TOOLS AND PRACTICES FOR INCREASING DIVERSITY IN ICT EDUCATION

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Toolkit Structure

This toolkit begins with an overview of the diversity in ICT landscape, the diversity goals of MPICT and the California Community College ICT Collaborative, making a case for change, and strategies for achieving diversity goals. The sections that follow the introduction are organized in a format that allows faculty, counselors, and administrators to identify and focus on specific changes they'd like to support and make happen. The last section of the toolkit invites users to join the Diversity in ICT Community of Practice where members share their experience using the tools and stay abreast of new practices, current data, and innovative thought that address the ultimate goal of a diverse ICT workforce.

Unless otherwise noted, the resources presented here are available for no cost to educators.

ICT and Diversity

The continuous decline of Blacks, Latinos, and Women in ICT is a foreboding indicator for the promise of our recovering economy. This is not news. For over a decade, pundits within the federal government, industry, and think tanks to non-profits and academia, have all declared the lack of diversity in ICT as a major competitive and socio-economic problem for our country. Yet underrepresented populations in ICT education and the workforce continue to decline. In 1985, 37% of computer science graduates were women; in 2009 that figure dropped to 11% (*By the Numbers*, National Center for Women in Technology). According to a 2006 survey cited in the book, *Stuck in the Shallow End*, just 8% of the bachelor's degrees and 4% of the master's degrees in computer science are awarded to African Americans and Latinos in the nation's computer science departments that grant Ph.D.s. Among California's high school students of color, who comprise 49% of the state's high school population, just 9% take the advanced placement (AP) computer science test that prepares them for college courses in the field. Yet, research has shown that minority students completing STEM programs and entering related fields experience significant economic benefits.

Even with unemployment at historic levels, there are still thousands of unfilled ICT jobs. Here in California, Economic Modeling Systems Inc. (EMSI) estimates the creation of 30,000 new ICT workforce jobs between 2011 and 2013 and more than 80,000 ICT workforce job openings due to replacements, for a total of more than 110,000 new and replacement jobs in the period. (See MPICT's *Phase 2 ICT Industry and Employment Outlook*.) Why aren't more African-Americans, Hispanics and women looking toward careers in technology?
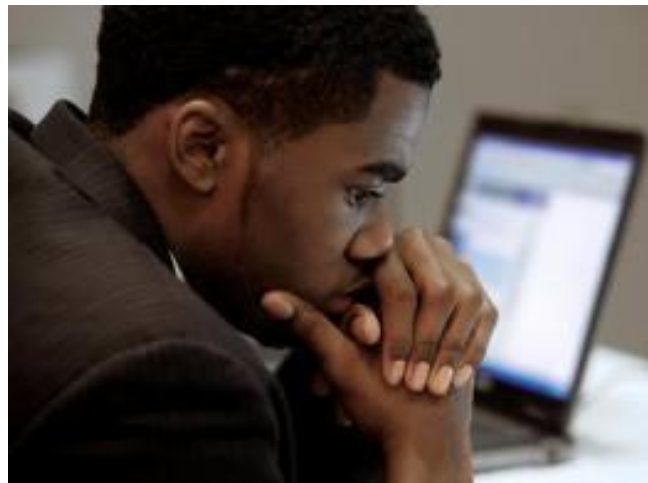
The answer turns out to be a complex equation of access, self-image, stereotypes, bad information, discouragement and socio-economics — and sometimes just wrong perceptions about ICT. For example, the decline of the dot.com era coupled with an increase in global outsourcing of jobs has negatively affected the appeal of ICT careers. People believe the press that all the jobs are overseas. The geek image is often a turn-off for young women and Blacks and they believe only a certain type of person and knowledge can be successful. But the biggest barriers are the lack of early introduction to STEM during K-12, availability of role models, and engaging pedagogy that leads to the choice to pursue a technology career.

This issue is foreboding because it glimpses a future where a large segment of our population will not have the qualifications and perhaps even the digital literacy to participate in an economy driven by technology. The U.S. continues to fall behind the rest of the developed world, as the gap between demand and qualified supply of technology workers, in general, grows larger. The gender gap is even more pronounced. Without even rudimentary knowledge, they will be relegated to be nothing more than consumers – if they can find jobs that don't require the use of technology.

U.S. Department of Labor projections estimate that there will be 1.4 million new jobs in ICT by 2014. If the decline in community college and undergraduate computing and information sciences enrollment continues, we will graduate only 29% of the qualified candidates needed to fill these jobs.

The ICT workforce continues to have the face of White and Asian males, a group that accounts for only 40% of California's population according to the 2010 census. Yet, community colleges in the state have a student body made up of a majority of students of color, immigrants, and low-income students.

If the decline in the number of underrepresented and special population ICT students continues, we're drawing our future technologists and technicians from only 40% percent of the talent available. Industry knows that diversity is a competitive edge. The impact reaches beyond California as America struggles to produce enough technologists to prosper in a world ruled by technology by closing the gap between the supply of ICT professionals produced by the educational system and industry demands.

MPICT and CCC ICT Collaborative Mission and Diversity

Increasing diversity in ICT is imperative, with systemic outcomes and consequences. It is change that must underlie all we do at MPICT and the CCC ICT Collaborative.

