



National Center for Women & Information Technology PROMISING PRACTICES CATALOG

 K-12 Education	 Undergraduate
	
	
 Graduate	 Career

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

NCWIT's mission is to ensure that women are fully represented in the influential world of computing. We emphasize full representation because diversity is about both numerical representation as well as women's integration in ways that make female participation valuable for individuals, organizations, and society. This document presents very brief summaries of promising and effective practices identified by NCWIT social scientists and will evolve as more practices are developed and recognized. The practices summarized here aim to:

- **Increase the numbers of girls and women in computing.** They have goals or benefits related to recruiting, retaining, or advancing the diverse range of females.
- **Make diversity in computing matter to individuals, organizations, and society.** They have goals or benefits related to innovation, communication, and talent development.

Each entry summarizes evidence related to research on a question about diversity goals or benefits and is followed by one or more case studies or a tool that presents a possible response or solution to the posed question.

Use the following key to identify the audiences for each case study, tool, or solution:



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We encourage you to explore other practices since many can be adapted to fit additional audiences.

HOW DO YOU INTRODUCE COMPUTING AND ITS CONCEPTS IN AN ENGAGING WAY?

Engage students not already drawn to computing by creating academic and social environments where these students feel like they belong. Students respond positively to solving real-life problems that draw on their existing knowledge and interests and that involve collaboration in hands-on projects.



Storytelling (Case Study 1)

- By focusing on problem-solving skills, the computer programming environment “Learning to Program with Alice” takes a new approach that helps students see programming as a series of causal relationships.



Unplugged (Case Study 2)

- “CS Unplugged” demystifies computing through hands-on activities, including one activity called “Sorting Network.” The activity employs kinetic learning and teamwork to illustrate parallel sorting networks to organize data.



Meet Them Where They Are (Case Study 3)

- The Girl Scouts’ “Technobile” is a mobile technology classroom with 12 workstations. It showcases technology and technology careers in ways that appeal to girls, while breaking down the access barriers to IT.



Teaching Programming and Language Concepts Using LEGOS® (Case Study 4)

- In this easy-to-implement classroom activity, individual LEGOS® bricks are used to express a special-purpose programming language, allowing students to kinetically approach concepts and skills in computing in a non-intimidating fashion.



Snap, Create, and Share with Scratch (Case Study 5)

- Scratch is a free “media rich programming environment” in which novice programmers can quickly express their creativity while learning computational thinking. Students “snap” together several categories of “building blocks” (e.g., statements, loops, variables) to quickly generate animations, games, and art.



Scalable Game Design for Middle School (Case Study 6)

- The middle school computing curriculum in Colorado’s Boulder Valley School District uses Scalable Game Design to introduce computer programming. Over the course of a one- to two-month module, students gradually learn more sophisticated topics in order to create increasingly complex games and computational science applications.



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HOW CAN UNBIASED SOFTWARE FACILITATE GIRLS' INTEREST IN IT?

Educational software can increase students' motivation, interest, and academic achievement in science and math. To do so, it must be selected and utilized properly to avoid gender bias.



A Checklist for Evaluating Software Bias (Case Study 1)

- A sample tool for guiding software selection is provided.

HOW DOES ENGAGING CURRICULUM ATTRACT STUDENTS TO COMPUTING?

Making curricula more relevant to students, introducing collaborative learning into the classroom, and tailoring courses to different student experience levels benefit female as well as male students.



Media Computation at Georgia Tech (Case Study 1)

- This approach to introductory computing involves encouraging social interaction and creativity while presenting subject matter that is relevant to non-computing majors. Evaluation at Georgia Tech showed that the Media Computation approach resulted in increased student success rates (earning an A, B, or C) from 72 percent to about 85-90 percent.



Harvey Mudd College's Successful Systemic Approach (Case Study 2)

- This case study focuses on the successful pre- and early-computing major redesign carried out at Harvey Mudd College. Student performance has held steady while skyrocketing women's representation from consistently less than 20% all the way to 50% of the incoming computer science majors.

WHAT ARE THE IMPORTANT COMPONENTS OF TARGETED RECRUITING?

Targeted recruiting means planning strategically: set quantifiable goals; identify large, capable audiences; personalize the content of your message; deliver that message in media that are relevant to your audience; and pay attention to people who influence your audience's decision-making.



Girls Exploring Science, Engineering, and Technology Event – GESET (Case Study 1)

- GESET annually introduces 1,200 middle school girls to the importance of STEM and IT education through hands-on activities and presentation of real-life applications of technology.



