

Directed Mentoring: A program of Industry-University Collaboration to Revitalize Electric Power Engineering Education

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Abstract

Many electric power engineering programs today face a challenge in attracting quality students. One reason is that the power industry has little visibility among freshmen and sophomore engineering students. As a result, few students think of power engineering as a career choice, and they often defer even the required power class(es) until their senior year, in consequence of which a decision to specialize in the field becomes difficult. Similar problems plague other engineering career tracks as well.

The program of Directed Mentoring at New Mexico State University (NMSU) was initiated in 2001 with a goal of increasing the visibility of electric power engineering and attracting students to the power area. Students work with faculty and receive financial aid during regular semesters, with the opportunity of employment with sponsoring companies during summer or co-op phases. They work closely with engineer-mentors from both faculty and industry to develop a broad understanding of real-world power engineering, in a carefully-coordinated program of student activities.

This paper describes the philosophy and concept of the directed mentoring program as established at NMSU, discusses its implementation and its first year, and cites some experiences and successes achieved thus far with its first group of students.

1. Introduction

Electric power engineering programs today often face a challenge in attracting quality students. One reason is that the power industry has little visibility amongst freshmen and sophomore engineering students. As a result, very few students even think of power engineering as a career choice, and many put off taking power classes (if they take any at all) until their senior year. We have often heard talented and motivated students to lament that they cannot take more electric power courses because they are about to graduate; their motivation to the power area and their realization of it as a viable major career path came too late.

In order to prevent this scenario, industry and faculty, as stakeholders, must become very actively involved in actively recruiting and importantly, we are convinced, *mentoring* the students in the early stages. While the problem cited above is not unique to the topic of electric power (indeed, some other engineering and non-engineering “tracks” face similar challenges), the present paper will summarize our intentions and initial experiences as they relate directly to our area of electric power systems education. The principles can be transferred to other disciplines and departmental tracks as well. In fact, the establishment of a set of mentoring programs ultimately competing for the available pool of students will not only be of value to the programs involved but will provide an encouragement to students to examine the available options and then choose (and work to succeed in) the program of their choice. In such a “friendly” competitive environment, all should benefit.

The Directed Mentoring Program which we established at New Mexico State University is designed to increase the visibility of power engineering and attract students (primarily undergraduate) to the power area. The concept is based upon our conviction that both industry and faculty must become actively involved in mentoring the students in the early stages. The program was begun with local utility support of four internship positions with the expectation of a five-year total program. Students in the mentoring program work with faculty and receive financial aid during regular semesters. They are employed by sponsoring companies during summer or co-op phases, working closely during that time with a engineer-mentor to develop a broad understanding of real-world power engineering. Faculty and industry advisors, working jointly, carefully coordinate student activities.

The Public Service Company of New Mexico (PNM) assumed the lead in helping to initiate the program by committing internship positions and providing financial support for each of the students. Three senior students, two juniors, and an exchange student initially joined the program and completed the first two power courses in the Spring 2002 semester. These students were employed by faculty during the Spring 2002 semester and three of them worked for PNM during the subsequent summer, after which they returned in the Fall to complete the power sequence. The senior students from this group are also completing their Capstone Design sequences with projects sponsored by a local utility and a National Laboratory. They will then consider employment with the power industry or the Electric Utility Management Program (EUMP) graduate electric program here at New Mexico State University (see description below).

This first year of experience has allowed us to test and refine the program. Our objectives and observations are described in this paper. We are pleased with the results so far and are actively looking at a group of students, possibly even larger (if additional support from other companies permits) for the coming year.

2. History of electric power engineering at NMSU

Electrical study at NMSU can be traced back to the late nineteenth century. Established as the land-grant college of the state of New Mexico, NMSU’s goal has been to address technical, vocational, and agricultural needs in the state and region. To meet this continued objective, the school has had a strong Engineering and Technology component for about a

century. Since at least as early as 1915, this has included Electrical Engineering. In keeping with the land-grant mandate, engineering programs at NMSU have typically included strong “practical” components such as laboratories and applied courses. This posture has been maintained in the electric power area even as the program has moved toward the inclusion of modern, research-oriented developments. As a result, graduates of the undergraduate program are appreciated by related industries, and the program has an excellent placement record. Since the utility area meets basic needs in our society, this has remained true even during periods of economic downturn.

