A Plan to Retain Women Students in an Electrical Engineering Technology Program

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Abstract

An innovative plan has been developed to secure the retention of women students in a four-year Electrical Engineering Technology program. Our aim is to recruit six to ten women and move them as a group through the complete program. Bolstering confidence levels, developing hands-on skills, and forming coping strategies are all addressed in unique and innovative ways. The thread that runs through the various components of our program is a group-based support network that moves with and coexists with the real-world demand of a technical environment. Every aspect of a technical climate such as being one of few women in classes will undoubtedly be experienced by these students. However, alongside will be a subset support environment to help anticipate these kinds of experiences and provide coping strategies. For example, the addition of an office hour spent between the group of women students and their professor will provide an alternative environment where women will be in a majority and can identify what they need from the professor.

1. Introduction

The successful completion of a four-year Electrical Engineering Technology (EET) program by women students has been addressed with a unique and innovative plan. Our aim is to recruit six to ten women and move them as a group through our program. Confidence-building, hands-on skills development and coping strategies, are all addressed in unique ways. A group-based support system has been developed that coexists with the real-world demand of a technical environment. A typical four-year engineering technology program includes classes where women are few, where there are few (if any) female instructors, and where hands-on lab experience is taken for granted. Women students will have to face these environments as they move through and complete our traditional program. However, along the way, a coexisting support network is at work, providing a vehicle for group learning, a place to validate feelings and experiences, and a safe space to build up necessary skills. As an example, classes will undoubtedly consist of mostly male students and instructors will be mostly male. By providing identical course schedules for the women students, there will be a consistent group of women within their classes.

Our plan targets many issues faced by female students. Long-range goals include positive additions to our overall program and the exposure of women students to instructors,

administrators, and fellow students. We work within the constraints of our well-established four-year EET curriculum that is a standard TAC/ABET accredited degree. While taking all required classes and tests, fulfilling requirements, and experiencing a real technical environment, the students experience a support group setting that coexists with the traditional program. Our goal is to enhance the EET experience to address the specific needs that women students may have and to provide a recitation forum where women can develop their own study skills and coping strategies.

There are defined structures to facilitate group support, namely, daily mentored recitations for general study (women will be taking the same classes, they will have the same homework and tests), and weekly meetings between the group and each of its instructors (a personal group office hour). Especially in the beginning, the recitations will be formal mandatory scheduled sessions where group support will be nurtured. An equipped laboratory will be available for the women to work on hands-on projects.

In the following section, some background information is collected from existing surveys and interviews of students. A description of overall program structure follows. Section 4 highlights special curriculum issues and Section 5 involves the recruitment of women students. Monitoring and evaluating the program is discussed in Section 6.

2. Background

The technical education of women and minority students is continuously highlighted as an important piece of our overall technical growth as a nation for reasons ranging from personnel demands of the field to the growth offered by additional perspectives. Many programs are currently in place to provide outreach to high school students, provide female role models to students, and provide communication networks for women entering the field. There have certainly been many surveys taken and much research conducted to identify issues. Some of the outstanding findings of these works are highlighted below. In our proposed program, specifically geared to women in undergraduate EET programs, we attempt to make use of these important contributions.

Group learning is cited as a major factor in the success rates of the Mathematics Workshop Program at Berkeley[1], run by Professor Philip Uri Treisman. He attempted to retain and accelerate minority students in freshman Calculus. The goals were three-fold: Emphasize collaborative learning and small-group teaching methods, require faculty sponsorship, and set a goal of success rather than avoidance of failure. The results of the workshop were very impressive.

One very interesting study[2] points out a drastic change that takes place in the confidence level of women during their college years. Eighty high school valedictorians (46 women and 36 men) were asked to estimate their own confidence levels at the end of high school and during their college years. At the end of high school 20% of the men and women rated themselves in the highest category. The percentage of the male students stayed at 20% during the sophomore year

and the percentage of females fell to 3%. About 1500 students who were planning graduate study in science, math, or engineering were surveyed about their undergraduate experience[3]. Women found their undergraduate work more difficult than men, seemed to enjoy their courses less, and were less inclined to see themselves as scientists or engineers and make contributions to their field. At our entry point to collegiate success it is of primary importance to address this decline in confidence levels.

3. Outline of Project

We will recruit six to ten women and start them together in our EET program as full-time freshman. The women will have identical course schedules for all required courses. There will be a dedicated study space for the group containing lab and computer equipment as well as reading material about women's issues in technology. Daily two-hour recitations with a mentor will be scheduled to facilitate group study and help develop good organizational study skills. To foster a congenial comfortable relationship with faculty, the group will meet with each of their professors for one hour per week in a group-based office hour setting. Sprinkled through the curriculum will be informal hands-on workshops that will enhance and/or provide those basic skills (usually taken for granted of an engineer) like handling various chassis, locating switches, identifying connectors, etc. Visits by local women engineers and possibly plant tours led by local women engineers will be arranged.

Arrangements with other departments shall be made in advance to reserve the required seating for these students to insure that they take their required courses together. Preliminary contacts with other departments indicate overall support for the project. Individual professors will be encouraged to support the efforts especially in regard to their office hour with the group. Various reading materials will be given to these professors regarding issues in the technical education of women. If funding permits, these faculty members will be compensated for their additional office hour. Hopefully they will look positively at the experience of the recitation. It will be something new for them as well.

The heart of the plan is the daily recitation period where the group can work for a couple of hours along with their mentor. At first, the mentor will facilitate the recitations in a structured way. The material covered in each class will be compiled using notes/recall of all group members. Hard assignments and soft assignments will be identified. Together as a group, a structured plan for that period's activities will be made. Basic skill-developing activities like test preparation, lab report development, and solving homework assignments can be scheduled in the appropriate priority. Some personal time can be allotted, which can initially be facilitated by the mentor to discuss issues pertaining to women in technology. In additions, articles can be read, experiences can be discussed, and personal problems may be shared.

