

Motivating Women Engineering Students through Community-Based Projects

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Abstract

This paper describes a collaborative project involving students, faculty, community members, and The Institute for Women and Technology. The Virtual Development Center (VDC) site at Santa Clara University is one of nine such sites at universities around the country, each committed to including the community in the definition of projects that truly benefit a segment of the population usually ignored in the design and development of new technology.

We begin with workshops that bring together women with a variety of life experiences (teenagers to octogenarians, technophile to technophobe), providing a forum for women in local communities to make their views on technological developments known to major research and development organizations; to generate new and unique ideas for technological changes and developments that would be of benefit to women and families; and to discuss their needs and increase their skills in expressing their views on technology.

In our third year we initiated a relationship with HomeSafe, a transitional housing community for survivors of domestic violence. We found that in addition to showing the students the benefits of serving the community, and of having to design for a specific real world user population, we were able to attract many of our women students to the project. The women students found the experience validated their feeling that engineering should have a positive impact in "the real world." This paper will describe the experience of the students and the projects they produced for the women at HomeSafe.

Institute for Women and Technology

The Institute was formed with a three-fold mission:

- To increase the impact of women on technology, in education, design, development, deployment and policy;
- To increase the positive impact of technology on the lives of all women;
- To help communities, industry, education and governments accelerate and benefit from these increases.

One of the programs supporting this mission is the Virtual Development Center (VDC), a collaborative network of nine colleges and universities, community members and sponsoring organizations that draws technical and non-technical women into technology by making the connection between technology creation and social impact.

Santa Clara University Virtual Development Center Site

The VDC provides an opportunity for students to experience the impact that technology can have on their community. We attracted students to the project simply through word of mouth, but found that it was an opportunity they were eager to pursue. The students signed up for the project

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by enrolling in a special course offering: VDC Community-Based Project. Even though the course was added to the schedule after it had been printed in the spring, we attracted 16 students, including 9 of the 18 female seniors in Computer Engineering. We also enrolled students majoring in English and Women's Studies lending their unique expertise to the projects and providing students the valuable experience of working on multi-disciplinary teams.

In the following, we describe the organization of the SCU VDC, the innovation workshops designed to elicit community participation in project definition, and two of the specific projects developed by the students in the 2001-2002 academic year.

The leadership team at Santa Clara University is made up of Ruth Davis, Professor of Computer Engineering, Barbara Molony, Professor of History and Director of the Program for the Study of Women and Gender, Lee Hornberger, Associate Dean of Engineering, and Nancy Nelson, Vice President, Engineering at Trimble, assisted by Cathy Valerga of the SCU Center for Science, Technology, and Society. The inclusion of people from many disciplines and backgrounds in the effort is important to IWT and to Santa Clara University, whose mission includes providing an integrated education that fosters the development of competence, conscience, and compassion in our students. The projects integrate knowledge, analysis and strategic approaches from diverse specialties.

Innovation Workshops

The starting point for the Virtual Development Center in defining projects to pursue is an innovation workshop. The goals of the workshops include:

- to offer an opportunity for women of all ages and backgrounds to increase their comfort and skills in working in a small group setting expressing their views on technology;
- to provide a forum for women in local communities to make their views on technological developments known to major research and development organizations;
- to provide a setting in which women of all levels of technical expertise can meet and discuss their hopes, dreams, and needs, and those of their families, friends, and colleagues; and
- to generate new and unique ideas for technological changes and developments that would be of benefit to women and families.

We have held five such workshops at Santa Clara University, each time including several women from the community. We invited women through several community connections we have. Each workshop is relatively small, involving only twenty to thirty participants. We ensure a balance by insisting that the participants register early, and limit the number we can accept. We have included women ages 12 to 86, with educations from eighth grade through Ph.D.'s, and backgrounds including technical and non-technical fields, laborers and professionals. The women included full-time moms, moms working outside the home, and women without children. While the workshop participants always expressed delight in the experience, we found it difficult to maintain their involvement throughout the development of projects in our first couple of years. In 2001 we established a relationship with the women at HomeSafe, a transitional residential community for survivors of domestic violence. This provided a community audience that was more easily reached for follow-up in the design and implementation phases of the projects. We continued to work with them in the 2002-03 academic year. Summaries of all the workshops and ideas generated are available on the SCU VDC website at: <http://vdc.engr.scu.edu>

The first objective of each workshop is to convince each woman of the value of her own experience, that in fact, there was no one more expert than she about what worked for her, and what she wanted. Facilitators encouraged respect for all participants by demonstrating how to create a Thinking Environment™¹ with specific strategies for attentive listening.

