FOCUSING FRESHMAN ENGINEERING AND DESIGN ON WOMEN AND TECHNOLOGY

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ABSTRACT

In the Fall of 1999, Texas A&M University (TAMU) was selected as a participating university in the Virtual Development Center (VDC) program sponsored by the Institute for Women and Technology (IWT). The objective of this program is to increase awareness of the impact of women on technology and technology on women. A special section of the Foundations of Engineering (ENGR 111/112) course is one way TAMU is supporting the VDC program. What makes this class different from the standard Foundations course is its focus on ideas for technologies that will be useful to women and families of the future.

INTRODUCTION

The IWT is an organization aimed at focusing a diverse assortment of women and men from industry, academia, communities, and government on the creation and development of technologies that have a positive impact on women and/or families. Four universities and several companies, including Hewlett-Packard, Sun Microsystems, and Xerox, are involved in this program. The Virtual Development Centers are a collection of education, research, and development institutions whose objective is that the ideas generated by women and for women through these centers can be realized by a cooperative effort between students and industries. Texas A&M University's involvement in the VDC is through a variety of courses in which the students participate in generation and implementation of technologies related to the IWT agenda. Course levels vary from freshman to senior, and disciplines vary from engineering and computer science to education and women's studies.

The focus of this work is the involvement of the freshman engineering course in the IWT project. A single session of this class has been created in support of the VDC. This section differs from the standard offering of this course in several respects, with the most important differences detailed below.

The biggest difference between this class and the standard freshman engineering class is the class projects, which focus on ideas for technologies that will be useful to women and families of the future. The student teams are intended to collaborate with students from other courses, both technical and non-technical, and at all levels. The result of this multilevel, interdisciplinary interaction is intended to be design or implementation of idea(s) generated by the IWT workshop.

Another difference is the female/male ratio in this class versus the typical engineering course. In the fall semester, 34 of the 52 students were female; approximately 5 times the typical female to male ratio compared to the other freshman engineering classes. In order to accomplish this, the section was advertised primarily to incoming female engineering students.

ENGR 11x COURSE STRUCTURE

Modern technologies are used in and out of the classroom to accommodate the increased class sizes. The 111/112 IWT classroom is configured with 26 HP Kayak desktop workstations for students. The instructors also have a workstation that allows course materials to be projected on a screen. Class materials are displayed using Microsoft PowerPoint and computer exercises, such as Excel and AutoCAD, are demonstrated in real-time. The document projector displays handwritten calculations and hand drawn sketches. The faculty, as a group, designs and writes materials for each day's class period prior to the start of each semester. The PowerPoint format provides another mechanism for large class sizes, and can be easily converted to a web page. ENGR 11x students can access the lectures, assignments and other documentation via the World Wide Web.

An Active/Collaborative classroom, where the professors are considered facilitators, rather than instructors, is used in the ENGR 11x classes. Students are organized into teams of three or four. Class periods are designed to include in-class exercises and assignments that encourage teamwork. The team assignments are designed such that teams of less than three cannot adequately solve the problem with the allotted resources. Assignments are designed to strike a balance between individual accountability and team responsibility. Each student must complete some assignments as an individual, and other assignments as a team. Typically the team assignments have more breadth and depth, and should be difficult, if not impossible, to complete without a team which functions well. Some students resist type of instructional environment, but most eventually agree that this method has helped them to learn more (than the typical lecture environment). This style of classroom environment is based on the real world teamwork experienced by most engineers. A side benefit of the teamwork should be the development of well-rounded engineers.

WORKSHOP

A workshop on technology in support of families, facilitated by the Institute for Women and Technology, was held in September of 1999. The following description of a similar workshop illustrates the goals and objectives of this type of workshop and can be found on the IWT web page [http://www.iwt.org/resultsreports/workshop_parc.html].

> *Topic:*
>
> *The topic of this workshop, Technology in Support of Family is broad reaching and therefore defines it as an exploration workshop. The topic*

was developed in reaction to two situations. First, major technology companies and universities have projects to develop Technology for the Home that employ no female technologists. Second, many futuristic descriptions of the home are filled with gadgets that are of questionable use to the people who make a house a home. We decided that we would like women to explore a human-centric rather technology-centric future of technology—thus technology for the family.

Goals:

The general goals of any IWT workshop apply to this one.

- *Workshops should provide a valuable experience for its attendees. Technologists should learn the viability of a design process that allows them to explore a broader range of problems than is available in the traditional lab and to experience brainstorming as women and as engineers simultaneously. Non-technical participants should begin to appreciate their potential impact on technology and recognize their own genius and power. Ideally, some might be drawn into longer-term participation in a technical career.*

- *The workshops should result in tangible outcomes. At a minimum, this includes reports on the technical ideas generated and an evaluative report on the workshop itself. Technical ideas may be entirely new, may be variations on what exists or is in the pipeline, or may validate or contradict current directions. Workshops may also generate plans, partnerships or collaborations for further work. In the best case, this would generate a local project to do further study or develop an identified technology or product. In the case of an exploration workshop, this might include plans for a follow-on innovation workshop.*

Participants at the fall 1999 workshop at Texas A&M University included women from the community, women faculty and staff, and women students. The group ranged in age from 8 to 80, was ethnically diverse, and had a broad range of technological backgrounds. An additional workshop was held in January of 2000 for the ENGR 112 IWT students. This workshop differed from previous workshops in that the participants' ages were between 18 and mid-thirties, and included males as well as females. Furthermore, participants in the second workshop had more similarity in their technological backgrounds.

During these and earlier IWT workshops lists of ideas were generated by unconstrained brainstorming by the participants on issues concerning women and families of the future. These lists were then refined, and the group selected a few of the ideas for further investigation. The brainstorming and refinement results were then used to motivate class discussions and project ideas for the ENGR 11x classes.

PROJECTS

The prospect of being involved in "real world" projects was an enticing feature of this course. Following the first workshop, students were asked to consider how any technological product would be different if women had been involved in the design process or if women had been considered a primary customer. This activity also helped to engage the students who were not included in the workshop in the focus of the IWT. Based on the brainstorming and refinement during both workshops, three projects evolved for exploration by the students.

The first project, done in ENGR 111, was to design and build an automated pill dispenser. One purpose of the project was to give students the opportunity to experience the implementation process and some of the issues that arise during prototyping. An additional objective was to connect with a recurring theme from the workshops of devices that enhance personal wellness.

The first project of ENGR 112 was to model the inner workings of a coffee maker based on theory as well as data from non-destructive experiments. Students were required to use the knowledge of thermal and rate processes gained from class materials presented in ENGR and physics classes. In addition, students were asked to propose improved designs for the coffee maker. In completion of this project, students gained experience with common engineering tools such as Excel and AutoCAD.

The final project of the ENGR 11x series was to design and build a roller coaster from Popsicle sticks, soda straws, and fasteners, with the "car" being a standard glass marble. The purpose of this project is to further the IWT goal of increasing interest in science and engineering particularly among traditionally underrepresented groups such as women. A successful design could be used as an educational component for teaching physics in elementary, middle, and high schools and promoting an interest in science and engineering in these young students. The assessment of the effectiveness of the designs in meeting the educational and motivational objectives will be done by the youngest workshop participant (now 9 years old).

CONCLUSION

The theme of women, families, and technology is proving to be an excellent vehicle for motivating and inspiring first year engineering students. The students gained additional insights through exposure to women's and family issues. The classroom environment, interdisciplinary teamwork, and industry interaction gives the students a positive experience and opens their eyes to many engineering issues that are not typically addressed by the curriculum.

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