We can help by:

- Identifying and disseminating tools and best practices for counselors, faculty and administrators for use in attracting, retaining and promoting the success of underrepresented groups in ICT
- Establishing a community of practice comprised of stakeholders and experts to monitor progress and collaborate on ways to continually improve student outcomes
- Partnering with community-based organization to increase interest in ICT in urban high schools and establish pathway programs that bridge high school and community college
- Collaborating with industry partners and our advisory panel to 1) identify opportunities to expose ICT students to real-world application of technology they are learning and 2) develop internship opportunities as learning segues into the work environment

Making the Case for Change: Why We Should Care

The Problem and Opportunity

The first stage in solving a problem, seizing an opportunity, or manifesting change is creating awareness and a sense of urgency. There is a huge lack of awareness of the consequences of the lack of diversity in ICT education. That's the problem perspective. The opportunistic view is one that understands how ICT education is the door to jobs and a leap in the quality of life for individuals who have traditionally been overlooked in the promotion of this pathway.

In much of the discourse on the impacts of the current recession in the US, the shrinking of the middle class is mentioned often. When combined, minorities and special populations make up a large percentage of the middle and lower classes of this country. Many middle and working class workers are/were skilled technicians. Vocational schools and community colleges are where many get introduced to or learned job skills. That was certainly the case prior to this recession, but as the funding of public education plummets, so has the focus on promoting career and technical education in urban and low-income communities.

A recent article in US News reports that, based on research at Stanford University, capable women in technical fields have less confidence than men that they will be successful. Women students perform as well as men technical programs, but are more likely than men to switch to a different major. These women switch because they don't believe that their skills are good enough and they don't feel like they "fit".

Stereotype threat creates the same lack of confidence in Black and Latino students in ICT education. A study by the WGBH Foundation and the Association for Computing Machinery found that the majority (53%) of Black and Latino boys in high school believe that ICT careers are a very good or good career choice, compared to 41% of White boys. If they start with this interest, why are Black and Latino men at the bottom of the list of demographics of ICT students and entrants to the workforce?

Assessment

Have you identified and defined what needs to change relative to your diversity goals? Do you know why your students are unengaged, discouraged, or uninterested? What are they **experiencing** that turns them off from pursuing or persisting with their ICT education? Is the barrier social or academic? As discussed above, there are many obstacles and challenges that underrepresented and non-traditional students encounter in their ICT education experience.

As in solving any problem, without a clear and well-defined understanding of the situation and climate, the goals are questionable and skew the consideration of alternatives to achieve them. If you can share the problem and the opportunity to others in the same way that you tell any story to illustrate a point, you not only raise awareness, you may also garner support.

The National Center for Women & Information Technology (NCWIT) provides a field-tested tool to help answer these questions. The Survey-in-a-Box: Student Experience of the Major (SEM) identifies conditions that are helpful or harmful for student retention. Based on research on increasing retention of women, the questions used are also effective in increasing engagement of students in general.

Survey-in-a-Box SEM Includes:
- Guide for administering the survey
- Sample letter for gaining institutional support
- IRB Process Guide from Assessing Women and Men in Engineering (AWE) for obtaining human subject approval, including sample text, process overview, and a guide to incentives
- Sample IRB form
- Sample Student Experience of the Major Survey
- Sample student invitation-to-respond
- Presentation template for reporting results to your faculty and students
- Pointers to recommended practices

NCWIT Extension Services provides guidance throughout the process, including survey customization. The survey can be administered in two forms: online or paper. Upon completion NCWIT-ES returns a summary of the results and can assist with creating an action plan. Most services are free of charge.

Survey-in-a-Box SEM is available for free download at NCWIT's Resources site.

Goal Setting

The California Community College Special Populations Collaborative has developed core indicators that can be considered in determining metrics to track the success of special population students in Career and Technical Education. Special populations are:

- Individuals from economically disadvantaged families, including foster children
- Individuals preparing for nontraditional fields in which one gender comprises less that 25% of the individuals employed in the field
- Individual with disabilities
- Single parents, including single pregnant women
- Displaced homemakers
- Individual of limited English proficiency

Based on Federal Perkins legislation, the five core indicators to measure effectiveness of improving diversity are:

1. **Technical Skills Assessment** in CTE courses
2. **Completion** of a CTE credential, certificate or degree
3. **Persistence** in higher education including transfer for higher instruction
4. **Employment** or placement in military service or apprenticeship programs

5. **Nontraditional Participation** in a CTE training area in which fewer than 25% of employees in that field are of the student's gender and **Nontraditional Completion** of a CTE training area are fewer than 25% of employees in that area are the student's gender

Institutions receiving Perkins funding must establish a performance goal for each of these areas, but even if your diversity initiatives are funded by other sources, these are useful metrics.

Of interest to California Community College (CCC) faculty is a recent report conducted and funded by MPICT and the CCC ICT Collaborative. The objective of *California Community College ICT Student Enrollment and Demographics* was to study ICT student enrollment and passing rate characteristics, student and faculty demographics, and their trends in ICT related programs across the California Community College (CCC) system. Some of the highlights include the following findings:

- Between 2008/09, female enrollment decreased 3% and male enrollment increased 3%.
- There was a 12,882% increase in ICT related enrollments for Two or More Races, from 2008-09 to 2010-11, from 106 in 2008-09 to 13,761 in 2010-11.
- Generally, Hispanics, Blacks and Multiple Races are gaining in proportional representation relative to Whites

CCC change agents may find that this report provides some baselines and benchmarks for setting department or institutional goals.