NMSU also possesses a strong *graduate* program in the electric power area, leading to both MSEE and PhD degrees. Within the masters’ track, the Electrical Utility Management Program (EUMP), originated by Prof. William Kersting, is a successful graduate program that has been in continuous operation at NMSU since the mid 1960’s and has graduated several students every year since its inception. The program uses contributions from sponsoring companies (primarily electrical utilities, consultants, manufacturers, and suppliers) to fund a typical pool of 5 to 7 graduate students for up to 3 semesters of study each. This has resulted in a graduation rate of an average of about 6 students per calendar year, plus others who are self-supporting or who are supported by research programs. Perhaps as many as 8-12 graduate students finish in the electric power area in a typical year. NMSU hosts an Advisory Committee meeting each spring, attended by EUMP students, faculty, and sponsor representatives. At this meeting, students present the results of their work, and policies are decided for the coming year.

The Electric Utility Management Program has been strongly supported by industry, and students in the program are encouraged to interview with each sponsor that is hiring. As a result, more than two hundred students have graduated with the MSEE in electric power and have been placed in positions within industry, government, and private practice over the history of the program. Most of these graduates have accepted employment with an EUMP sponsoring company.

In recent years, discussions have been conducted with EUMP supporting industries concerning ways to motivate *undergraduates* into the electric power option. These discussions have led to an expanded view of industry support for power education targeted to the undergraduate. The most recent, and perhaps most potentially successful, augmentation of the original EUMP objective is the program of directed mentoring described below.

3. The Directed Mentoring Program

As pointed out above, the mentoring program was actually initiated in the Fall semester of 2001 on a small scale. It was officially proposed, in the form described in this paper, at the EUMP Advisory Committee meeting, where we recommended that it be formally initiated as the “Undergraduate Fellow” program within EUMP. This was endorsed by the Advisory Committee.

The goal of the directed mentoring program is to encourage students to consider power engineering as a career choice. Identifying students as early as their freshmen or sophomore years, and engaging them in power engineering, is seen as the path to accomplishing this goal.

The competitive mentoring program, a major incentive of which (from the student's point of view) is financial support and the near-guarantee of a summer or co-op position, is advertised and presented to promising students on a one-to-one basis by faculty. Additional advertising occurs through faculty visits to lower-division classes and student organizations, campus visits and presentations by industry advisors, and most importantly by 'word of mouth' among the students. As with other available scholarships, the College of Engineering scholarships office coordinates the application process.

Specifically, students who elect to participate in the program have the following opportunities:

- Work with faculty during regular semesters while they take power area classes
- Work with a sponsoring member company during the summer or co-op phases
- Have these opportunities available to them through their graduating semester.

At the same time students have the following responsibilities:

- Maintain interest in power engineering by following the sequence of power and related area classes.
- Participate in education and research activities.
- Actively participate in student activities, in particular as IEEE members, and seek leadership positions
- Seek employment opportunities in the power industry
- Participate in outreach activities

It is critical to ensure that on-campus work assignments, as well as industry work assignments, present a positive picture of power engineering careers. To this end, industry advisors and faculty work together to carefully design, monitor and assess each student's program. Additionally, Industry mentors commit to being directly involved in the student's work phase and to making special opportunities available to students. Faculty, on the other hand, commit to involving students in their teaching, research and service activities.

In many ways the program is similar to the classical co-op program. The principal difference is the above commitment from faculty and industry mentors. It is important to note that this is a very serious commitment in terms of time.

A goal of the program is to ultimately support 10 to 12 undergraduate fellows during any given semester. Students supported through other research grants and contracts to the largest extent possible, to provide diverse experience and to allow a larger number of students to

participate at a given time. Additional industry support is being sought to ensure a base level of funding.

Any undergraduate Electrical Engineering student can participate in the mentoring program. Exchange students from other institutions may also participate. However, recruitment efforts specifically target students in the first two years (freshmen/sophomore) of their undergraduate programs. It is intended that students will continue in the mentoring program through their final semester, if their interest in power engineering continues. Students are aware that continued support is contingent on positive recommendation from the student's industry supervisor as well as continued successful academic performance. They are also aware that they may exit the Direct Mentoring program at the end of any semester if they develop a preference for another area besides electric power. So far, as we anticipated, all students enrolling in the mentoring program have remained with it.

