



# Circular Thinking?

## From Liberal Arts to Engineering to Community Benefit at the Arizona Food Bank

While Gina Godoy, 28, was growing up in her traditional family in Orange County, California, she imagined that after she graduated from high school she would move into one of two traditional jobs for women: teacher or secretary. She decided to teach and enrolled part-time at a local community college while she worked full-time at Canon as a secretary in the company's service division.

After earning her associate's degree in liberal arts, she began volunteering at local schools and realized that teaching was not for her. Happily, through her work at Canon she discovered an interest in learning how machines work, why they sometimes don't work, and how product performance can be improved. She decided to return to school, this time to study engineering at the University of Arizona, in Tucson.

The switch from liberal arts to engineering was an eye-opener, Godoy says. "Everything had come easily in high school and community college," she says, "but in engineering classes I had to develop good study habits and work hard for grades." Still, all did not go smoothly, she says.

"My first male professor in a computer programming class said, 'Women are circular thinkers, that's why you're going around the problem. Men are linear thinkers and can go right to the solution,'" she says. "That made me think I might not be able to understand it, that maybe

I'm not going to be an engineer, and I dropped the class. Then I got angry—How dare he think I can't do that!—but after I got over the anger, it became about doing this for myself because I knew I could. I took a different programming class of equal credit in the department and got an A in it."

Godoy went on to major in industrial engineering and to participate for two years in the Virtual Development Center program at U of A. She is now working for Honeywell and is on target to graduate in December.

"More than anything, the VDC program is empowering. At my first Innovation Workshop, I realized how many things women have invented, how much we contribute to society," she says. "I felt inspired to be creative and dedicated, to be organized and meticulous and carry out a new idea to the finish."

The VDC project that Godoy's team's got to carry out was driven by a need of the Tucson Community Food Bank for an ergonomic assembly-line system for volunteers who pack thousands of boxes of food every month for distribution to needy families. The system that the team researched, designed, and implemented with the input of their client includes components such as ergonomic mats, a lifter, and assembly-line rollers. It was chosen Best Interdisciplinary Project from a field of 20 presented at the university's Senior Design Day.

Dr. Jeff Goldberg is associate professor of systems and industrial engineering in the College of Engineering at U of A. He is also the program director of the Bachelor

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of Arts in Engineering Degree and is on the VDC faculty team. Goldberg describes his role as soliciting local non-profit organizations as VDC partners and brainstorming ideas with VDC faculty teammates Dr. Meredith

Aronson, projects manager of the Interdisciplinary Engineering Design Program and adjunct assistant professor of materials science and engineering, and Marie-Elena Reyes of the Southwest Institute for Research on Women. Goldberg also leads students through a class in requirements design.


“My personal motivation is to get opportunities for students and to get engineering into the community,” Goldberg says. “The student opportunities end up looking much like life in the real working world: Students must manage their project, go out and talk to the client, figure out what to do when things don’t go well. They have to rely on their partners—other students, professors they’re working closely with, people in the community. The expectations are high. But at the end of the day, what I see in the students who participate in the VDC program is a jump in confidence.”

For female engineering students, who can get swallowed up in large class settings of mostly males and are often relegated to note-taking or report-writing roles in group projects, these lessons in

confidence are key. For Godoy, the lessons from the VDC went far beyond confidence.

“The VDC program taught me that engineers must be open-minded. Working with diverse clients and teammates can be frustrating because you can think, ‘How will we ever see eye to eye?’ “ Godoy says. “But I learned that engineers need to listen to their clients and give those needs priority over their own thoughts and opinions. Sometimes decisions must be top-down, but when you can hear the ideas of the workers or clients, you see they are at least as good if not better than yours. If you’re not open to hearing those ideas, you miss opportunities.

“Before my involvement in the VDC, I would’ve called myself an aspiring leader,” she continues. “But I was the project leader on my team for one semester, and I had to be two steps ahead of the team, knowing what was due and coming due, needing to have a plan of action, being organized. It helped teach me how to get people to do things they may not want to do, how to equalize the workload among individuals while keeping the group on track.

“Companies want leaders, so universities are very leadership-focused, but the VDC program is the first I’ve heard of where young women in engineering schools are really getting hands-on training to be leaders in the corporate world,” Godoy says. “I liked that, and the greatest part was seeing what people can do when they work as a team.” 

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# Defining Engineering

~~ENGINEERING: (1) To lay out, construct, or manage as an engineer (2a) To contrive or plan out usually with more or less subtle skill and craft (b) To guide the course of~~

## on your own terms

What makes an engineering student switch from saying, “I cannot wait to be done with my degree” to “I’m going for my Ph.D.”?

