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• • • Bridging the Gender Divide

BY MARGUERITE RIGOGLIOSO

School of Education Researchers Help Girls Become Tech Savvy

When Stephanie was 11, she stumbled into computer programming the way many girls do—through her friends. They showed her how to design web pages using HTML, and before long she decided it wouldn't be a bad idea to take the programming, web design and even industrial technology courses predominantly attended by boys at her middle school. By the end of seventh grade, the young Silicon Valley teen knew that she wanted a career in computer technology. By eighth grade she was using on-line learning communities to develop her skills and was invited to design the website for her father's start-up company.

Stephanie's story illustrates how early experiences can make all the difference in helping girls cultivate the prowess and confidence they need to be successful in computer science into adulthood. But encouraging girls to become players in the influential world of technology is about more than just offering courses in school, says School of Education Associate Professor

Brigid Barron. It's also about providing resources and encouragement outside of school in the form of computer clubs, after-school programs, and informal networks where children can have access to the ideas, tools, mentoring, and time they need to create real hands-on projects.

Barron, the beneficiary of a five-year National Science Foundation (NSF)-sponsored CAREER award and co-leader of the NSF-funded Learning in Informal and Formal Environments Center, has been researching the "gender divide" in the high-tech world for the past three years in collaboration with her research group,

YouthLAB (Youth Learning Across Boundaries). She and School of Education students **Ugochi Acholonu, Karin Chapin, Rachel Fithian, Sarah**

continued on page 2

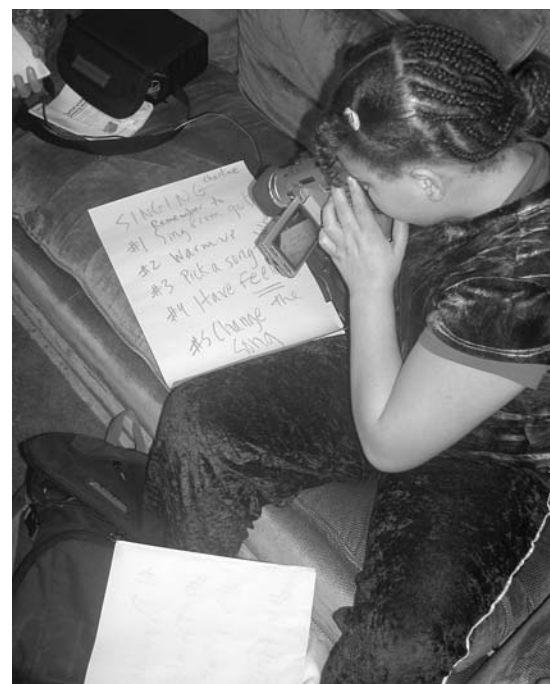


PHOTO: A middle school student films materials for a web site development project at a community-based after-school program in Silicon Valley. Associate Professor **Brigid Barron** is researching how the "gender divide" may be bridged through out-of-school learning activities.



continued from page 1

Lewis, Emma Mercier, Kathleen O'Connor, Colin Schatz, Sarah Walter, and Susie Wise, and alumna Caitlin Kennedy Martin (MA '99) have been conducting research that demonstrates how the "gender divide" may be bridged in the area of high tech, and suggests how various aspects of a young person's "learning ecology"—the total environment of home, school, peers, and virtual spaces that provide opportunities for learning—may be enhanced and lead to the development of new interests.

Tackling the "Incredible Shrinking Pipeline"

The field in which Barron has focused her studies, computer science education, currently suffers from the phenomenon commonly known as the

the doctoral graduates, and 10 percent of professors in the field. That also means fewer female hardware and software programmers, designers, and engineers. Why don't more women go further? According to Barron, the reasons are complicated.