The Thinking Environment™ is a model of human interaction that is based on the idea that things work best when everyone is able to think at their best. The underlying framework asserts:

1. Action is only as good as the thinking that precedes it (nothing new here); but also that
2. The quality of a person's thinking depends on the quality of attention she is given while she is thinking.

Now that is fairly revolutionary. The model says that the quality of our thinking is *not* primarily determined by things such as IQ, degrees, gender, race, age, social status, or education, but that *high quality thinking*, the ability to think for oneself, *is a function of high quality human interaction*.

In the technology innovation workshops we run, we give participants a chance to practice four behaviors that foster a high-quality thinking environment.

- First is attention. The listener *always* keeps her eyes on the eyes of the thinker/speaker; she *never* looks anywhere else. Now that doesn't mean "staring," you may blink, and you should try to be aware whether or not you have a welcoming expression on your face. You don't want to slip into a worrisome, frowning, disapproving, skeptical, shocked, or startled expression. You don't need to appear approving, but you should present a relaxed and interested, neutral and receptive, easy face to talk to.
- Equality — all participants are equal in terms of their ability to think. Everyone gets their turn, and all thinkers are given equal attention. In our workshops we avoid having people introduce themselves and their background until the end. Each participant is treated as an equal in her ability to think about technology, especially since she is being asked to think about the impact of technology in her own life; and in this, she is the only expert.
- Ease — We offer an easy and relaxed environment to each other while we're thinking and listening. There are NO interruptions. No one is ready to pounce on the first pause; no one worries about getting a chance to have her say. We allow silences. Someone can be thinking, lose a thought, or change direction, pause quietly, and continue, or not, relinquish the floor, or not. There is plenty of time and attention to go around.
- Appreciation — At the end of the day, we explicitly acknowledge what we appreciate in one another and about our experience in the workshop.

Three of the outcomes that consistently emerge from practice with this thinking environment are:

1. Enhanced quality of thinking;
2. Increased trust within the group; and

¹ The Thinking Environment is a trademark of Nancy Kline, President, Time to Think, Inc., and author of *Time to Think: Listening to Ignite the Human Mind* (Ward Lock, London, 1999) .

3. Enhanced individuals' self esteem and willingness to assume increased responsibility for oneself by speaking up and taking appropriate action.

When people feel really heard, they not only seem to be able to think better, but they also feel better about themselves. In the workshops we've run, this has translated into participants' expressions of amazement at how comfortable they were thinking about technology, and their expression, at least in that moment, of a willingness to become more active in technological discussions.

These workshops accomplished their goals of making women aware of and comfortable with expressing their views of technology; of developing and refining the product wish lists; of demonstrating factors for effective group dynamics; and of making ordinary women feel consulted, even “wooded,” by major technology companies. Two projects were defined as a result of the workshop: ANEW and KnowItAll; each is described below.

ANEW: Action Now in Employment for Women

Domestic violence impacts all socioeconomic groups, and makes it difficult for victims to achieve financial stability and independence. Many women who are in domestic violence situations are forced to leave the workforce, thus losing job skills and experience. Women who are able to break away from the cycle of violence often find themselves unprepared to enter the workforce. There is a great need for the training of women in emerging technologies and skills that will enable them to become self-sufficient.

Getting and keeping a job can also be a very positive experience for victims of domestic violence, promoting healing and raising self-esteem. ANEW (Action Now in Employment for Women) provides resources and assists in job training that will promote career advancement. ANEW is accessible as one of the 2002 project links on the VDC website mentioned earlier, or directly as: <http://vdc.engr.scu.edu/ANEW>.

The career resource website is composed of the following six sections: (1) About ANEW, (2) Job Searching, (3) Link to Tutorials, (4) Resume and Cover Letter Building, (5) Training Classes, (6) Helpful Links. The about ANEW page introduces project goals, and provides a very brief overview of the website pages and functions. The job searching section lists employment resources and agencies, in addition to linking users to various job search engines. The tutorials page is a list of online tutorials for common computer applications, such as Word, Excel, PowerPoint, Internet, and typing skills. The resume and cover letter section includes guidelines, keywords, and general advice for career-oriented documentation. Users may construct their own resumes and cover letters by using the resume and cover letter builders provided there. The training classes section contains all syllabi and resources from training classes taught at HomeSafe. The Helpful Links page provides information on local agencies that offer additional employment and career-oriented training.