One student, Catherine Newman, is a 2003 mechanical engineering graduate of the University of California at Berkeley who has completed a year of graduate school. Newman, who will earn her Ph.D. in mechanical engineering with an emphasis in mechanical design in 2007, says two things helped her commit to a Ph.D. program: defining engineering on her own terms and finding validation from the Anita Borg Institute for Women and Technology’s Virtual Development Center (VDC).

“I constantly have ideas for inventions—usually things that come from needs in my own life—yet many times as an undergraduate I thought, ‘Why am I studying engineering?’” Newman says. “The rewards of becoming a doctor or lawyer are well-defined but not so for engineers ... Nobody ever told me I could tailor

my engineering studies to my dreams and my personality, and it took me years to figure that out.”

The notion of personalizing her engineering studies was sparked by participating during her senior year in the VDC, housed in the School of Engineering at Berkeley. Newman was a research assistant to Dr. Alice Agogino, the Roscoe and Elizabeth

Hughes Professor of Mechanical Engineering, in Agogino’s VDC class for freshmen and sophomores, called “Designing Technology for Girls and Women.”

“They were studying the new-product development process, and I was studying how steps in the process related to gender. The students looked not only at gender but at diversity in general and at what constitutes a true customer population for product design,” Newman says. “The class had a mix of majors—computer science, biology, women’s studies, architecture—with many more people outside of engineering than in. That mix was so inspirational to me! All the students in the class came out believing they could have some impact on the design process, and I took that lesson away myself.”

Jane Margolis, research educationist in the Graduate School of Education and Information Studies at UCLA and co-author of *Unlocking the Clubhouse: Women in Computing*, believes that like many female students, Newman responded to the highly interdisciplinary perspective advanced by the VDC.

“Innovative educators concerned with diversity are emphasizing that engineering and computer science are sciences that require critical thinking skills for solving problems across disciplines—health, architecture, the environment, and so on—and for enhancing investigation in these fields,” Margolis says. “If you want to introduce students to literature, you don’t focus on grammar, you talk about the big ideas and beauty in literature, what it conveys, what it can help you understand about the world. In the same way, engineering and computer science should have

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this interdisciplinary emphasis rather than a narrow focus on physics and programming.”

During the spring of her research assistantship, Catherine Newman attended the annual VDC Conference, observing the Berkeley students’ presentation of their VDC project [briefly describe the project here]. This year she attended the conference again, to present the results from her research in Agogino’s class. The two conference experiences had a great impact on her, she says.

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“Attending the VDC conference is powerful.

Influential people from IBM

and HP and Microsoft were there, and I got a taste of academic camaraderie that I don’t think you can get at your home institution,” Newman says. “Plus, I want my projects to be interesting and meaningful to more than just me; I need a reason to keep going, and I’m motivated by programs and organizations like the VDC and the Anita Borg Institute. They don’t just say, ‘We’re out here supporting you’—they visit each year, ask how our project is going and how we followed up on last year’s project, and bring students together in conference. That third-party interest is energizing.”


Understanding how outside interest motivated her led Newman to think that a Ph.D. could be worth pursuing. “I realized that I wanted to emerge from my education with a body of new work to contribute,” she says, “and that a Ph.D. dissertation would bring in that third-party energy I like.”

The interdisciplinary mix and ‘third-party energy’ that Newman describes is affirmed by Dr. Agogino, who has taught at Berkeley for 20 years.

“After the VDC Innovation Workshop at the beginning of the class, Catherine said to me, ‘If I’d only had this as a freshman, my whole undergraduate experience would’ve been better,’ ” Agogino says. “I knew exactly what she meant. It’s thrilling for me as an instructor, too—I don’t get the chance to teach an interdisciplinary class like ‘Designing Technology for Girls and Women’ very often.”

Presenting their research from the class at the VDC conference and another design conference, and later getting that paper accepted for publication in an international journal, provided more outside recognition of Newman’s work and possibly helped turn her on to the possibility of a Ph.D., Agogino suggests. She also says she understands Newman’s comments about validation and tailoring engineering to fit your dreams and personality.

“Generally speaking, if you go to engineering conferences, it’s all men doing gear design ... it seems narrow and you wonder how it’s benefiting the world,” she says. “At the VDC conference, socially beneficial design is important, and I feel validation myself from the VDC and from other professionals who are involved in it and who value the goals.”

Newman, who is a [professional? amateur?] dancer as well as a Ph.D. student, is working now with a manufacturer of ballet toe-shoes to design a protective-pad insert. For her dissertation, she plans to pursue a topic of abiding interest: redesigning, or using elements of existing designs to create entirely new designs. 

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## A Unique VDC Site and collaboration to “Teach Our Youth Technology” (TOYTech)



TOYTech

The Virtual Development Center (VDC) at Smith College, in Northampton, Massachusetts, was established two years ago in conjunction with the school’s new Picker Engineering Program, the first engineering degree program at a women’s college. The Picker Program aims to link engineering with humanistic concerns while educating the public about what engineers actually do.