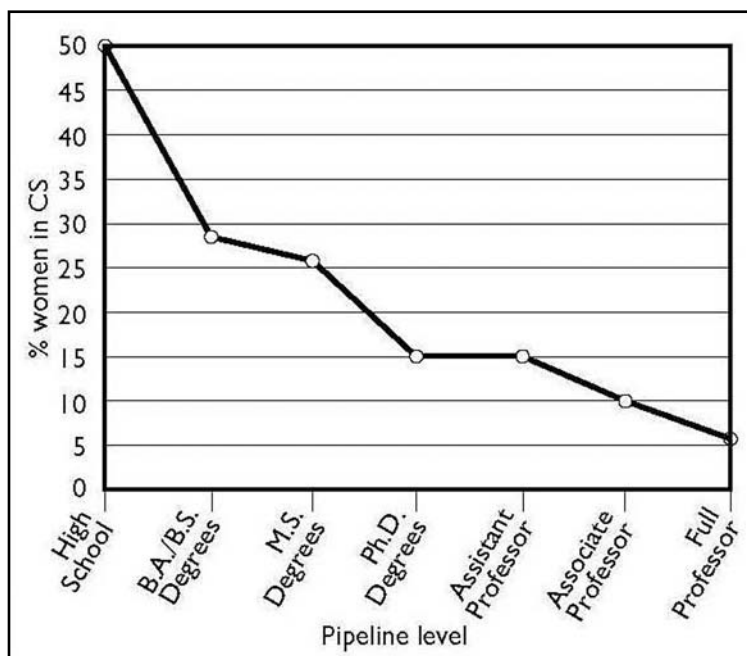
Through a series of surveys and interviews of students and their parents, Barron has found that one factor possibly discouraging junior and senior high school girls is the prevailing stereotype of the computer expert as an anti-social or nerdy male. Even more significant, however, is the fact that parents treat male and female children differently when it comes to exposing them to computer technology and instruction. "Fathers seem to involve sons more than daughters in design and technology from an early age," Barron observes. "More boys are given unlimited access to

than the girls report themselves. With boys at an advantage early on, they are much more confident than their female counterparts about taking computer courses and pursuing technology-related careers once they get to college.

In fact, Barron's own data reveal that just as many pre-college girls as boys are broadly involved in computer-related activity. "Some girls are highly engaged in computer-related activities," she stresses. "What we need to understand is *how* girls become engaged and excited." Therefore, the task of educators, she says, is to provide early experiences that will be interesting to both genders—and to recognize that such interventions can take place in a multiplicity of fertile settings.

What's at stake is not just equity for individuals, but also the health of the technological and human design fields—if not the health and well-being of humans more broadly. "Technology is changing our lives, the way the disciplines operate, and the way innovation happens in every single field," she explains. "You want girls and other underrepresented groups to understand the computer as a tool that can address all kinds of problems so they can bring new ideas to the table. And you want a broader group of people designing tools and hardware so that a wider range of values, needs, and concerns can be incorporated into computer solutions. You also want people from different perspectives to be able to critique technology and influence its designs."

Computer games and applications often reflect the interests of their creators, she elaborates. Most of today's computer games, for example, mirror the personal penchants of their designers—young males in their twenties. In contrast, Barron describes Maria, a sixth grade student and recent immigrant



"incredible shrinking pipeline." "You see women participating in decreasing numbers as they proceed up the academic ladder," she explains. Specifically, women make up only 28 percent of college majors in computer and information science, 15 percent of

machines, learning opportunities, and books, while girls are less likely even to be given a computer of their own."

Other research by University of Michigan researchers has shown this may be because parents perceive their daughters to be less interested in computers

IMAGE: The computer science field has long suffered from the shrinking pipeline problem, as shown in Tracy Camp's 1997 *Communications of the ACM* article, "The Incredible Shrinking Pipeline." Although females comprise 50% of high school computer science (CS) classes, the percentages of women who attain CS degrees and become CS faculty members plummet through the academic ranks.

continued on page 3

from Mexico she interviewed. “When I asked her why she was so interested in learning to design web sites, she spoke of the need to have sites that would help newcomers to the country learn to communicate in English and help English-speaking teachers understand words in Spanish,” says Barron.

online club or community. “All of these contribute to what we call the ‘learning ecology’ of the student,” says Barron.

“Game playing can be a significant spark, especially for boys, to learn programming themselves,” she says. Since girls are less frequently encouraged to pursue computer-related activities at home, connections with peers

enacting active interventions. In several cases, this has involved establishing computer courses for young adolescents—and observing the ripples. Her team’s six-year longitudinal project conducted in Bermuda in collaboration with Professor Eric Roberts of the Stanford Computer Science Department, for example, proved enormously



PHOTO: YouthLAB is studying how interest and technological fluency develops among youth. Researchers include (L to R) School of Education students **Rachel Fithian, Emma Mercier, Maryanna Rogers, Ugochi Acholonu**, Associate Professor **Brigid Barron**, **Sarah Walter**, alumna **Caitlin Kennedy Martin**, and student **Sarah Lewis** (not pictured: students Karin Chapin, Kathleen O’Connor, Colin Schatz, and Susie Wise).