Change the Gender Composition of High School Computing Courses (Case Study 2)

- High school computer science teachers who actively recruit girls and minority students report more students overall and more female students in their courses.



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How do you recruit or retain women through inclusive pedagogy?

Women and minority students are not in computing courses under the same conditions as their white male classmates. Instructional practices offer opportunities to level the playing field and improve the retention of underrepresented students.



The Conversational Classroom (Case Study 1)

- Professor William Waite abstained from lecturing his students on assigned reading and relied instead on the students to direct the information discussed in the classroom. Despite initial student resistance to the unorthodox format of the class, repeat evaluations show that students in these classes out-perform students in prior semesters where lecturing was used.



Designing for Diversity (Case Study 2)

- A new, smaller introductory computer science class tailored for inexperienced students at the University of Virginia recruited more minority and women students and resulted in many more students declaring a major in computer science.



Equal Access: Inclusive Strategies for Teaching Students with Disabilities (Case Study 3)

- More students with learning and physical disabilities are in the educational pipeline than ever before. Being aware of the issues, tools, and services for students with disabilities makes it easier for them to learn and for you to teach them.

How does the physical environment affect women's entry and persistence in computing?

The décor of physical spaces conveys messages about the kinds of people who belong there and the kinds of activities that should be done there. Understanding this influence allows us to actively craft an environment that makes a broad range of people feel welcome in computing.



Design Physical Space that Has Broad Appeal (Case Study 1)

- The Paul G. Allen Center for Computer Science & Engineering at the University of Washington opened in 2003. The building was intended to be warm, welcoming, and "non-techy" in appearance, applying principles supported by research on stereotypes and the environment. Combined with the department's other diversity initiatives, the building may be accomplishing its goal. The department has seen increases in women's representation at a time when peer institutions saw declines.

How can encouragement increase persistence in computing?

Encouragement increases self-efficacy, which is the belief in one's ability to successfully perform a task. Because we are more likely to engage in tasks that we believe we can perform successfully, encouragement may be especially useful for attracting women to male-stereotyped fields such as computing.



Encouragement Works in Academic Settings (Case Study 1)

- Simple though encouragement is, fewer than half of the faculty members in the average computer science department in the United States say they do it. This case study shares examples of the role encouragement from teachers, faculty members, and advisors has played in students' decisions to pursue and persist in computing.



Encouragement is Effective in Work Settings (Case Study 2)

- Encouragement is a powerful tool for increasing employee confidence and engagement, but it seems to be underutilized in the workforce. The example in this case study illustrates the profound positive impact a simple encouraging conversation can have on a career.



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HOW DO ADMISSIONS CRITERIA AFFECT WOMEN'S REPRESENTATION IN GRADUATE COMPUTING?

When admission committee members minimize the biasing effects of stereotypes and consider applicants' membership in an under-represented group as a positive characteristic, they promote diversity.



Attempts to Equalize a Subjective Process (Case Study 1)

- By looking carefully at women and considering their life experiences, University of California, San Diego and University of California, Berkeley admit more women students than their peer institutions.

HOW CAN ORGANIZATIONS RECRUIT DIVERSE TALENT IN WAYS THAT PROMOTE INNOVATION AND PRODUCTIVITY?

Significant evidence suggests that diverse work teams produce tangible benefits, including improved innovation, problem-solving, and productivity. Some of this research also illustrates how teams of diverse agents produce better results than teams of "highest-ability" agents.



Interview Strategies that Identify Functionally Diverse Perspectives (Case Study 1)

- Companies can implement interview strategies that identify candidates with functionally diverse perspectives likely to improve innovation and productivity. Moving beyond traditional methods that value "highest scores," these methods offer ways to identify and give credit for different kinds of approaches to problem-solving.

HOW DO YOU RETAIN WOMEN THROUGH COLLABORATIVE LEARNING?

Collaborative learning can improve retention rates, critical thinking, appreciation of diversity, and development of social and professional skills. When implementing collaborative learning, match students roughly according to experience levels and make sure to give students opportunities to work together for both graded and un-graded assignments.



Pair Programming (Case Study 1)

- Pair programming assignments within computer science courses both attract and retain more students in CS majors. In addition, women feel more confident when pair programming is used in the classroom.