Strategies for Change

The current state of education, especially in cities and states with higher percentages of students from underrepresented and special populations, is discouraging to both students and educators. The recession that began in 2007 continues to take its toll in 2012 with continuous statewide budget cuts forcing the reduction of courses, programs, faculty, and other resources that support student success. Making change happen in these conditions is a major challenge that will require a vision of learning environments where full participation by all students is the norm, not the exception.

In 2011, the US Census Bureau confirmed a major milestone that will impact policy and education in years to come – Non-Hispanic whites accounted for 49.6 percent of all births in the 12-month period ending July 2011, while minorities — including Hispanics, Blacks, Asians and those of mixed race — reached 50.4 percent, representing a majority for the first time in the country's history. Overall, whites will remain a majority for some time, but a younger generation is being born in which minorities are the majority. But while we're transforming into a globalized multiethnic country demographically, to date the US has a bad grade in educating minority youth. "An increasingly diverse young

population is a potential engine of growth, but it can become a burden if it is not properly educated" (Tavernise, 2012).

California Tomorrow recognizes this shift and reports that one of the most challenging trends facing community colleges is a permanent transition to a student body made up of a majority of students of color, immigrants, and low-income students. To develop strategies for increasing diversity in ICT education, community college educators and administrators must recognize that this change isn't isolated to a discipline or a few departments. For resources for campus-wide change strategies, see CA Tomorrow's Addressing Access, Equity, and Diversity in California's Community Colleges: Resources for Campus Change and the Equity-Driven Systems Change Toolkit, both of which offer a complete set of tools aimed at campus leaders who want to:

- Identify their college's current strengths and assets; as well as gaps and weaknesses.
- Consider strategies for engaging campus leaders from key departments, programs, and administrative functional areas that are needed to strengthen the college's culture and practices.
- Identify initial priorities for initiating or strengthening comprehensive campus change efforts related to diversity and equity; and,
- Build a leadership team that can work effectively to lead change on their campus.

Influencing Change

As implied above, achieving diversity goals in a sustainable manner requires systemic change, even at a department level. Just as there are multiple factors that contribute to under-representation of minorities, women and special populations in both ICT education and the workforce, change will require a multi-faceted approach. Effective practices must be mainstreamed into the experiences of all students, not just those of women or minorities. NCWIT Senior Research Scientists Lecia Barker and Joanne Cohoon created a model of undergraduate experiences that affect women's participation in undergraduate programs that is applicable to all students, shown in Figure 1.

Figure 1: System of Undergraduate Computing
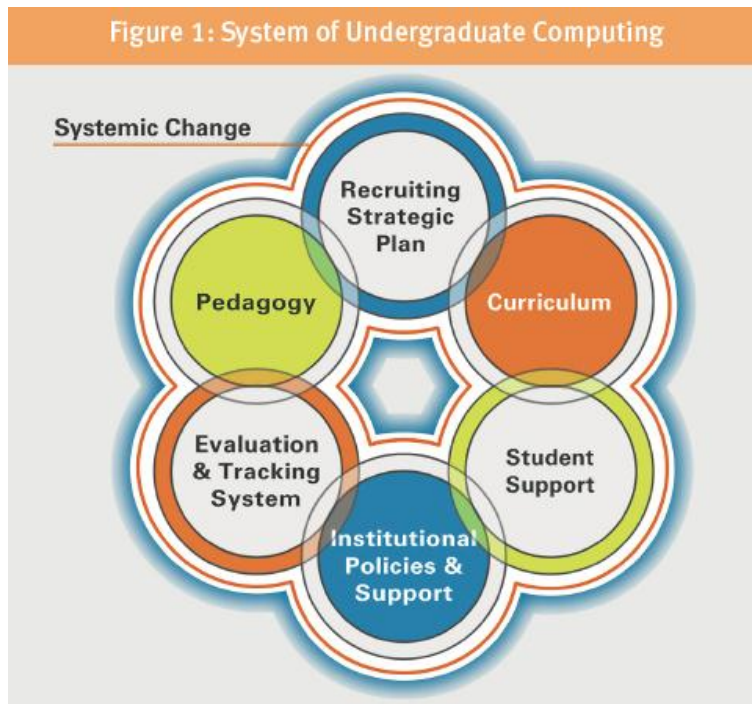
Each of these components can promote or inhibit diversity either independently or combined with others. When parts of the system are changed, mutually-dependent components can reinforce and perpetuate the results. When we ignore the system, efforts can be neutralized as other components maintain the status quo.

NCWIT's Strategic Planning for Increasing Women's Participation in Undergraduate Computing workbook is an extremely valuable resource for defining strategies that, when implemented in concert, are sustainable and support the retention of ALL students. However, even the best of plans fall short of goals if the fundamentals and influences of change management are not considered.

According to more research by NCWIT (Small Steps Toward Systemic Change), several conditions increase the chances that an organizational innovation will be adopted:

Dissatisfaction with the status quo. Are faculty members satisfied with the number and quality of students in ICT programs? If not, point out the large untapped but capable talent pool of women and minorities. Are they aware of the under-representation and trends in their ICT programs and how they compare with other institutions?
Feelings of competence to make the change. Are faculty members aware that male mentors **can** be particularly beneficial for women? Do they realize the impact that peer role models can have on new Latino and Black students? Have they ever witnessed collaborative or cooperative learning, such as pair programming?
Resources, including time, for making the change. Does the department provide temporary reduction in course load or summer support for course re-design or faculty development focused on pedagogy?

