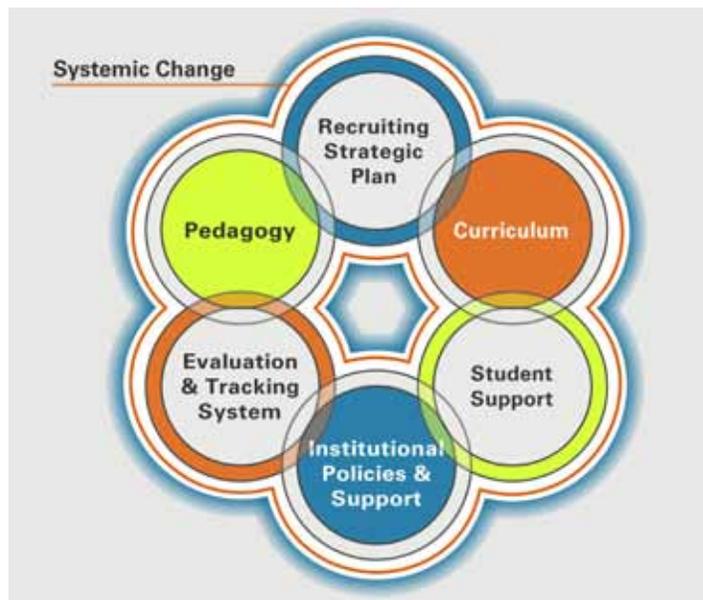


National Center for Women & Information Technology

PROMISING PRACTICES

How Can You Re-Engineer Your Undergraduate Program to Increase Women's Representation in Computing?

No simple or single explanation accounts for the gender imbalance in computing. No admission requirement forbids women's entry. No instructional practice or content is beyond women's ability to master. No female shortcoming requires compensation. No formal policies of exclusion exist. Instead, the gender imbalance results from a complex process of factors in which our normal educational system intersects with socialization and stereotypes about gender and technology to steer women away from computing.



Changing a single element is seldom enough to turn the tide of the undergraduate computing program if other elements in the system continue to inhibit women's full participation. Departments can change the gender balance of their student body through deliberate effort directed at the local system that creates and maintains gender imbalance. That system has several major components, each of which can promote or inhibit diversity either independently or combined with others. When we change parts of the system, mutually-dependent components can reinforce and perpetuate the results. When we ignore the system, our efforts can be neutralized as other components maintain the status quo. Undergraduate departments can take small steps to effect change in the parts of the system their students experience. The effects of systemic change are more widespread and sustainable than the effects of individual changes by a few students or faculty.

Change is never easy. According to Ely, several conditions increase the chances that an organizational innovation will be adopted:

- *Dissatisfaction with the status quo.* Are your faculty members satisfied with the number and quality of students in your degree program? If not, try pointing out the largely untapped but highly able talent pool of women. Are they aware of the gender imbalance and trends in your program and how they compare with other institutions?
- *Feelings of competence to make the change.* Are your faculty members aware that male mentors can be particularly beneficial for women? Have they ever witnessed collaborative or cooperative learning, such as pair programming?
- *Resources, including time, for making the change.* Does your department provide temporary reduction in course load or summer support for course re-design?
- *Rewards or incentives for making the change.* Do annual reviews consider diversity activities such as outreach or mentoring as service to the department and the discipline? Do conference and journal papers disseminating your successful practices contribute to your publication count?
- *Participation in decision-making about the change.* Are faculty members engaged in broad-based or department-wide actions that promote diversity?
- *Visible support from institutional leaders.* Are your chair and dean publicly endorsing your efforts and applauding your successes? Do they expect reports on the outcomes of your efforts and track your progress?
- *Committed change agents.* Are faculty members piloting practices to demonstrate that diversity is achievable? Are they communicating their successes to motivate and facilitate adoption by others?

