The CalWomenTech Project: Using Surveys to Inform Retention Strategies of Female Technology Students

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Abstract
What retention and support strategies do women students in STEM courses find most helpful? In 2009, the Institute for Women in Trades, Technology and Science (IWITTS) conducted a survey of female students in technology courses in which they are underrepresented across seven of the eight community colleges participating in the CalWomenTech Project and 60 female students responded. These surveys collected data on both current recruitment and retention strategies, focusing mainly on retention and what female students would like to see more of in the STEM classroom. Selected results from the newly compiled surveys are published here for the first time. Also discussed is how the survey results have been used to evaluate and inform support strategies employed by colleges to retain women in technology programs.

The CalWomenTech Project was highlighted by the National Science Foundation (NSF) following an expert panel review at the three year mark in December 2008 for demonstrating significant achievement and program effectiveness to the Committee for Government Performance and Results Act (GPRA) Performance Assessment. Retention strategies implemented by the eight community colleges participating in the CalWomenTech Project have led to a significant net increase in the completion rates of not only females, but also males, in several of the colleges. Both colleges that saw the largest increases in female completion rates, from 81% to 100% in 15 months and from 57% to 100% in 9 months, also saw a 20% increase in male retention.

CalWomenTech Project Results and Strategies
Project outcomes (increases in female completion numbers and enrollment) part-way through the five-year, NSF-funded CalWomenTech Project show that community colleges that proactively work to recruit and retain women into technology programs can have a significant increase in the percentage of female students enrolled and retained in as little as a year's time.

In the first year, the two sites participating in the CalWomenTech Project's first research group (a cohort of four colleges) that implemented project recruitment strategies within the recommended timelines had an increase in women in their targeted programs of 10% to 15%. After two and a half years of participation for the first cohort and one and a half to two years for the second cohort, six of the eight colleges have had increases in female enrollment with two colleges having significant increases of female enrollment. City College of San Francisco's Computer Networking and Information Technology (CNIT) program has gone from 18% to 30% female students and San Diego Mesa College's GIS program has gone from 35% to 50% female (data from spring 2009).

The retention strategies implemented by CalWomenTech colleges have also led to a significant net increase in the completion rates of not only females, but also males, in several of the eight community college technology programs involved in the CalWomenTech Project, and it is the retention of female students that will be the focus of this paper. Aggregate retention rates have improved and as of the fall 2008 term the female retention rates have surpassed the males 81% to 79%. Retention rates for female (and male) students were calculated by dividing the average number of females completing a course by the average number of females enrolled in the course. All retention strategies were implemented in the classroom right away and did not require significant lead time.

Two CalWomenTech colleges that have seen some of the largest increases in female completion rates, from 81% to 100% in 15 months (San Diego Mesa College) and from 57% to 100% in 9 months (Evergreen Valley College), also saw a 20% increase in male retention. Las Positas College went from a baseline retention rate for female students of 74% to an average female completion rate of 98% post-CalWomenTech Project (an increase of 24%), while the male completion rate for the college went from a baseline of 88% to an aggregate of 96% (an increase of 8%). City College of San Francisco's ICT program saw a significant improvement to retention after repeated focus on this with both full-time and adjunct faculty. Female baseline completion rates increased from 64% in 2006/2007 to 90% in spring 2009. CCSF's male retention rates also increased from 72% to 88%.

The retention strategies implemented in colleges with the biggest leaps in retention included:

- On campus faculty trainings focusing on teaching to female learning styles, providing building block skills, and integrating female students into the classroom.
- Revising the program's curriculum to be more female friendly. Some changes included using more contextual examples that appeal to women, more collaborative projects, ensuring female students spent equal time using the equipment in the labs, and providing additional open lab time outside of the classroom.

The improved retention of both women and men in the classroom across the community college sites has been a major highlight of the CalWomenTech Project, which IWITTS attributes to classroom strategies employed by instructors that have positively impacted female and male students alike. The evidence of the improved retention strategies and the cause for this is taken from the following sources: 1) college completion data available through spring 2009 across colleges; 2) the results of a survey of female students in targeted programs across seven of the eight colleges (n=60) asking them which retention strategies they have experienced and asking them to rate them; 3) the retention strategic plans of the colleges; and 4) retention training provided to the college sites.