Early on in the program, and as deemed necessary, each of the students will meet once a week with the recitation mentor. Special needs of the students (academic, emotional) can be identified early in the program. The wealth of on-campus student services, like counseling and academic skills, can be called upon if needed. It is hoped that, in time, some of these special concerns will

be “taken on” by the group either directly or indirectly.

Studies have shown[2] that women in technical fields do not always feel bonded or connected with their technical institution, be it their school, department, or company. As a step toward creating this bond, the group will have regular meetings with the department chair to discuss their progress. The chair can provide encouragement and care at the department and institution level.

4. Curriculum

It is the "traditionally male" air given to technical items that serves to keep females at arms-length. This distance, for many women interested in the field, poses obstacles to participation in traditional technical programs. Though many women can and do achieve successful completion of such programs, various studies site the small numbers of women completing technical programs. The following twofold plan attempts to make up for the limited technical exposure of most young women: Strengthen theory with additional class work and strengthen hands-on skills with workshops.

Graduates of our program find employment in areas ranging from troubleshooting to design modification to testing. They need a good theoretical foundation that is well connected with practical aspects.

4.1. Theoretical Course Work

Calculus, physics and chemistry provide the theoretical foundation of Electrical Engineering Technology. In our particular program, we require two semesters of study in each area. There are two tracks of calculus, physics, and chemistry at most schools. One is a rigorous track that is taken by students majoring in physics, chemistry and engineering. The other track serves the remaining areas of study. Our EET program accepts either set of courses.

We would like to give the group the opportunity to complete the rigorous track of courses. It is noted[4] that women in Turkey earn a much larger percentage of physics degrees at all levels than do women in the United States. The Turkish curriculum is extremely structured and a first-year female student at the university has a science and math background equal to that of her male counterparts. In contrast, U.S. data show that female students in high school take fewer years of science and math than do male students.

In order to meet the requirements of the rigorous courses, we will start the group in the non-intensive track followed by completion of the rigorous track. For example, the group can take Physics 1 for non-majors, followed by the rigorous first course in physics. The same course structure can be used for Physics 2, the chemistry sequence and calculus sequence. Discussions with the Physics Department regarding this course sequence strategy were favorable. They did caution that there would be some repetition of material. The Physics Department at Massachusetts Institute of Technology had a positive experience offering an introductory physics course at a slower pace.[5]

College-level algebra is the prerequisite course for the less rigorous Calculus 1 course. Our students would complete this course sequence (or a portion of this sequence) prior to taking the more rigorous Calculus courses. The Mathematics department has a special program where pre-Calculus and Calculus 1 (for majors) are taken at the same time, as one large double-credit class. The purpose is to initiate the material of Calculus 1 and return to Pre-Calc as necessary. After completing college algebra and Calculus 1 for non-majors, this may be an excellent opportunity for the students.

4.2. Workshops

There are many practical skills that are taken for granted in the engineering technology field. There are no formal mechanisms to learn these skills; the expectation is that the skills will be picked up along the way, by experience. These skills frequently require spatial visualization, and include using tools, locating mechanical subassemblies like switches and connectors, opening chassis, and removing circuit cards. Results of a spatial visualization exam at Michigan Tech resulted in 50% failure by women compared to 15% of the men[6]. Michigan Tech went on to develop a course that emphasizes a gradual process to improve visualization skills.

Workshops will be interspersed in the curriculum and will be geared toward developing these skills. The workshops will be conducted in ways that do not assume prior knowledge and provide encouragement and positive reinforcement. Workshop leaders will be carefully selected. The workshop settings will be informal. Each student can request to be considered for a certificate of expertise whenever they feel they are ready.

5. Recruitment

Our goal is to bring together a diverse group of women students. Two areas for recruitment are targeted. Objectives are to make local high schools, especially technical high schools, aware of our program. An information package will be sent to the high schools followed by a personal communication from our department. A Women in Technology Afternoon will be scheduled, where high school seniors and their parents can visit our campus and learn about our program. In addition to recruiting at high schools, undecided majors on campus will be sent information about the program. Undecided majors who are interested can come to the Women in Technology event and can also set up an advisement session with the department to evaluate the credits they have already accumulated.

6. Monitoring of Program

Students in the group are expected to meet the same standards and expectations as all students in our program and school. Students are expected to maintain a cumulative GPA of at least 2.0. Our school has innovative procedures in place to address probationary status for students who fall below this requirement. If these requirements are not met, an informal board consisting of college faculty and deans meets with the student an develops a course of action (leave school for

a year, use academic skills, take fewer courses etc.) At the group level and at the department level, we will try to preempt this situation.

7. Summary

A group of women students will be recruited to complete the four-year EET degree. Many innovative methods have been developed to insure their retention in the program. These group-based learning techniques can coexist with the structure of our standard TAC/ABET accredited program and maintaining department-level and school-level requirements. It is our hope that some of our techniques will stand out as major contributors to the retention of female students in EET programs and can be incorporated into the existing program framework.

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2. Leveson, N. G., Educational Pipeline Issues for Women, transcription of a talk at a CRA Snowbird meeting.

3. Grandy, J., Love of Science Draws Women Grad Students, Research Brief, Women in Higher Education.

4. Minard A. and Uzon A., Educating Women for Success in Physics: Lessons from Turkey, Am. J. Phys. 61 (7), July 1993.

5. Women Undergraduate Enrollment in Electrical Engineering and Computer Science at MIT, Final Report.

6. Ercolano, V., Seeing is Achieving, ASEE PRISM, December 1995.

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