Peer-Led Team Learning – PLTL (Case Study 2)

- Peer-led team learning in computer science allows students to work together with a classmate or more advanced peer directing group exercises and discussion. Courses that have utilized PLTL boast lower course drop rates and higher grades.

HOW CAN REUS HELP RETAIN FEMALE UNDERGRADUATES?

Undergraduates with positive research experiences feel more confident and motivated to enter graduate programs. To facilitate successful REUs, supportive faculty advisors or graduate mentors should clearly communicate goals to students and allow them to spend a large amount of time on research, increasing independence as the project progresses.



Faculty Perspectives (Case Study 1)

- Professors Scott McCrickard of Virginia Tech University and Margaret Burnett of Oregon State University treat their undergraduate researchers as members of their respective research teams. Both professors have seen how undergraduates can make research teams more productive while encouraging students to further their research careers.



Affinity Research Groups (Case Study 2)

- The Affinity Research Group model (ARG) integrates student participation in research teams and a structured cooperative learning environment. The result is greater engagement, increased confidence, increased likelihood of pursuing a graduate degree, and the development of collaboration skills.



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HOW DO YOU SUPPORT COMPLETION OF GRADUATE DEGREES AND ENGENDER COMMITMENT TO A RESEARCH CAREER?

Students most likely to complete their graduate studies are those who are viewed as junior colleagues in a positive relationship with their advisors and who are well integrated into their department's or lab's intellectual community.



Advisor as Steward of the Discipline (Case Study 1)

- Where one woman graduate student finds support and guidance from her advisor, another is stifled by her advisor's inconsistent and inappropriate behavior. Systems of accountability, together with trained and caring advisors, increase the chances that doctoral students will successfully navigate the path to research careers.

HOW CAN COMPANIES ATTRACT AND RETAIN MID-CAREER FEMALE EMPLOYEES?

Flexible work arrangements and career paths, along with re-entry training and support, can attract and retain mid-career female employees.



Constructing On-Ramps (Case Study 1)

- In order to retain women in IT by attracting those who wish to return to work, Lehman Brothers Encore program seeks out non-traditional resumes, provides reentry training and support, and offers flexible work arrangements. In its first year, the program hired 20 new employees.



Military Spouse Reentry Programs (Case Study 2)

- Military spouses are a large and often overlooked population that could be well-served by IT training and could bring more diversity to IT. The Women in Technology (WIT) Military Spouse Certificate Program is one innovative program that attempts to meet this need.

HOW CAN LEADER-MEMBER RELATIONSHIPS PROMOTE WOMEN'S RETENTION AND ADVANCEMENT?

Positive leader-member relationships are characterized by exchanges of trust, respect, and low formality. They measurably improve performance, job satisfaction, and commitment.



Taking Stock of Leader-Member Relationships (Case Study 1)

- This practice sheet offers sample survey items to help with conducting "relationship audits" that can be used for benchmarking the quality of leader-member relationships in an organization.

HOW DOES COMBATING OVERT SEXISM AFFECT WOMEN'S RETENTION?

Sexism has measurably harmful effects, but sexist behavior can be minimized. Instructors and supervisors can practice zero tolerance and facilitate positive peer interactions, and they can provide highly visible leadership, policies, and procedures that go beyond legalities to explicitly denounce sexism.



Assessments for Identifying Overt Sexism (Case Study 1)

- This case study identifies available surveys and issues that should be considered when assessing the prevalence of sexist behavior in an organization.



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How do you mentor technical women at work?

Paired mentors and protégés exchange advice for career advancement and reduced turnover. Formal mentoring programs may include organized activities that provide a framework for the mentor-protégé relationship and can lead to more rapid career advancement and higher career satisfaction for participants than non-participants.



Sun Engineering Enrichment and Development (SEED) Program (Case Study 1)

- New hires and established employees at Sun Engineering are paired with executives and senior Engineering staff in a well-organized program. Participants are four times more likely to be promoted and twice as likely as company averages to earn superior performance ratings.

How do you mentor faculty women?

Faculty mentoring programs help junior faculty to acclimate and promote relationships that can cover a broad range of topics. These programs enhance career commitment and self-confidence in women. Successful programs initiate mentor pairings early for new faculty and formally facilitate the relationship until the mentor-protégé bond is established.



Georgia Tech Mentoring Program for Faculty Advancement (Case Study 1)

- In a proactive attempt to facilitate faculty advancement, Georgia Tech created a formal mentor program for tenured and tenure-track faculty that has three core components: an online, interactive career-planning tool; intra-departmental mentor pairings; and cross-college workshops to discuss topics that apply to all university faculty.