The results of the "Survey of Female Technology Course Students" administered by the Project's external evaluators in spring 2009 are invaluable in determining which classroom strategies the women are currently experiencing, those they find most helpful, and those they would most like to experience going forward. Fifty percent or more of the survey respondents reported exposure to 12 of the 20 classroom retention strategies listed in the survey. It appears that instructors in the targeted classes have implemented over half of the 20 recommended strategies in their classrooms at this point in the Project, and after seeing the survey results many instructors have committed to making those strategies female students would most like to experience a part of their regular teaching strategies. As part of the monthly phone conference calls IWITTS holds with each of the CalWomenTech colleges, some instructors and administrators on each college's CalWomenTech Leadership Team—teams made up of eight to ten technology faculty members, counselors, and administrators—were exposed to the results of the "Survey of Female Technology Course Students" from their college. The one college that did not distribute the surveys to their female students was still exposed to the compiled survey results from all the colleges during a retention training and has committed to using the survey in spring 2010. From late spring 2009 to fall 2009, the survey results were used by the colleges to evaluate and inform which existing and new retention strategies would be employed going forward.

The IWITTS Project model is to provide CalWomenTech Leadership Teams with training on recruitment and retention, exposing them to a wide menu of strategies. The CalWomenTech teams then select which strategies they want to implement in the coming year. Up to spring 2009, all of the colleges chose to focus on classroom strategies to increase female retention instead of implementing support strategies—such as creating a Women in Technology club or providing mentoring. All eight colleges received an initial training by IWITTS on retention and almost all the colleges had at least one follow up retention training with faculty. The CalWomenTech Project was successful in getting both permanent faculty and most adjuncts to attend by paying for a working lunch and by paying adjuncts their customary hourly rate.

CalWomenTech Project Model

The intent of this NSF initiative is to broaden the participation of girls and women in Science, Technology, Engineering, and Math (STEM) education. In particular, the extension services are to "provide consulting services to educators and institutions, to enable them to adopt and embed proven gender-inclusive policies and practices in pedagogy, the design of curriculum materials, student support programs, educator, and faculty development (NSF 2004, 4)." The percentage of women in STEM education and related occupations is very small (NSF 2008). The absence of women from STEM education and careers affects more than the women; it is a missed opportunity for those fields. When women are not represented in STEM careers the perspective of a large percentage of the population is left out of the design process and this can result in problems with products and services that have unfortunate results (Margolis and Fisher 2002).

The first goal of the CalWomenTech Project is to increase the number of women enrolled and retained in STEM education in the eight selected CalWomenTech community colleges. The second goal is to institutionalize gender equity strategies in each participating college to make sure that the successful recruitment and retention strategies are used beyond the life of the project. The third goal is to illustrate to the California and national community college system that STEM gender equity strategies increase recruitment and retention of women in STEM courses, through both state and national dissemination of the project.

Anticipated outcomes include:

- Increased enrollment of women by an average of 10% to 15% in targeted STEM classes.
- A retention rate for females that is comparable to males in targeted classes.
- CalWomenTech recruitment and retention strategies incorporated directly into the college's regular practices.
- Dissemination of successful CalWomenTech strategies statewide and nationally via the mainstream education system.

- Increased focus of the California community college system on recruitment and retention of females into STEM.

Significantly increasing the retention rates of male students alongside that of female students was not one of the original anticipated outcomes of the Project; however, this development indicates that the CalWomenTech Project Model and many of the CalWomenTech retention strategies that female students find helpful can also be used to retain male students.

The CalWomenTech Project embodies two core beliefs of the IWITTS organization. The first is that the vast majority of educators are eager to recruit and retain women in STEM; however, they don't know how and lack the time and resources to figure it out on their own. IWITTS believes that the more off-the-shelf, turnkey solutions can be provided, the faster the colleges will implement the program elements that CalWomenTech Project results show will result in successful outcomes. It is for this reason that each of the eight community college sites in the Project were provided with as many off-the-shelf tools as possible. For example, the CalWomenTech Learning Library's mission is to provide building block technology skills to female (and male) students who may come with less experience than their classmates. One example of a library holding is a CD and workbook on spatial reasoning that NSF research has shown improves retention of women in engineering by teaching them this skill (Sorby 2001). The second core belief is that change will happen faster and be institutionalized if it is supported from the top down. To this end, IWITTS's focus is not just on STEM instructors, but also includes the key leaders, staff and administrators of the colleges in a variety of functions.

