually moved from the board to the overhead projector to my laptop and back to the board, with short breaks for questions and comments in between each subtopic. Keeping the attention of more than one hundred students is difficult and with my limited experience it's hard to know how well I did. The students in the front of the classroom were engaged, but those in the back much less so. Most questions came from the center of the room, so I am not sure if those on the right and left wings of the lecture hall were fully engaged with the material or not.

Despite some successful and other less successful attempts at creative classroom interaction, I approached the class with added enthusiasm and a portfolio of methods to try. I also approached the class with an understanding that becoming an effective lecturer is a process and that the skills and techniques required for graduate courses in my own subject area will require a different sort of preparation and interaction than will large undergraduate level classes.

Designing Problems, Evaluating Student Learning, and Developing a Course

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The EESP sessions by Ken Heller, Lillian McDermott, and Jim Stice were most influential in shaping my outlook on my role as an educator. The first two sessions concentrated on specific techniques in the classroom, such as cooperative learning, problem solving skills, and assessing the level of conceptual understanding of the students. The third session dealt with the actual design of a course and incorporated the effective teaching techniques gained from the other two sessions.

In Ken Heller's session, we examined the difference between well-designed problems and those that did not instigate proper student reactions. We discovered first-hand that rewriting problems from a conventional physics book in a way that would enhance the conceptual understanding of the students was not easy. This involved many steps including assessing the backgrounds of the students, clearly stating the objective of the problem, probing the conceptual thought process, and developing a logical solution. Devising good problems will take many years of experience but, with EESP, we have an early start.

Lillian McDermott's workshop was very helpful in presenting ways to evaluate the students' level of understanding after being taught. During the workshop attendees were divided into groups and took tests normally given to students to dig deep into their knowledge base. The questions were also designed to lead students to assess their own level of understanding by prompting students to ask *themselves* the right types of questions. For example, a student learning Ohm's law and circuit analysis might be asked "What exactly is the role of a resistor in the circuit, and why do I need it?" Aside from getting great ideas on effective techniques in assessing student performance, I obtained a new understanding of undergraduate teaching. I now

realize how important it is to present students with the bigger conceptual picture, including actual engineering applications, even when teaching basic concepts in lower level classes.

In the practice session devised by Jim Stice, we split up into groups to develop a syllabus for the course of our choice. We realized the importance of differentiating between goals and instructional objectives, and we were encouraged not to use broad words like "understand" and "know" for objectives. We also found that developing assessment techniques other than tests, homework and quizzes was more difficult than anticipated. We then presented our syllabus to the rest of the EESP attendants and defended it. This session gave me not only a better understanding of the specifics involved in designing a class, but also insight into dealing with a group of peers and learning to compromise on teaching and assessment techniques. This was valuable experience for future participation on curriculum committees.

Since EESP, I have had opportunities to teach in place of my advisor during the semester. Although I was not able to implement a large number new teaching strategies, I presented the course material as being part of something grander by providing many real world examples. These examples were devised to answer the typical student question of "Why am I doing this?" and also to cause students to consider if they really understand the material in its proper context. In addition, I incorporated more conceptually oriented problem solving skills when designing exam preparation questions.

EESP was invaluable to me in providing an array of different teaching approaches and assessment techniques, while inherently stressing the importance of camaraderie and cooperative work. A combination of the workshops focused my goals as an educator and provided me with the tools to achieve my goals. EESP also allowed me to step into the shoes of both a teacher and a learner, to experience the challenges facing both, and to solve problems through effective communication and teamwork.

Insight on Professional Development and Grant Proposals

In addition to receiving many benefits related to teaching and learning strategies, participants also credit EESP with an early opportunity to "learn the ropes" of the academic career. EESP addressed topics including the hiring process, mentoring, promotion and tenure, and writing grant proposals. This brief section outlines one participant's insight and experience.

Amelia Regan, Assistant Professor
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EESP provides invaluable information for graduate students and young faculty members who need to "learn the ropes" of academia. The truth is that an academic job is very different from most other jobs. Despite the fact that young academics have spent years in school, being a student is very different from being a member of the faculty. I came from a research program where most of the Ph.D.'s entered the academic job market, and, in the past few years, most found academic jobs. The lessons passed on to me from classmates who entered academia, coupled with the support of my dissertation supervisor and several other faculty mentors, equipped me much better than most to enter the academic job market. Another advantage I had

was being in a field where the number of active teaching/research programs in the US is small enough that one can identify almost all of them fairly easily. For EESP participants for whom that was not the case, the introduction to engineering programs at primarily teaching colleges was enlightening. Most of us come from large research programs, and many had little idea what life at teaching-oriented institutions is like. Through EESP we discovered that there is a range of institutions with widely varying goals and that one should clearly understand the mission of each institution and one's own personal goals to ensure a suitable "match".