5. Student Activities on Campus

During regular semesters, the program calls for the students to work with electric-power faculty as they take power system classes. Commensurate with financial aid provided, these students are involved in supporting the teaching, research and outreach missions of the program. Examples of some activities of the academic-year phase that the students have undertaken, are as follows:

- Work on a project suggested by a sponsoring company. The project is in fact a continuation of work performed while employed by the company during the summer/co-op phase, and synergistic with a current research project.
- Assist faculty with sponsored research
- Assist EUMP fellows and doctoral students with their research projects
- Work on a capstone design project. Currently, one such project is sponsored by industry, the second by a National Laboratory, and a third is supported under a laboratory development grant.
- Assist in laboratory maintenance and development
- Assist in teaching activities (for example, provide paper-grading and tutoring services for power classes)

There is considerable added value to sponsoring companies for providing projects that the students can pursue beyond their industry work phase, and indeed this is probably the best objective. However, this is not critical. Our strong teaching and research programs, continuing education, and faculty consulting provide ample opportunity for challenging assignments (with the incentive of financial remuneration) for the students.

6. Student Activities with Industry

The activities of students during their summer jobs and co-op phases are necessarily constrained by company needs and policies. However, we began our discussions with industry with the desire to provide greater opportunity to these students as well as to set higher expectations for them. The engineer-mentors were encouraged to design a work-phase that maximizes the student's exposure to all aspects of the respective companies, including engineering, operation, business and customer service. A goal was to encourage the industry mentors to expose each student to both 'everyday' tasks typical of the industry as well as to at least one challenging project.

In their first year students were all given specific engineering tasks commensurate with their academic standing. Additionally, the sponsoring company arranged for meetings with company officers, field trips, and other opportunities to "see the business side". Finally, within the purview of a broader internship program in the company, students worked on a project to develop a new generation resource. This project culminated in the presentation of the business case for the project.

7. Experience and concluding remarks

The Directed Mentoring program has been in existence for less than a calendar year. So far, a total of six undergraduate students have become a part of the program. Two senior "capstone" projects (defined as per ABET accreditation requirements) have been completed so far this (2002-2003) academic year as of the end of the Fall semester, involving a total of six undergraduate students, three of whom have been supported under the mentoring program. Two additional capstone projects, each a continuation of this semester's project, are being undertaken in the Spring 2003 semester.

The program has, so far, shown itself to be successful. It has served as a catalyst in focusing our Electrical Engineering undergraduates' attention upon the electrical power area. Word of available financial support (including summer placement in a remunerative and responsible industry position) travels fast among the undergraduate population. Also circulated among the students is the requirement of high class standing and commitment required for admission to the program. Thus the Directed Mentoring Program already seems to be acquiring the status of a sought-after niche by seniors and juniors. Of course, our first class of students in the program was, for the most part, a hand-picked group of our more motivated undergraduates. Although grade-point average did not play a major role in selection, it was clear that scholarship expectations would be high. We are pleased that evident interest in the subject area, and the competitive nature of the program (not all students who apply will receive scholarships) appears to be conferring a status of eliteness and desirability upon the program commensurate with other competitive undergraduate funding programs within the Department.

Students within the program have generally been pleased with their experience. This is perhaps more easily quantifiable with the summer industrial segment of the program than with the academic component, since motivated undergraduate engineering students generally

appreciate summer employment and an evaluation of their performance is usually provided by the host industry as feedback. Planning on the part of the students has been enhanced also, as they appear to be taking courses early and in sequence. All of the students involved are scheduled to complete “depth” classes in one or two areas besides electric power.

Additionally, the faculty have noticed an eagerness and a willingness of the scholarship students to perform beyond anticipated levels of academic participation. Perhaps this is partially due to the availability of additional paying assignments (such as paper grading and preparation of examples and drawings for short courses) which we have been able to offer these students. Likely additional reasons may be that these students had already expressed interest in the power program, were academically superior, and were actively recruited. Regardless of the motivation, the program seems thus far to be fulfilling its goals of attracting quality students to the electric power area, providing them with successful industrial and academic experiences, ensuring their retention, and making them available as “value-added” employee candidates.

The Directed Mentoring program requires a serious commitment from both faculty and industry. In order to make the program successful, both groups must commit the additional time needed to properly mentor each student. When we proposed this program to our industry sponsors, we were confident that this commitment would pay off in terms of maintaining both the enrollment and vitality of the electric power program at New Mexico State University. So far, our experience with this program has proven this assumption to be justified. We hope to expand the funding base in the coming year.

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