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 the chair and dean publicly endorsing efforts and applauding successes? Do they expect reports on the outcomes of efforts and track the 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?

Advocating/Communicating for the Change

Increasing the number of underrepresented groups in ICT has to be girded by fundamental social change, and social change requires advocacy for commitment to make the change happen over time.

Engaging in conversation and sharing stories are the most sustainable approaches to learning and change. They are also the most effective means of advocacy. Conversation and stories open the mind to possibilities. One reason a role model has such an impact on the vision of a young person is that the story is first hand.

Being able to talk about the real successes and opportunities of a career in ICT can increase awareness and motivate action in students, parents, peers, staff and leaders. You'll find that your own awareness and motivation grows with the number of scenarios and testimonies you can cite or share.

Again, NCWIT has a wonderful list of Talking Points at its Resources site that are great scripts for advocating for diversity beyond more women. NCWIT Talking Points are easy-to-use conversation cards designed to help promote women (and any population) in IT. The double-sided cards help people talks about the issues with solid research, simple text, and appealing photos for easy reference. Here are the links:

Why Should Young Women Consider a Career in Information Technology?

[Comparing U.S. K-12 Students' Math and Science Performance Internationally: What are the facts, what do they mean for educational reform, and how do I talk effectively about the issues?](#)

[Communicating for Change: Persuade Colleagues to Get on Board](#)

[Institutional Barriers & Their Effects: How can I talk to colleagues about these issues?](#)

[Moving Beyond Computer Literacy: Why Schools Should Teach Computer Science.](#)

NCWIT also offers a [library of multimedia tools](#) for making the case for diversity in ICT. The library of audio and video content includes presentations on research, meeting keynotes, interviews and celebration of [Aspirations in Computing Educator Award](#) winners.

Facilitating Change

Change management has become a growing practice and key element of strategy execution in many large businesses, agencies, and institutions. The more complex the organization, the more difficult it is to successfully implement change that actually meets expectations.

Integrating these tools and practices for change management into a plan for improving diversity not only increases the probability for success, it also lays the foundation for sustained engagement of the people that make things happen. Facilitating change has five steps.

1. Creating a sense of urgency with a compelling vision and business case – a story that builds coalition and generates support. Communication is key.
2. Engaging ALL stakeholders and understanding their needs, concerns, desires.
3. Developing an incremental change plan, a pathway, based upon a change impact analysis that tracks the progress of the system change(s)
4. Ensuring that the individuals who must carry out the change are prepared to do so
5. Facilitating review meetings on a rhythmic basis in order to ensure outcomes are met and shift tactics if they are not.

Specific strategies for change management in higher education are few, California Tomorrow's [Addressing Access, Equity, and Diversity in California's Community Colleges: Resources for Campus Change](#) is a very good start with practices that can be applied to most of the steps above.

Strategies and Tools for Achieving Diversity Goals

In the research and preparation of this compilation of promising practices and tools, we confirmed that there is no "one size fits all" approach to increasing the success of students of underrepresented groups and special populations. Consider the student demographics and circumstances these two terms include:

- Economically disadvantaged students
- Female students
    - Black
    - Latino
    - White
- Students who are single parents
- Black male students
- Latino male students
- Students with disabilities
- Students preparing for occupations that employ 25% or less of their gender
- Older students learning new skills
- Displaced homemakers (adults who have been out of the workplace)
- Students with limited English proficiency
- Students who are recently returning veterans

This list makes it apparent that attracting and supporting the success of one group will not always work for another, simply because each has their own unique barriers and potential opportunities.

For example, a 19 year-old Black female, raised in the suburbs, exploring network management classes at her local community college will have very different perceptions, attitudes, and needs, than a 23 year-old Black single mother living in inner-city public housing who has been mandated to take office technology courses at her local community college as part of a welfare to work program. Although these two students have much in common, they also have major differences in the barriers they must overcome to successfully complete their educational goals.

To date, we have not identified and collected the information needed to prepare a toolkit that addresses each of these ten categories separately and thoroughly. The good news is that new programs and practices are continuously being developed, applied and

made available. For this reason, the toolkit is dynamic and evolving, relying on its users to share the learning and outcomes of their experience applying it. (See Identifying and Sharing New Tools and Practices.)

General Strategies, Practices and Tools

For Raising Awareness

There are multiple reasons students from underrepresented groups are not attracted to ICT subjects and careers. Many simply have no exposure to technology beyond its consumption. Some are from social and economic environments where role models and parent encouragement toward that pathway are scarce. Ongoing budget cuts in public education hit inner city schools hardest. Few have the tech academies and computer science AP classes as options.

Under the existing educational policy of election, computing is rarely required in secondary school. This means students are likely to have a narrow and inaccurate view of what IT study involves, what careers are possible, or what kind of people "do" IT.

Image is also an influential factor when young people begin to think about a career. A study by the WBGH Foundation and the Association for Computing Machinery (ACM) found that misperceptions and negative images play a significant role in low interest in ICT. They believe ICT is boring, difficult, antisocial, or doesn't have much impact of solving the world's problems – not the best choice for their futures.