CalWomenTech Project Evaluation Methodology
The CalWomenTech Project developed an evaluation methodology and plan in collaboration with the Project's external evaluator, Evaluation & Research Associates, to measure both quantitative and qualitative outcomes. As Vicky Ragan, Director of Evaluation & Research Associates (ERA), wrote in the evaluation section of the Project's annual report to NSF for year three, "To date the evaluation team has administered surveys, conducted key informant interviews, observed a Project Partner Meeting, reviewed documents, and collected enrollment and retention data for each targeted technology course (Ragan 2008)."

In their Project applications the participating colleges provided baseline enrollment and completion data for the targeted technology courses for both women and men. ERA collects enrollment and completion data for the targeted courses each quarter for analysis. Each college provides the total number of students enrolled, females enrolled, males enrolled, females completing, and males completing. ERA uses the raw data from the colleges to calculate the percentage of females in course, percentage of females completing and males completing, retention rate difference between females and males, and the increase from baseline in percent female enrollment and retention (Ragan 2008).

The goals behind collecting and analyzing this data include measuring the Project's progress towards meeting the stated outcomes of the CalWomenTech Project, to provide the colleges with "real time" data on their outcomes, and to inform Project strategies.

CalWomenTech Community College Site Descriptions
Eight community colleges were brought into the project in two groups of four, with the first cohort of colleges coming on board in June 2006 and the second in January 2008. The first four CalWomenTech colleges and their targeted programs brought on board in June 2006 include:

- City College of San Francisco Computer Networking and Information Technology Program, with a focus on the new Digital Home Integration Technology Certification
- San Diego Mesa College's Geographic Information Systems Program
- Cañada College's new 3-D Animation and Video Game Art Program
- El Camino College's Air Conditioning and Refrigeration Program

The second cohort of colleges and programs, brought on board in January 2008 include:

- Evergreen Valley College's new Hybrid-Alternative Fuel Program
- Irvine Valley College's Electronic Technology Program
- Las Positas College's Welding and Automotive Technology Programs
- San Jose City College's Facilities Maintenance Technology Program

Survey of Female Technology Course Students Demographics
The CalWomenTech college completion data provided by the external evaluators and the results of the "Survey of Female Technology Course Students" administered to women in the targeted classes across seven of the eight colleges provides evidence that classroom strategies (e.g. learning style, appealing to female interests, a positive classroom environment, building block skills, etc.) appear to be succeeding in improving retention rates of female (and male) students. To IWITTS' knowledge, this is the first time that female students in technology courses have been surveyed on what retention strategies they have experienced in their courses and which ones they feel are most helpful. Sixty female students responded to the survey out of the 121 female students enrolled in the targeted courses at the seven colleges that distributed the survey. The CalWomenTech Project has no way of determining the unique number of female students enrolled in the targeted courses as some women take multiple courses and the college data collection systems are not set up to take this into account. All female students were instructed to take the survey only once.

The women who took the female technology survey are a racially diverse group, reflective of California's community college population with 25% of the students identifying as Hispanic, 14% as Asian, and 17% as multi-racial (see Figure 1, Question 12). These female students are also evenly spread across a broad age range with 35% of students under the age of 25 and 48% over the age of 31 as seen in Figure 1, Question 11. Another important result seen in the demographic section of the survey is that almost 80% of the women are working and taking technology courses at the same time with 32% working more than 40 hours a week (see Figure 1, Question 13). Faculty and administrators at the eight CalWomenTech colleges have found it helpful to find out more about the backgrounds of their female students. It was unexpected that a third of the women worked more than 40 hours a week and only 15% of the female students were single mothers (in total 36% of the women had children).

After seeing these results, many of the leadership teams were able to make better informed decisions about what retention and support strategies would be most helpful to their female students. For example, one of the colleges that put on a small get-together for female students in their technology program—which none of the women were able to attend—realized after seeing the survey results that their female students did not have time to attend face-to-face events and support groups outside of class. This same college took this new information into account and as one of their retention strategies invited a female role model to speak during the evening course that had the most female students enrolled. Several of the colleges have come to this same conclusion and decided that if they are going to hold special events with female role models they will attempt to do so during class time or remotely using new Web 2.0 technologies to try and accommodate their students' busy schedules.

Figure 1. An Excerpt from the Demographic Section of the Survey
Question 11) What is your age?

Choice	Number of Respondents	Percentage of Respondents
18-21 years old	13	21.7%
22-25 years old	8	13.3%
26-30 years old	10	16.7%
31-40 years old	12	20.0%
41-50 years old	11	18.3%
51+ years old	6	10.0%

Question 12) What is your ethnicity?