Discussions about tenure and the varying institutional expectations of teaching, research and service were candid. Participants asked pointed questions about criteria for tenure, including the weight given to teaching. Through several sessions we realized that research carries the real weight at most institutions, although poor teaching can adversely affect tenure decisions. It was also helpful to learn years before tenure decisions are made what the process and rules are.

Another important topic covered by the EESP workshop was grant proposal writing. This too is an issue that is elusive during our graduate student years. Several presentations focused on opportunities provided by the NSF, while others mentioned a wide array of alternative funding sources for engineering and science researchers. Through young faculty talking about their own struggles in finding suitable research sponsors, an important point arose—that of making the best use of review comments on unsuccessful proposals. I felt better equipped to tackle this process because of the introduction presented during EESP and am now more willing to both put in the effort required to write good proposals and to learn from inevitable rejections of some proposals.

Tips on Implementing EESP

The positive impact of EESP has motivated NSF and others to spread EESP around the country to benefit larger numbers of future faculty members. In this section, lessons learned over the past two years at the University of Wisconsin at Madison are shared to help other institutions implement EESP. These lessons include tips for partnerships, the importance of the evaluation process, and perspectives on the future of EESP.

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Tips for Partnerships

The importance of partnerships in implementing and improving EESP cannot be overemphasized. EESP has been successful due to a partnership among the University of Wisconsin at Madison, the National Science Foundation (NSF), and all the institutions that sponsor participants or are home to the nationally recognized experts. The benefit of EESP has increased each year primarily due to two factors: collaboration among all those involved and dissemination of program evaluations by the Learning through Evaluation, Adaptation, and Dissemination (LEAD) Center at the University of Wisconsin at Madison.

For future programs such as EESP, the following tips can help ensure a successful collaborative effort:

1. Establish and maintain connections with national agencies such as NSF and educational institutions throughout the U.S.
2. Establish and maintain local support of your Graduate School and respective schools and colleges, including the College of Engineering.
3. Involve local faculty, staff, and graduate students in planning and implementing workshops and associated activities.
4. Rely on electronic communication for application processes, interactions among participants, and networking after the program.
5. Listen to the participants through day-to-day conversations and a formal qualitative evaluation plan.
6. Facilitate networking by including enjoyable social events and adequate free time.

The Evaluation Process

The evaluation process has become an important key to the successful development of EESP. Goals for the evaluation fall into three areas: a) assessment of learning, b) evaluation of the program, and c) dissemination of innovative and effective materials. Researchers from the LEAD Center are conducting an on-going evaluation of EESP and its long-term effects on participants. Based on LEAD's initial report[3], a recent paper[4] traced the first class of participants through the program and drew on contacts in the five months after the program.

Based on feedback from LEAD evaluations and discussions with NSF representatives and local University of Wisconsin experts, changes to EESP ’96 fell into the following categories: fewer, but more in-depth, topics; longer sessions with fewer experts; more information on academic jobs; more community-building activities; and better accommodations. See References 1 and 3 for additional details.

A preliminary assessment of the daily journals and pre- and post-surveys of EESP ’97 participants indicated the following short-term program outcomes for participants:

1. Increased motivation to become engineering education change agents
2. Increased knowledge of techniques and resources for improving teaching
3. Expanded network of colleagues
4. Increased knowledge of resources for accessing research funding.

LEAD conclusions may differ upon a full data analysis; however, Section II of this paper clearly confirms the first two items as program outcomes.

The Future of EESP

Future directions for EESP are still up for debate. The following two issues, which are based on the 1997 LEAD evaluation report, are intended to frame the debate:

1. *The benefits of expansion versus staying small*. The evaluation data from both the pilot and 1997 programs suggests that some of the most important benefits of the program result from the small size of the program and the select group of scholars and presenters from around the country. Would it be better to sacrifice some of these benefits, which reach just a few dozen participants each year, in order to expose several hundred participants to EESP? Or would it be better to keep the program small and provide more opportunities for these scholars to develop into leading change agents who could institute their own programs elsewhere?

2. *The feasibility of addressing both research and teaching issues*. Based on feedback from the pilot program, the objectives of EESP '97 were expanded to include not only strengthening teaching skills but also enhancing participants' knowledge and skills required to survive the tenure process. However, there is a question as to what can be effectively accomplished in a weeklong workshop. As EESP was created to fill a perceived gap in students' preparation to become faculty members—specifically their lack of teaching experience and skills, it is important to consider the extent to which the program can be broadened while still accomplishing this primary goal.

Regardless of what conclusions these debates produce, one thing is clear: *EESP has already begun to make a difference in undergraduate engineering education at various institutions across the country*. With continued support and growth, EESP will have an even greater impact in equipping new faculty to become change agents who will help reform undergraduate engineering education in the U.S.

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Figures—Engineering Education Scholars Program Sessions

Figure 1. Informal Group Interaction

Figure 2. Informal Group Interaction

Figure 3. 1997 EESP Participants