Research has shown awareness needs to start early, in middle school, but what can be done to impact the impressions of high school and community college students making decisions about their postsecondary education? The following tools and practices can be useful for creating interest and awareness in ICT study and career pathways:

Which majors are right for me? This card, developed by NCWIT and co-branded with ACM, explains how computing interests and talents line up with different degrees and the careers that follow

Why Should Young People Consider Careers in Information Technology? Created for school counselors by Counselors for Computing (C4C), a project of the NCWIT K-12 Alliance made possible by the Merck Company Foundation, this card gives adults talking points and additional resources for a conversation with their students, children, and/or other young people. The main message is that ICT offers meaningful work, security and high salaries, and flexibility and variety. Information is provided to address these specific questions: What should you tell a young person about a career in ICT? How can a young person prepare now for a career in ICT?

For Outreach, Recruitment and Preparation

One of the most comprehensive strategies for outreach, recruitment, and preparation is the National Alliance for Partnership in Equity's Nontraditional Career Preparation: Root Causes & Strategies. The document is a literature review organized into research theories, evidence, recommendations and strategies, and effective practice and resources based upon root causes. It is designed for use by CTE professionals at secondary and postsecondary institutions to recruit and retain more students in nontraditional careers. The guide is organized into the following categories:

- Support Services
- Academic Proficiency
- Early Intervention
- Access to and Participation in Math, Science and Technology
- Characteristics of an Occupation: Job Satisfaction/Career-Family Balance/Occupational Perception/Wage Potential
- Curriculum
- Family Characteristics
- Instructional Strategies
- Internal/Individual
- School and Classroom Climate
- Societal Issues
- Materials and Practices: Assessment, Interest Inventories, and Marketing & Recruitment

Each category is divided into root causes about which a theory is proposed along with the improvement strategies. The guide provides effective practices and resources to implement the strategies

For Engaging and Retention-Focused Curriculum

The content of computing curriculum, especially introductory courses, is believed to be a contributor to the under-representation of women and minorities in ICT. It's a challenge is to develop engaging assignments and curriculum that can appeal to a variety of students with different learning styles, interests, socio-cultural backgrounds, and abilities while maintaining the rigor toward success outcomes. Putting the concepts of ICT in appealing scenarios and building on existing skills and interests can level the playing field for those with limited exposure and experience.

NCWIT research has shown that student-student interaction was the most powerful predictor of students' intention to persist in the major beyond their introductory computer science course. This finding lends support to the use of *collaborative, scenario- and problem-based learning to engage and retain all students, not just those from underrepresented groups.* But because girls, Blacks, and Latinos aren't as likely to

have peer support in ICT classes, the curriculum must engage students while encouraging collaboration. An excellent resource for curriculum, tools, and research for problem-based learning is provided by the Buck Institute for Education.

The effectiveness of scenario- and problem-based learning stems from adding meaningfulness to the lesson or concept. To be inclusive, the examples and assignments are designed to be meaningful to diverse students' life experiences and interests. The National Institute for Women in Trades, Technology, and Science (IWITTS) provides a complete annotated bibliography on problem solving resources for curriculum development.

The Career Ladders Project has compiled a significant list of resources for contextual-based learning as a means to, improve outcomes for academically underprepared college students, a major obstacle for some underrepresented groups for a variety of reasons. Contextualization is the teaching of basic skills in the context of disciplinary topic areas.

The earlier a student develops interest in technology, the more likely they will stick with it. Pathway programs that link K-12 curriculum to community college ICT certificate and degree programs are discussed below, but an appreciation for what it takes to inspire the curiosity of middle and high school students can open up perspectives on how to retain them as their interest leads them to community college.

Exploring Computer Science (ECS) has developed socially relevant and meaningful curriculum for diverse 10th through 12th graders that culminates in final projects around topics of human-computer interaction, problem solving, web design, programming computing and data analysis, and robotics. Ethical and social issues in computing, and careers in computing, are woven throughout the year-long, six unit, college preparatory curriculum.

The ECS curriculum is based on research that began in 2000 and continues today which explores why so few African-American, Latino/a, and female students were learning computer science at the high school level. One of the key findings was that the mechanisms and beliefs that channel students of color away from computer science learning opportunities do the very same thing throughout the entire college-preparatory educational system. To begin to make a difference, understanding how to change those mechanisms and impact unfounded beliefs about the subjects, we must also

acknowledge that there are cultural and gender perspectives that impact student learning perspectives.

For example, collaborative learning or pair programming is a proven approach to engage female students that has also been shown to be effective for all students. NCWIT offers Pair Programming-in-a-Box: The Power of Collaborative Learning, which provides all the components needed to successfully use pair programming methods in computer science courses. The team approach to learning has benefits beyond success with female students because it prepares all students for the learning methods they'll encounter in most post-secondary programs and the expectations of today's work environment. Again, the tools recommended in this tool kit can increase the success of all students because research and industry reports continue to show that employers are in general satisfied with the technical knowledge of graduates but find that they are lacking in other skills, such as communication and working cooperatively.

Developing curriculum that engages female students is a good baseline for most underrepresented groups because the first step must be introducing meaningfulness to the subject matter. Girls are interested in technology if they see its implications and can relate courses to real life experiences. Although they have a different perspective from boys in that they are more likely to address a problem from within a context while boys consider task apart from its context, there must be a problem to solve to bring out these traits for every student.