Choice	Number of Respondents	Percentage of Respondents
Caucasian/European American	19	32.2%
Latina/Hispanic	15	25.4%
Multi-racial	10	16.9%
Asian and/or Pacific American	8	13.6%
Black/African-American	3	5.1%
American Indian/Alaskan Native	2	3.4%
Other	2	3.4%

Not Answered = 1

Question 13) Select the answer that best describes your current work situation.

Choice	Number of Respondents	Percentage of Respondents
40+ hours per week	19	31.7%
31-40 hours per week	8	13.3%
21-30 hours per week	10	16.7%
11-20 hours per week	8	13.3%
Work less than 10 hours per week	2	3.3%
Not working	12	20.0%

Not Answered = 1

Successful Classroom Strategies from the Survey of Female Technology Course Students

As is apparent from the use that the CalWomenTech Leadership Teams made of the results from the demographic section of the "Survey of Female Technology Course Students," one of the key outcomes of conducting this survey has been that the leadership teams at several colleges have taken the results from the female student surveys and incorporated them into their strategic plans (colleges were first provided with the female survey data filtered for their college before being exposed to the compiled results at an annual Project Partner Meeting). Instructors that went over the results during a monthly conference call or site visit and strategic planning session came up with creative ways to start incorporating the strategies female students requested and found most helpful in their classroom. One instructor from San Diego Mesa College came up with a plan to start assigning leadership roles in group projects randomly by drawing straws to avoid men taking the leadership role in groups more often than women (Rosser 1998), after she saw how many women wanted to try out a leadership role in class or found it helpful. Important to note is that the factual data from the female student survey results did not always match the preconceived ideas of the leadership teams when it came to what they considered the most important strategies and in some cases the results caused the team to go in a different direction with their college's strategic plan after seeing what the female students really found most helpful.

One good example of the female survey informing a college's strategic retention plan comes from El Camino College. El Camino's Leadership Team learned during a retention training how important providing more hands-on experience through strategies such as extra open lab time can be when it comes to building the confidence and improving the performance of female technology students (Elissa 2002), but it was only when they saw how many female students would like to experience more of it (43% of the female student survey respondents at El Camino College thought extra lab time would be helpful) that they decided to create an official retention strategy based on open lab time. Two of the technology instructors on the CalWomenTech Leadership Team opened their lab courses to students from other classes so that students could spend extra time in the lab as needed, and the dean sent out an email letting other instructors know that the open lab time was available to their students. Adding flexibility to the lab times also allowed students who had their schedules change due to work or family obligations, the ability to easily get time in the lab. So far the instructors have reported that both female and male students have regularly utilized the open lab policy.

What follows in Figure 2 is the "Retention Activity/Strategy" portion only of the female survey (aggregate across seven of eight colleges as one college did not participate).

Figure 2. Retention Activity/ Strategy:

Question 1) Please indicate the level of helpfulness the following activities or strategies have had on your decision to remain in your courses or program. If you have not experienced the choice, please indicate whether you are interested in experiencing the activity or strategy in the future, by selecting either "Have not experienced, and I am not interested" or "Have not experienced, but I am interested." Otherwise, indicate how helpful the activity or strategy was.

Note: Activities and strategies are ordered by frequency of "Helpful" and "Very Helpful" responses. Items total 100 percent within "Have Experienced" and 100 percent within "Have Not Experienced."

Retention Activity/Strategy	Have Experienced			Have Not Experienced		
	Rated Helpful or Very Helpful	Rated Not helpful	Count	Interested	Not Interested	Count
Learned basic skills needed for the course during the first few weeks of a course	100.0%	0.0%	49	50.0%	50.0%	6
Instructor demonstrated or modeled before we did lab activities	98.1%	1.9%	52	66.7%	33.3%	3
Was taught modules or small sections of instruction focused on one aspect of a course	97.4%	2.6%	39	53.3%	46.7%	15
Used software to help me with problem-solving	97.0%	3.0%	33	54.5%	45.5%	22
Helped with tool identification and use	96.9%	3.1%	32	60.0%	40.0%	20
Participated equally with males during hands-on activities	95.7%	4.3%	47	44.4%	55.6%	9
Taught the process of problem-solving	93.8%	6.3%	32	56.3%	43.8%	16
Personally received encouragement	93.2%	6.8%	44	54.5%	45.5%	11
Female role models (examples) used in my courses	92.6%	7.4%	27	62.1%	37.9%	29
The "big idea" or theory was given before starting to learn specific concepts	91.5%	8.5%	47	100.0%	0.0%	8
Took an extra course(s) that helped build my skills needed for the course or program	89.3%	10.7%	28	66.7%	33.3%	27
Worked in small groups	87.8%	12.2%	41	86.7%	13.3%	15
Provided with lab time with female staff or extra lab time	83.3%	16.7%	24	54.8%	45.2%	31