What makes electronic mentoring effective?

By removing time and location constraints, e-mentoring allows women to connect with many more women than face-to-face mentoring permits. It can also promote more open mentor-protégé communication by limiting status differences.



MentorNet – www.MentorNet.net (Case Study 1)

- MentorNet is an online resource for women in engineering and science who seek one-on-one guidance from mentors in their respective fields. By providing mentors with online resources for training, coaching, and consulting, MentorNet provides positive structure for the mentor-protégé relationship. Both mentors and protégés report benefiting from the program.

How do you provide intentional role modeling?

In addition to demonstrating expertise and experience, intentional role models display their strengths and weaknesses and help observers see how they could attain a similar position. Role modeling is less interactive than mentoring, but is often a component of mentoring relationships.



Regional Celebrations of Women in Computing – R-CWIC (Case Study 1)

- Women attending the Indiana and Ohio Celebrations of Women in Computing observe role models who are keynote speakers from technical fields, panelists with technical careers in industry, and presenters of technical papers. Ninety-seven percent of attendees report that their time was well spent by attending the conferences, and 93 percent would recommend the conference to a friend.

How can companies achieve organizational diversity?

Companies that establish organizational accountability for diversity, whether in the form of full-time diversity staff or a diversity task force, are more likely to increase the representation of women and minorities in management than companies that use only mentoring or diversity training programs.



Establishing Institutional Accountability (Case Study 1)

- Five years ago, Company ABC began the process of establishing formal accountability for diversity because company leaders saw diversity as necessary to retain employees, foster better business practices, compete nationally and internationally, and better respond to client needs.



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HOW DO STEREOTYPE THREATS AFFECT RETENTION?

Stereotype threat harms both performance and motivation by reducing our feelings of competence, belonging, and trust in our colleagues. However, careful thought, education, and regular assessment of diversity practices can help minimize incidents of stereotype threat.



Better Approaches to Well-Intentioned, but Harmful Messages (Case Study 1)

- Examples show how instructors and advisors can minimize stereotype threat by creating an accepting environment where students feel at ease and are recognized for their achievements. In addition, student test scores improve and gender gaps are eliminated when students are taught that intelligence increases through effort.

HOW CAN YOU RE-ENGINEER YOUR UNDERGRADUATE PROGRAM TO INCREASE WOMEN'S REPRESENTATION IN COMPUTING?

The socio-educational system a student experiences shapes participation in the major. Altering one element of that system is often not enough to create enduring change. When faculty members are ready to implement organizational innovation, success is more likely if they receive support from institutional leaders, have access to adequate resources, and are able to participate in decision-making about the change.



Small Steps Toward Systemic Change (Case Study 1)

- Computing departments at universities across the country have been implementing changes to the educational system experienced by all students to increase women's representation in computing. Among other efforts, implementing collaborative learning environments (pair programming), creating flexible entry points into computing, and fostering supportive peer communities that extend beyond the classroom have resulted in increases in women's representation in computing.

HOW CAN COMPANIES PROMOTE INNOVATION WITH DIVERSE EMPLOYEES?

Diverse work teams can improve innovation, problem-solving, and productivity. Patenting is one important measure of recognized and rewarded innovation efforts in IT, but female patenting rates are quite low. A few companies have started patenting or innovation communities to increase women's participation.



Patenting Learning Communities (Case Study 1)

- In order to reap the benefits of diverse innovation, two companies implement "inventor learning communities" to increase female participation in innovation and patenting.

HOW CAN REDUCING UNCONSCIOUS BIAS INCREASE WOMEN'S SUCCESS IN IT?

Research shows that even individuals committed to equality harbor unconscious biases that impact everyday decisions and interactions. In the IT workplace, unconscious gender bias can mislead employers, both male and female, to make inaccurate judgments in hiring, performance reviews, and promotion.



Avoiding Unintended Gender Bias in Letters of Recommendation (Case Study 1)

- This case study highlights findings on the differences between letters of recommendation for women and men and gives practical ways to reduce bias when writing letters of recommendation.



Avoiding Gender Bias in Recruitment/Selection Processes (Case Study 2)

- This case study focuses on the profound effect unconscious bias can have on the recruitment and selection process — from crafting and distribution of job postings to interviewing and hiring. Steps are offered for overcoming this bias.

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