Effective curriculum includes context or scenarios that tap into diverse backgrounds to solve a problem. If girls think technology is important because it helps them understand and solve the world's problems, and boys think it's important to their careers, then bringing these multiple views of meaningfulness to a team effort is good for all involved. It's important to also note: it can't be generally assumed that girls think one way and boys another. Lynette Kvasny, associate professor at Pennsylvania State University has done significant research on Black women and ICT. Some of that found Black girls are more inclined to pursue ICT to advance their careers. Although there is no one size fits all for an engaging ICT curriculum, when it includes opportunities that allow students to apply it within their personal context, the likelihood of their success is improved.

Following are links to additional research, whitepapers and practices for developing curriculum that engages students from all underrepresented groups from the National Center for Women in Information Technology (NCWIT):

- [How Does Engaging Curriculum Attract Students to Computing? Media Computation at Georgia Tech (Case Study 1)](#)
- [How Does Engaging Curriculum Attract Students to Computing? Harvey Mudd College's Successful Systemic Approach (Case Study 2)](#)

For Faculty Development and Pedagogical Interventions

The number of ICT faculty members that have experience with contextual, collaborative, or problem-based learning during their educational or teaching careers is low but increasing. ICT educators that have participated in professional development that focuses on integrating ICT content and basic skills instruction are also a small minority. These areas of pedagogy are critical elements of programs that aim to increase the success of ICT students from underrepresented groups. As presented earlier, students want to find personal connection, work as pairs and teams, and see a purpose in their work. The fact of the matter is that students receiving this type of instruction are better engaged. What often makes the difference is the amount of encouragement, motivation, preparation and exposure they receive after they enter the ICT classroom. Applying these techniques help to make ALL students successful.

NCWIT offers [Pair Programming in a Box: The Power of Collaborative Learning,](#) a guide for adding to curriculum the opportunity for students to work and learn together.

The teacher is most often the biggest influence on a student's motivation and choices. Teachers must be coaches and facilitators of learning, especially for these students who, in many cases have limited exposure to the possibilities and few people to inspire their potential. Calling attention to the under-representation of a student's demographic group, even with good intention, can cause *stereotype threat*, which occurs when an individual believes stereotypes about their group.

NCWIT has identified common, unintentional mistakes made in the classroom that feed stereotype threat and, through case studies and best practices, suggests how faculty can increase their awareness of it and counter its negative impact. See [How Do Stereotype Threats Affect Retention? Better Approaches to Well-Intentioned, but Harmful Messages (Case Study 1).](#) There is also a very informative article, [Reducing Stereotype Threat,](#) provided by the ACTE Issue Brief: CTE Role in Dropout Retention and Recovery (from JSPAC Effective Practices/Models).

NCWIT provides a variety of tools, listed below, to assist faculty, counselors, and administrators with identifying the personal approaches and behaviors that create an environment where engaged and meaningful learning can take place.

[How Can Encouragement Increase Persistence in Computing? Encouragement Works in Academic Settings (Case Study 1)](#)

For Mentoring

MentorNet is the award-winning nonprofit e-mentoring network that positively affects the retention and success of students in engineering, science and mathematics, particularly but not exclusively women and others underrepresented in these fields.

Bridge Programs

Bridge programs that provide pathways from high schools and community based organizations to community college have effectively served underrepresented populations as a means of outreach, awareness, and motivation to obtain a postsecondary education. ICT pathway programs expose students to ICT career prospects early high school and support them with opportunities to cultivate that interest with benefits such as dual enrollment, internships, and interpersonal skills development.

Bridge and pathway programs often require collaboration with multiple stakeholders. In addition to the schools and community organizations, funding organizations such as local and federal workforce development agencies, private industry and foundations are part of a very coordinated effort.

Given the strategic importance of ICT education in meeting workforce demand for such skills and creating opportunities for all students, the development and implementation of ICT pathway programs has been an area of focus for NSF ATE Centers such as MPICT.

MPICT, the CCC ICT Collaborative, Boston Area Advanced Technological Education Center (BATEC), the California Department of Education (CDE) and the San Francisco Unified School District (SFUSD) are in partnership with local CBOs and the City of San Francisco to support a three-year project to develop coherent K-12 to community college pathways in ICT. In addition to improving access to ICT jobs, an important objective of the SF ICT Pathways Project is to produce a model that can be replicated elsewhere in California. Parties interested in participating or tracking the project's progress, are invited to join the Project's Community of Practice.

The Career Ladders Project provides a very comprehensive list of research and best practices for developing and implementing bridge programs at its Bridge Programs page.

In partnership with City College of San Francisco, the Bay Area Video Coalition (BAVC) offers City College of San Francisco (CCSF) students and its Digital Pathways alumni opportunities to participate in its BRIDGES program, an enhanced internship program that allows students to apply their coursework in the workforce. In addition to placement in a paid internship, BRIDGES provides mentorship, career skills training, and

family engagement events. Graduates of BRIDGES will have an opportunity to return as paid mentors in the Fall.

Women Students

As evidenced by the tools and practices already presented in this toolkit, much of the attention given to increasing diversity in ICT and been on girls and women. Justifiably so, since females are 50.8% of the US population. But according to the Department of Labor the percent of women in computing occupations in 2009 was only 29%. That number is declining. In 1986 the percentage was at its highest at 40%. Obviously, ICT is becoming less friendly for females and according to the Anita Borg Institute for Women and Technology, "it's no mystery. Women who pursue ICT careers do so under extremely trying circumstances, which are almost entirely cultural."