Retention Activity/Strategy	Have Experienced			Have Not Experienced		
	Rated Helpful or Very Helpful	Rated Not helpful	Count	Interested	Not Interested	Count
Had a mentor (virtual or in-person)	83.3%	16.7%	30	64.0%	36.0%	25
Partnered with other females in courses	77.8%	22.2%	27	51.7%	48.3%	29
Participated in exercises that reward guessing and intuition	76.7%	23.3%	30	43.5%	56.5%	23
Received tutoring or extra help with math used in the course or program	66.7%	33.3%	15	43.9%	56.1%	41
Put into a leadership position (in a small group or large group)	66.7%	33.3%	18	60.5%	39.5%	38
Other strategy, please specify below.	66.7%	33.3%	3	41.7%	58.3%	12
Used software to help me with math used in the course or program	62.5%	37.5%	16	35.9%	64.1%	39
Subscribed to an email discussion group related to women in technology	46.2%	53.8%	13	63.6%	36.4%	44

Some general observations about the female survey follow:

- 50% or more of the respondents reported exposure to 12 out of the 20 retention strategies.
- Of those females who experienced the strategies, 19 out of the 20 strategies were rated as helpful or very helpful by at least 63% of the female students. Half of the strategies were rated helpful or very helpful by 90 to 100% of the students.
- Many of the students who did not experience the strategies wanted to do so. Of those strategies the female students did not experience, the top three strategies they most wanted to experience included learning the "big idea" or theory before specific concepts (100%), working in small groups (87%) and taking an extra course to build skills for the program (67%). The top two strategies that the largest n of female students had not experienced—and most wanted to experience—included being put in a leadership position (73% of women had not experienced this strategy and 61% of those 38 wanted to) and subscribing to an email discussion group related to women in technology (63% of women had not experienced and 64% of those 44 wanted to).
- Overall, most of the female student respondents had experienced many of the instructor classroom strategies and found them helpful and those that hadn't experienced them wanted to. This indicates that these instructor classroom strategies for retention are welcomed by the women that they are intended to impact.

Figure 3. Excerpts on Classroom Environment from the Retention Section of the Survey
Question 3) Overall, how would you describe classroom environment in your technology course(s)?

Choice	Number of Respondents	% of Respondents
Very positive	43	72.9%
Slightly positive	8	13.6%
Neutral	8	13.6%
Slightly negative	0	0.0%
Very negative	0	0.0%

Not answered =1

Question 4) Have you ever had a negative experience in a technology course?

Choice	Number of Respondents	Percentage of Respondents
Yes	13	22.4%
No	45	77.6%

Not answered = 2

The survey indicates that overall females feel that their technology classrooms provide a positive classroom environment—73% find it to be very positive and none rated the classroom environment as negative; however 22% had, had some kind of negative experience in a course that they did not extrapolate to their experience as a whole. Three students did report a gender issue: 1) "My teacher called me gal." 2) "One of the guys asked me what was I doing in a [course type] class because I don't know to [skill] at all." 3) "Verbally harassed by other male classmates while attending [course and college]." However, one hundred percent of the female student respondents would recommend another female enroll in their technology program.

When the Project's external evaluator did a cross tabulation between those "female students that had a negative experience" with those that had ever dropped out of a technology course they discovered that of those (22%) who reported a negative experience, 69% dropped out compared to the dropout rate of 6.7% among the population of respondents who did not report a negative experience. The fact that 69% of the female students that dropped a technology course had, had a negative experience at some point may indicate how important a positive classroom environment is when it comes to retaining female students (Bennett 1996).

Conclusion

The CalWomenTech Project, in a relatively short period of time—two and a half years for cohort one and one and a half to two year for cohort two—has assisted community colleges in increasing the number of women in STEM programs in which they are underrepresented and in retaining them. The "Survey of Female Technology Course Students" on what strategies have proven most effective and helpful has been an invaluable part of this process. To the Project's knowledge, this type of research on what community college female technology students need in retention has not been conducted before and provides a unique source of strategies to the wider educational and gender equity community. The CalWomenTech Project intends to redistribute the survey to the female students in the targeted technology courses at all eight CalWomenTech colleges again in spring 2010.

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