Smith’s relationship with the Anita Borg Institute for Women and Technology began serendipitously, before a 2002 meeting in Palo Alto, California between the Director of the Picker Engineering Program, a senior director of corporate and foundation relations at Smith College, and the director of university relations at Hewlett-Packard. An HP executive on loan to the Institute, Nancy Levitt, saw what the Picker philosophy of socially beneficial technology development shared with the Institute. Levitt invited Anita Borg to the meeting, and soon after, Smith became the Institute’s ninth VDC campus. HP supported the new Picker program with a \$250,000 equipment donation.

Smith, however, was an anomaly in terms of the other VDCs, which were on bigger campuses in more established engineering programs. As a result, says Sandra Doucett, Smith’s senior director of corporate and foundation relations, “On the way home, we were brainstorming how

we could structure our VDC, and we came up with the idea for TOYTech.”

In the TOYTech (“Teaching Our Youth Technology”) program, Smith first-year engineering students work in local elementary and middle-school classrooms to develop gender-neutral educational modules and teaching tools that are toylike and fun. The Smith students get hands-on interaction with the community—their “clients”—and the schoolchildren get to meet female role models in a traditionally male-dominated field. “Imagine when the classroom teachers say to their students, ‘Today the engineers are coming to work with us,’ and in walks a group of young women,” Doucett says. “This is probably the first exposure these kids have to people who are going to become professional engineers, and it’s a roomful of women. That’s a powerful message to send.” In the VDC students also create and design new ideas for toys.

Dr. Domenico Grasso has headed the Picker Program since its inception. “We need more women in engineering because we need greater diversity at the design table,” Grasso says. “We think our program is attracting students to engineering with its socially relevant combination of science and humanities. Many students have said the VDC was among the best experiences of their first year of college.”

Smith students attended their first VDC Conference in April 2002 to present their project, a set of 15 toy-based, education modules demonstrating concepts related to propulsion, liquids, pulleys and gears. Former astronaut Dr. Sally Ride, America’s

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first woman in space, keynoted the conference and watched the presentation. Later, Ride contacted Grasso about Smith possibly becoming part of her Sally Ride Science Club for upper elementary and middle school girls interested in science, math, and technology.

The following year, Smith partnered with the Sally Ride Science Club, toy manufacturer Hasbro, and Sigma Xi, the Scientific Research Society, to launch TOYChallenge, an outreach activity to engage middle-school-aged students, especially girls, in science and engineering and to inspire them to pursue careers in those fields. TOYChallenge includes a national competition, which is sponsored by Hasbro

and Sigma Xi. Teams of fifth- through eighth-graders create and design a new toy or game in categories specified by the sponsors. Half the team members must be girls, and each team must have an adult coach.


This past spring, Smith hosted a TOYChallenge regional showcase, with Smith engineering faculty serving as judges alongside Hasbro toy designers. The showcase featured the top 10 teams pre-selected from more than 240 entries, as well as 40 other teams who were encouraged to finalize their toys for presentation at the national TOYChallenge Festival. At the finals in San Diego in July, three teams won a week at Space Camp for each team member; Hasbro action figures created in their likeness and a behind-the-scenes tour of Hasbro; and a VIP tour of NASA's Kennedy Space Center with private question-and-answer session with an astronaut.

Dawn Scaparotti, assistant director of the Picker Engineering Program at Smith, was a judge at the finals.

"Research shows that at a certain age girls tend to lose interest and confidence in the classes critical to future careers in science," Scaparotti says. "At Smith, we believe that if you introduce kids early in life to the creative and collaborative aspects of engineering through a program like TOYChallenge, the fun will carry them through the hard classes later. If the goal is to increase the number of people from underrepresented groups in engineering, you must ensure that people are educated in those fields and introduce them to the fields when they're young."

Scaparotti says that during the national judging, she asked each team what had been the most challenging aspect of building their toy, and the answers surprised her.

"Every single team said that learning how to work in a group and how to compromise were the hardest parts—not learning the math behind the concept or picking what material to use for the toy, but working together," she says. "Participating in these team-based projects exposes and encourages the development of collaborative skills. Both school children and Smith undergraduates benefit from this teamwork. So when the Northampton schoolchildren see Smith students in their classrooms, and the TOYChallenge teams see the judging teams evaluating projects, they see role models working together.

Scaparotti, who takes over direction of the Smith VDC this fall, says her goal for the program is greater collaboration. "While aspects of the VDC encourage women to think critically and creatively, the teamwork encourages and teaches collaboration as well. 