Moving Girls from Googling to Programming and Design

So how do you get more girls to move from email, chat groups, and Googling activity to the hard-core work of program coding, designing robots, working out 3-D models with computer-assisted design, or creating simulations and models? “There are many pathways by which a student can develop an interest in design-related activities,” Barron says.

Through surveys and case studies conducted in Silicon Valley and the country of Bermuda over the past six years, Barron and her colleagues have found that the entry point for student interest can be a personal passion for computer games or art, a child-parent activity, a school course, a summer camp, an after-school program, a peer network, or an

and informal networks are what tend to draw them to a deeper engagement with technological activities. “One girl I interviewed developed an interest in coding through an online math club,” she says. “She noticed people were chatting about their favorite programming languages and says she got ‘jealous’ because she had no idea what they were talking about.” Soon after, she found a free online tutorial on the programming language C++, took a class in her middle school, and later sought out additional opportunities to code using a 3-D graphic arts program suggested by members of an online math community.

Providing students with opportunities for teaching others is another way to help them develop technology competency. “When young people teach others, they’re more likely to see themselves as competent,” Barron says. “It boosts confidence.”

Barron’s group is not just collecting data, but is also

influential in the learning and career trajectories of a number of young Bermudians, who are now entering their twenties.

Among them is Monica, who took advantage of all the computer electives Barron’s team helped implement, often staying after class to learn new concepts and applications from her teacher. The young teen leveraged an assignment in a work experience class to set up an opportunity to “shadow” an independent computer consultant; from there she used her connections to secure a technology internship and eventually a full-time job. Monica now plans to pursue higher education in software writing and game design. “This is a girl who probably would not have followed a high-tech path had it not been for a series of courses offered at school with the first course required by all incoming students,” Barron says.

In other studies, Barron’s group focused outside the

continued on page 4

continued from page 3

traditional classroom, teaching young people game design during summer school and contributing to a youth community-based clubhouse with high-end computing tools and software, but no formal instruction, to see how students would take charge of their own learning. "Since children and teens learn everywhere, it's important to offer activities, people, and resources in

Expanding the Future of Learning

Barron recently received a three-year grant from the MacArthur Foundation to study the enrichment of "learning ecologies" for inner-city children participating in after-school technology programs and clubs developed by Nichole Pinkard of the University of Chicago's Center for Urban School

technology alone. "We're hoping to show general processes that lead to learning across settings, not only in school," she says. "This area has not been studied very much, and yet the way we learn outside the classroom is highly important because it's where we spend most of our time."

For now, her research on the development of technological fluency is uncovering valuable information about how young people can better cultivate their own inner techie. She and her colleagues at the YouthLAB are not only discovering where girls, boys, and minority students currently fall on the spectrum of technology fluency, but are also enhancing the future for such youth through innovative, interactive design experiments. "Our field is increasingly aware that out-of-school activities can offer powerful developmental opportunities that engage young people in the arts, sciences, and community service. Our goal for this research is to define design principles for creating engaging learning environments inside and outside of school that we believe can be self-sustaining and synergistic. It's very rewarding to be a part of research that's making a difference," says Barron.

IMAGE: Karin Chapin, a YouthLAB researcher and doctoral student in the Learning Sciences, Technology and Design program, teaches game design to two middle school students attending a summer school in Silicon Valley. This was the first time either of the two girls had done any type of programming.



multiple settings," she says. "For non-school environments, the challenge is to provide a balance between structure and freedom so that students have the learning opportunities that get them started and the time and autonomy to create real projects." One technique she has found that spurs learning in extracurricular spaces is presenting opportunities for children to gain public recognition for their work through contests and special events.

Improvement. Sites in California will also be identified for comparison. Barron and a research team in Chicago headed by University of Chicago Education Professor Kimberley Gomez will follow the students to understand how their developing technological fluency is expressed and developed in school, at home, and in the broader community.

Barron's work also has implications for the field of education that go beyond helping young people develop sophistication in the area of