Tools for Attracting and Retaining Female Students

The National Institute for Women in Trades, Technology, and Science (IWITTS) knows the impact of image recognition and has multiple tools for this practice. IWITTS offers posters, banners and videos that highlight women working in the ICT field, reinforcing the idea that they women belong in these occupations. IWITTS recruitment materials, which are available for a fee, can be customized for a particular educational institution or program. New images of women in ICT reconstruct the idea of the industry as being male dominated, providing a more welcoming outreach into the field and empowering them to stay.

The National Center for Women in Technology (NCWIT) also offers a "talking points" card that gives adults talking points and additional resources for a conversation with their daughters and/or other young people. The main message is that IT offers meaningful work, security and high salaries. Go to Why Should Young Women Consider Careers in Information Technology?

Tools for Developing Curriculum that Engages Women Students

Following are links to additional research, whitepapers and practices for developing curriculum that engages underrepresented groups, including those with disabilities.

From the National Institute for Women in Trades, Technology and Science (IWITTS):
- Engineering Education: How to Design a Gender-Inclusive Curriculum
- Model Eliciting Activities: An In-Class Approach to Improving Interest and Persistence of Women in Engineering
- Retaining Women in First Year CS Courses

From the National Center for Women in Information Technology (NCWIT):
- How Do You Retain Women through Collaborative Learning? Pair Programming (Case Study 1)

- [How Do You Retain Women through Collaborative Learning? Peer-Led Team Learning (Case Study 2)](#)
- [How Can Unbiased Software Facilitate Girls' Interest in IT? A Checklist for Evaluating Software (Case Study 1)](#)
- [How Do You Recruit or Retain Women Through Inclusive Pedagogy? Conversational Classroom, (Case Study 1)](#)
- [How Do You Recruit or Retain Women through Inclusive Pedagogy? Designing for Diversity (Case Study 2)](#)

For a full list of NCWIT's best practices in engaging and retaining women students in information technology see its [Resources Page](#).

Tools for Mentoring Women Students

The [Center for Women in Technology](#) has developed [The Center for Women & Information Technology: Mentoring Tool Kit](#) and a companion Peer Mentoring Toolkit. NCWIT provides [Mentoring in a Box: Faculty Women in Computing.](#)

Women Students of Color

There is very limited applied research on the topic of attracting and retaining women of color, particularly Black and Hispanic women. As mentioned above, [Lynette Kvasny](#), associate professor at Pennsylvania State University has done [significant research](#) on Black women and other minorities and ICT, including access, digital literacy, attraction and retention in both education and the workforce. Although not enough of Dr. Kvasny's research has been applied her findings often reflect the current demographics. For example, [fewer women of color perceive ICT as a masculine career than white women](#). This is an important consideration in developing strategies and practices for engaging this group.

[African American Women in Technology](#) offers a mentoring services that matches Black women mentors with mentees. The [AAWIT Big Sister Network](#) is a **short-term, advice-based** program, which allows AAWIT members to be mentored by other women who are more advanced and knowledgeable in their respective careers and personal development. Women do not need to be employed in or aspiring to be employed in the field of Information Technology to become a mentor.

Black and Latino Students

Although there are a handful of ICT professional organizations and communities that promote Blacks and Latinos participation and leadership in the industry, there is very little support for students. (See [ICT Educator Resources for Improving Diversity in ICT](#).) This is an area in which we will continue our search for resources and best practices.

Students with Disabilities

Following are links to additional research, whitepapers and practices for developing curriculum that engages students with disabilities.

From the National Center for Women in Information Technology (NCWIT):
[Equal Access: Inclusive Strategies for Teaching Students with Disabilities](#)

The National Science Foundation recently awarded a 4-year grant to the National Technical Institute for the Deaf in Rochester, New York to launch [DeafTEC,](#) which stands for Technological Education Center for Deaf and Hard-of-Hearing Students, an Advanced Technological Education National Center of Excellence. There are several dozen Advanced Technological Education centers in the U.S., but this will be the first aimed at serving the deaf and hard of hearing. High schools, community colleges and employers will be able to tap into its resources for study in the areas of science, technology, engineering, and mathematics. DeafTEC's goal will be putting more deaf and heard of hearing students into jobs by providing information related to preparing these students for technical careers.

Students with Limited English Proficiency

An increasing number of English as a Second Language (ESL) students at City College of San Francisco (CCSF) express interest in learning job-specific English, either to improve their job performance or to increase their chances of finding work. In response to this interest, CCSF has been expanding the numbers and types of vocational ESL (VESL) classes offered. Class materials and other resources can be at [Teaching Materials for Vocational English as a Second Language](#).

Additional resources for English language learners and vocational ESL can be found at the [Career Ladders Project site](#).

Identifying and Sharing New Tools and Practices

The project to create the first version of a Diversity Toolkit revealed that there is much work to be done to address the disparity of students from underrepresented groups in ICT. This is not surprising, considering the realities of the situation. If adequate resources and practices were available and applied, the gaps wouldn't be so large.

To continue to improve this toolkit, MPICT, in partnership with the California Community College ICT Collaborative, has started a community of practice (CoP) with a focus on Diversity in ICT. Inviting ICT educators attending diversity tracks at faculty development events was the initial approach to building the community. This group of approximately 25 educators and ATE center staff agreed on purpose, goals and design of the CoP, which was launched in May 2012 and the community was opened to all.