RESOURCES

Ely, D. (1990). Conditions that facilitate the implementation of educational technology innovations. *Journal of Research on Computing in Education*, 23(2), 298-305.
"What is systemic change?" National School Board Association information and tools for systemic change in education: <http://www.nsba.org/sbot/toolkit/edsctls.html>
Kuh, G. D., Nelson Laird, T. F., & Umbach, P. D. (2004). Aligning faculty and student behavior: Realizing the promise of greater expectations. *Liberal Education*: [http://cpr.iub.edu/uploads/Kuh,%20Nelson%20Laird,%20Umbach%20\(2004\)%20Aligning%20Faculty%20and%20Student%20Behavior.pdf](http://cpr.iub.edu/uploads/Kuh,%20Nelson%20Laird,%20Umbach%20(2004)%20Aligning%20Faculty%20and%20Student%20Behavior.pdf)

NCWIT offers practices for increasing and benefiting from gender diversity in IT at the K-12, undergraduate, graduate, and career levels.

Visit www.ncwit.org/practices to find out more.

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PROMISING PRACTICES

Small Steps Toward Systemic Change (Case Study 1)

Examples of Initiatives to Increase Women's Representation in Computing



Undergraduate

Carnegie Mellon University has had well-documented and celebrated success with improving gender diversity in its College of Computing. Its research-based systemic change included: recruitment through feeder networks and outreach; revising admission criteria to maintain high academic standards, but deemphasizing experiences women were less likely to have; offering multiple entry points to accommodate incoming students' different levels of programming experience; and creating a supportive peer community for women. The resulting change was dramatic: women's representation in the incoming class rose from 7 percent to 40 percent between 1996 and 2000.

The University of California at Irvine's Donald Bren School of Information and Computer Sciences has made fundamental changes in introductory CS courses to improve retention and increase student pass rates. The School implemented pair programming, redistributed course topics to reduce duplication, provided better training for TAs, increased shared lab time, and introduced peer lab tutors. Evaluation showed promising results: student pass rates increased from 50% to 82%, with improved retention overall. Initially skeptical instructors became advocates for the changes when they saw substantial improvement in student performance based on individual assessments. Most students thought it was easier to complete assignments and felt their programs were more reliable. While most students felt pair programming was extremely helpful, female students were more likely to recommend pair programming and to believe that it develops teamwork skills and leads to greater success than individual work. In addition to improved student performance overall, men and women were equally likely to persist through the end of the course and believe that they would complete their ICS major.

The University of Virginia School of Engineering & Applied Science requires that all freshmen take an introductory computer science course. This policy creates an opportunity for attracting students to the major. To attract more women into the major, the Computer Science department changed the introductory course. First, students were directed into different sections, depending on their programming experience level. Second, the inexperienced section incorporated structured laboratories into the "lecture." Third, the instructor repeatedly and explicitly encouraged students to choose a computer science major. Fourth, the instructor used examples and assignments designed to be meaningful to diverse students' life experiences and interests. Fifth, a positive class culture extending beyond the course was established. Evaluation showed that, together with a reduced class size of 43 students, the course change markedly increased the yield of CS majors. Moreover, 33 percent of the women and 27 percent of minority students from this course chose CS majors.



NCWIT Extension Services for Undergraduate Programs supports undergraduate computing departments in their efforts to reengineer their programs and create diversity. There are two levels of service: targeted and full. Targeted service supports clients implementing a single effective practice by providing information and consultation, helping to build and implement an evaluation plan, developing a survey of students, etc. Full service clients receive assistance with creating departmental conditions conducive to systemic change. We:

- Describe current conditions and compare them with other institutions
- Inform faculty of opportunities and methods for increasing gender diversity
- Enlist high-level university support for your initiative
- Assist with developing a comprehensive diversity plan and support its implementation
- Guide evaluation
- Participate in dissemination of your successful practices and telling your story

NCWIT offers practices for increasing and benefiting from gender diversity in IT at the K-12, undergraduate, graduate, and career levels.

This case study describes a research-inspired practice that may need further evaluation. Try it, and let us know your results.

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