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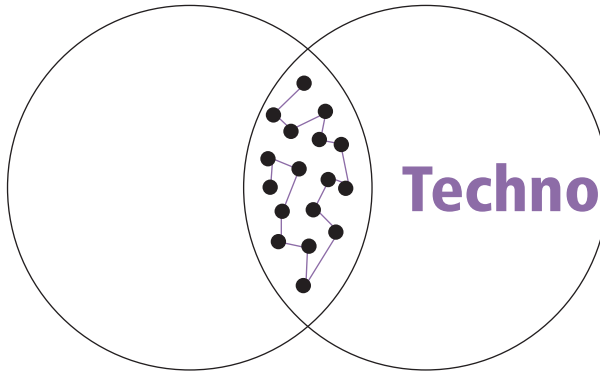
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TWO YEARS OF VDC AT UTEP:

## Technology is for Everyone

The Virtual Development Center (VDC) site at the University of Texas at El Paso (UTEP), now two years old, is directed by a faculty team led by Dr. Patricia Nava, associate professor of electrical and computer engineering who has taught at UTEP for eight years. When she was first approached about launching a VDC site on the UTEP campus, Dr. Nava says she saw how the program could support a special interest of hers: encouraging women in engineering.

“When I was an engineering student, I had many professors who were very resistant to the notion of women in engineering, and they actively discouraged me,” Nava says. “Later, when I became a teaching assistant, I saw so many talented women leave the program because they had been similarly discouraged. These young ladies were making excellent grades and would’ve been wonderful engineers. I believe losing these individuals was a loss to the engineering field, as well as the community.”

Nava saw how the VDC could help keep female engineering students in the pipeline by building camaraderie, skills, and a sense of belonging and by providing a sense of purpose through community involvement. She saw how she could be a role model for VDC students. And she made a strategic choice of a teaching assistant to help run the VDC.

Elvia Martin Del Campo, 26, grew up in Ciudad Juarez, just across the Mexican border from El Paso. For four years

as an undergraduate student, Elvia had to cross the border to UTEP every day. That entailed getting a ride (from her mother or whomever was available) or riding a Mexican bus to the border, crossing on foot, then catching a US bus on the other side. The complicated commute ended at UTEP, only to be repeated going back home. Although time consuming, she felt it was entirely worth the effort.

“When I was about to graduate from high school and said I wanted to go to UTEP to try electrical engineering, everyone asked, ‘Are you crazy?’ They said, ‘Why not go to the University of Juarez, speak your native language, and study communications?’” Martin Del Campo says. But she wanted to push herself, and at UTEP that meant, among other things, memorizing math terminology in English in order to take pre-calculus her first semester.

It also meant smashing stereotypes that some professors held about Latina students in engineering.

“I had doubts about my abilities at first, and I didn’t realize that I could go to a professor’s office for help,” she says. “So with a few other students, mostly female, I finally went to the pre-calculus professor with my questions about lab exercises and homework assignments. He said to me, ‘What are you doing here at UTEP?’ I said, ‘Trying electrical engineering.’ And he said, ‘You’re never going to make it. Engineering and math are not for you. Go back to what you were doing before.’

“I’m the type of person who, if I’m told I cannot achieve something, will try that much harder,” Martin Del Campo says. “That professor gave all of us an F in

“You’re never going to make it. Engineering and math are not for you. Go back to what you were doing before.”

the class, but later I tested out of the class and went directly to calculus, where I got a B and did fine.” She says she believes stereotypes were at work in this encounter, as the group was comprised mostly of girls—girls whose English was not perfect—and they did not look or sound like what this professor thought future engineers should look and sound like.

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In 1999, Martin Del Campo married and moved to El Paso and finished her bachelor’s degree in electrical engineering. Nava’s offer of a teaching assistantship helped cement her decision to pursue a master’s degree in computer engineering, which she will complete in August. Working in the VDC program for the past

two years, she says, has confirmed something she has believed all along: Technology is for everyone.

“The most important point that is made through the VDC is that it’s not only elite people in science and engineering who get to invent things. Everyone has the opportunity to participate in technology,” Martin Del Campo says. “Most people believe that in order to study engineering or science, you have to be a nerd, you have to love math. But when I encourage people to follow their interests in science and technology, I tell them, ‘You don’t have to like math, you just have to understand it. And anyone can understand it.’ ”

Nava and Martin Del Campo teach a two-semester course that requires VDC teams to choose a project, then design and create a prototype. The 2002-2003 team created a “voice-activated spell checking pen”

that allows a user to view the correct spelling of a word spoken into its miniature microphone. The 2003-2004 team researched and developed a fingerprint identification system of blood donors for United Blood Services of El Paso that could be adopted by the entire UBS network across two states. The course also prepares the team for their end-of-year project reporting at the annual VDC Conference.

“The experience that the team members get by developing their projects is unlike any other experience in undergraduate engineering classes,” Martin Del Campo says. “And the exposure they get at the conference is wonderful. It helps them learn to value what they know and what they’re doing.”

To learn more about the VDC Site at UTEP go to <http://www.ece.utep.edu/research/webvdc>.

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