The second component of project ANEW was to provide hands-on experience and training to women in the HomeSafe community. The classes offered an introduction to computers and information technology. No previous knowledge or experience with computers was required. In addition to learning about the basic concepts of computer systems, students gained hands-on experience with applications such as word processors, spreadsheets, and presentation software, as well as tools for exploring and utilizing the Internet.

KnowItAll

In addition to the ANEW project, a separate group of students chose to address another need identified at the workshop. Some of the women at HomeSafe expressed that they had little or no time; others felt they lacked the knowledge to help their children with their homework. KnowItAll is not intended to be a complete replacement for the valuable insights that only parents can provide for their children. However, KnowItAll aids children whose mothers may not always be available to help their children with homework, as well as provides some features that assist the parent in working with and checking the work of their children.

Many websites exist that help children of all ages, and deal with all subjects. This project is unique in that it focuses on specific grade levels (1-4) and material specific to the local school district.

KnowItAll integrates three main subjects & four grades: Social Studies, Math, and English from First Grade through Fourth Grade on one site. In each of these twelve areas there is a collection of animated lessons, games, quizzes, songs, poems, visual aids, and links for further exploration of the material. The entire application is designed with a child-friendly web-based environment.

The graphical user interface is appealing for children of all ages, and includes colors, pictures, and animation where applicable. Navigation through the website is easy, as a beginning page includes links to the four grade levels. From there, each grade level links to a page containing the three subjects.

Student Experience

The students all appreciated the opportunity to work with the community on projects with real customers whose needs and abilities had to be carefully considered. They learned there is a huge difference in designing something for yourself and designing it for others. They also learned a great deal about their own tendency to stereotype others. One group provided the following insights. "Before meeting with the HomeSafe women we had several misconceptions, as to the backgrounds, of the community that we were going to be working with. After the initial meeting we were surprised to learn the women came from various socioeconomic backgrounds. Several of them were well educated; however, because of their situations, they fell behind in the technological arena. From such a diverse group of people we were able to get substantial information for the initial design of our program."

Several students mentioned that what attracted them to the VDC was the opportunity to be "conscious members of this community" by working on "a senior design project that would be of assistance to the community in which we live." Their own evaluation of the project included the following statement. "The most important lesson we learned is that, as engineers, we sometimes get carried away with maximizing the speed and complexity of things and we often ignore the needs of the individuals who cannot quite catch up to us. Sometimes we need to slow down and think about what we can do to help the lesser technically inclined individuals. The ability to be able to help those who have very little or no input into the products that they use in their everyday lives is a responsibility that we now take seriously."

Another quote from one of their reports: "in designing, developing and implementing our site, we always kept in mind the needs and suggestions of the HomeSafe community along with the vision of the school of engineering: 'to combine our Jesuit tradition of competence, conscience,

and compassion with a Silicon Valley entrepreneurial spirit to produce engineers who by their professional activities will make a strong, positive impact on their communities and the world.' "

Conclusion

Our efforts to involve students in projects that reach out to the community are not unique. For example the EPICS program at Purdue (and now other places as well) is a much larger scale effort along similar lines. What is different about the efforts of the VDC is its focus on involving women. As in the stated goals of the Institute for Women and Technology, we want to increase the impact of women on technology and the positive impact of technology on the world's women. By doing so, we improve the impact for everyone.

It may be coincidence, but it is worth noting that this effort attracted a very large percentage of the women students. Of the seniors involved in these projects, we had 9 of 18 female (50%) and one of 41 male (2%) seniors. Of course, we cannot claim on the basis of one experience that such projects are more attractive to female students, though it is often reported that women are more attracted to socially relevant majors and leave engineering because they fail to see the connection.

Santa Clara University President Paul Locatelli, S.J., commented on the fit of the VDC goals with the University's mission. "IWT's interdisciplinary approach is a perfect match for SCU's vision of offering an integrated education that prepares ethical engineers who will make our information society a better place for all people." We hope that through our work within the VDC we will continue reaching out to our local community and the world beyond in order to better inform technological development. We also hope to attract and retain more women in engineering by educating the community and the students to the value and social impact of engineering.

Biographical Information

RUTH E. DAVIS holds Bachelors and Masters degrees in Mathematics, and a Ph.D. degree in Information Sciences. She received the ACM Doctoral Forum award for outstanding Ph.D. thesis in Computer Science in 1979. She is currently Professor of Computer Engineering at Santa Clara University, with research centered on formal methods in software engineering and improving the diversity of the engineering workforce.