The mission and goals are:

To share and gain knowledge on how to attract and improve the experience of ICT/CTE students from underrepresented groups

Community goals:
- **Identify sustainable strategies and practices for attraction, retention, and completion**
- **Understand the challenges and barriers to implementation these practices**
- **Recognize what we're learning about CoPs and use that knowledge to sustain what we accomplish in this and other communities**

The Diversity in ICT Community of Practice is powered by Groupsite.com, a multi-purpose social collaboration platform. "Social collaboration" is the blending of community and collaboration, which is at the core of the CoP's mission and goals.

Since its launch, members of the CoP have posted notices and recaps of events, calls for funding proposals, and discussion threads seeking feedback on work-in-process and ideas for a future community face-to-face meeting. MPICT and the CCC ICT Collaborative invite ICT faculty, counselors, administrators, and members of centers and organizations with interest in improving the diversity of underrepresented groups in ICT education and workforce to join in on the community. Go the site and click on **Join this Group Now**! Working together, the fruits of the collaboration will provide content for ongoing update to this toolkit.

References, Resources and Events

Early College High Schools: Clifford Adelman. 2006. *The Toolbox Revisited: Paths to Degree Completion from High School Through College.* Washington, DC: U.S. Department of Education.)

Margolis, Jane (2008) *Stuck in the Shallow End*, The MIT Press

Tavernise, Sabrina (2012) *Whites Account for Under Half of Births in U.S.* New York Times, Retrieved from http://www.nytimes.com/2012/05/17/us/whites-account-for-under-half-of-births-in-us.html?pagewanted=all

Wiseley, W. Charles (2011). Effective Basic Skills Instruction: The Case for Contextualized Developmental Math. Pace Policy Brief. School of Education. Stanford University

Black Girls Code
http://www.Blackgirlscode.com/index.html
A bay area organization dedicated to increasing the numbers of young women of color in the field of digital and computer technology by providing free camps, workshops, role models and other opportunities including a blog written by girl participants of all ages.

Center for Urban Education (CUE) Toolkit for increasing Latina and Latino STEM Baccalaureates
http://cue.usc.edu/tools/stem_focus.html
This toolkit develops competencies that facilitate Latina/o student success in STEM, by helping both campus teams and individuals understand issues facing these students.

The Coalition to Diversify Computing (CDC)
http://www.cdc-computing.org/about/
CDC projects seek to target students and faculty with the expressed intent of increasing the number of minorities successfully transitioning into computing-based careers in academia, federal laboratories and industry.

CompuGirls: A Social Justice Technology Program for Girls
http://sst.clas.asu.edu/compugirls
CompuGirls is a culturally relevant technology program for girls, grades 8-12, from under-resourced school districts in the Greater Phoenix area.

Culturally Situated Design Tools
http://www.ccd.rpi.edu/Eglash/csdt
Culturally Situated Design Tools (CSDT) are software applications aligned with computer science curriculum. CSDTs address African, African-American, Latino, Native American, and Youth Subculture themes.

Into the Loop: Computer Science Equity Alliance
http://idea.gseis.ucla.edu/projects/into-the-loop
Seeks to deepen the capacity of the Los Angeles Unified School District to offer and support high-quality, college preparatory computer science classes.

Microsoft Community Learning Portal
http://www.microsoft.com/en-us/itacademy/mclp.aspx
Free online learning opportunity for approved nonprofit centers and computer labs that offer ICT skills training to underserved communities.

Viva Technology™
http://www.greatmindsinstem.org/k-12/viva-technology-over-view
A program designed to engage inner-city and rural K-12 students, teachers and parents in activities that stimulate their interest and academic achievement in STEM subjects.

CAITE Events
Access from http://caite.info/news/index.html
A list of upcoming events related to women and minorities in computing/IT (includes links to websites).

CAITE Resources for Educators
http://caite.cs.umass.edu/educators/
A compilation of resources relevant to CAITE's mission: guides, workbooks, ideas, and various other ways to improve and increase the participation of women and minorities in computer science and IT.

Grace Hopper Conference
Access at http://gracehopper.org
The Grace Hopper Celebration of Women in Computing is a series of conferences designed to bring the research and career interests of women in computing to the forefront. Presenters are leaders in their respective fields, representing industrial, academic and government communities. Leading researchers present their current work, while special sessions focus on the role of women in today's technology fields, including computer science, information technology, research, and engineering.

National Women of Color Technology Awards Conference
Access at: http://www.ccgmag.com/woc/index.php
The Women of Color Science, Technology, engineering and Math (STEM) Conference has been the conference of choice to recognize the significant accomplishments of minority women in the digital world, and attract and leverage talent in innovative, professional, and technical positions. A leading, high-level meeting of minority women in information technology, computer science, information science, bioinformatics, digital arts, and system, the Women of Color STEM Conference is the place to connect with the key issues in U.S. job growth diversity, the critical shortage of women in IT careers, technological innovation, and women-owned IT ventures.

Richard Tapia Celebration of Diversity in Computing
Access at http://tapiaconference.org
The Tapia Celebration provides a supportive networking environment for underrepresented groups across the broad range of computing and information technology, from science to business to the arts to infrastructure.