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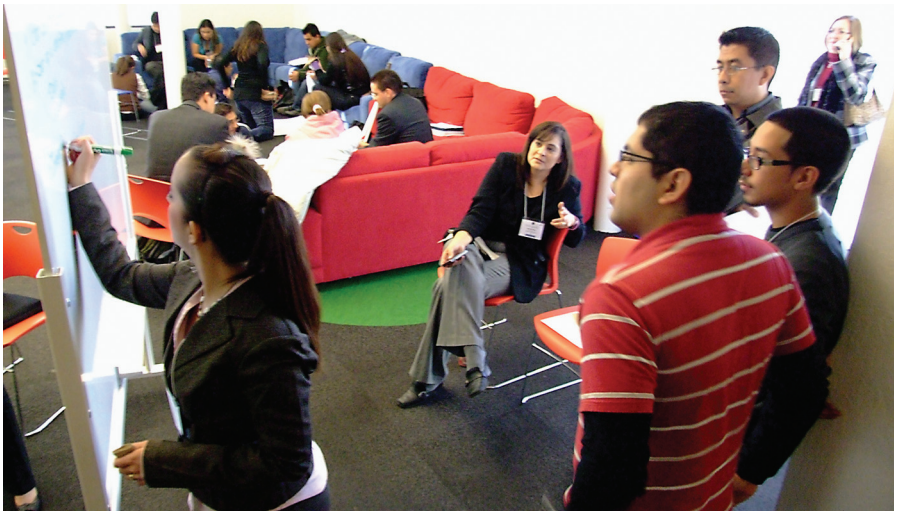
Broadening Participation

A Program Greater than the Sum of Its Parts: The BPC Alliances

Changing the trajectory of participation in computing for students at various stages of development.

There is virtually no discipline or aspect of our daily lives that is not positively impacted by advances in computer science. It has become the backbone of our technologically dependent society. In fact, computer software engineers are among the occupations projected to grow the fastest and add the most new jobs over the 2008–2018 decade.[6] Yet, bachelor's, master's, and Ph.D. degrees earned by U.S. citizens and permanent residents continue to decline.[3,7] Further, degrees earned by women, persons with disabilities, and underrepresented minorities (American Indians/Alaskan Natives, African Americans, Native Hawaiian's/Pacific Islanders or Hispanics) lag those of non-resident Aliens, Asians, and White males.



Students at the CAHSI 2009 annual meeting held at Google headquarters.

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Program Focus

Rather than focus on the problems that beset computing, we will emphasize solutions in the form of the National Science Foundation's (NSF) Broadening Participation in Computing (BPC) program.[a] The BPC-A program supports three categories of awards: Alliances; Demonstration projects (DPs); and Leveraging, Scaling, or Adapting Projects, or Demonstration Projects (LSA). Typical DPs pilot innovative programs that, once fully developed, could be incorporated into the activities of an Alliance or otherwise scaled for wider impact. LSA projects can leverage, scale, and adapt the work of Alliances or DPs, as well as efforts by other organizations to extend the impact of effective practices. Alliance and Alliances Extension Projects (Alliances) represent broad coalitions of academic institutions of higher learning, secondary and middle schools, government, industry, professional societies, and other not-for-profit organizations designing and carrying out comprehensive programs to reduce underrepresentation in the computing disciplines. Projects may target stages of the academic pipeline from middle school through the early faculty ranks, and are expected to have significant impact on both the quality of opportunities afforded to participants and the number of participants potentially served.[5]

NSF funding for the Alliances began in 2005/2006 with most programs operating with students approximately one year later. Ten alliances constitute the core of BPC as of 2009. An eleventh alliance, the National Center for Women & IT (NCWIT), predated the BPC program, but has served as a focal point and resource for all the Alliances, par-

a For additional information on the BPC program, visit: http://www.bpcportal.org/bpc/shared/home.jhtml.

NSF BPC Alliances*

A4RC (N. Carolina A&T)	www.a4rc.org
AccessComputing (U. Washington)	www.washington.edu/accesscomputing
CAHSI (U.Texas-El Paso)	http://cahsi.org
Computing Research Association-Women/Coalition to Diversify Computing	www.cra-w.org and cdc-computing.org
STARS (U. N. Carolina)	www.starsalliance.org
ARTSI (Spelman College)	http://artsialliance.org/
CAITE (U. Massachusetts)	http://caite.cs.umass.edu
El (Rice U)	http://empoweringleadership.org
GeorgiaComputes! (Georgia Tech)	http://gacomputes.cc.gatech.edu/
Into the Loop (U. California, LA)	http://intotheloop.gseis.ucla.edu
NCWIT (Nat'l Ctr for Women & IT)	http://www.ncwit.org

*as of 2009

ticularly for those focusing on gender. Jointly, these 11 Alliances have blanketed computer science with alternatives for diversifying participation in computer careers (see the table here).

In unison, the BPC Alliances endeavor to significantly increase the number of U.S. citizens and permanent residents receiving degrees in the computing disciplines, with an emphasis on students from communities long underserved in computing. Cohorts of students—those steeped in poverty, first-generation college-goers, ignored through stereotyping and low expectations, academically underprepared or not resembling what computer scientists traditionally look like—are being reached, gaining confidence and skills, and making progress toward degrees and careers in computing.

By working to create a critical mass on campuses, the BPC Alliances have built their own infrastructure(s), encompassing both the physical (facilities, instrumentation) and the social (networks, partnerships) components of their activities. The Alliances extend organizational commitments to educate, train, and utilize science, technology, engineering, and mathematics (STEM) professionals in various communities. Individually impressive, the BPC Alliances are more than the sum of their parts and greater than the sum of their experiments. Some Alliances target specific races or ethnicities, others direct their efforts toward women or persons with disabilities, and several Alliances reach to all underrepresented groups. Together, the Alliances are a cohesive entity, providing the field with alternatives that enable participation by all.

The BPC Alliances are not about quick fixes. Rather, they aim to produce systemic changes—changing the trajectory of participation in computing for students at various stages of development. Such change comes not only through impacts on individual students and educators, but also as institutions adjust their approaches and structures to enhance the teaching and learning of computing. The Alliances embody goal-directed change across the educational spectrum. Simply put, they develop talent. Students are encouraged to work hard and be successful, whether that means entering the work force upon high school graduation or pursuing a college or advanced degree.

The American Association for the Advancement of Science (AAAS) Center for Advancing Science & Engineering Capacity[b] staff conducted a three-year portfolio assessment of the Alliance component of the BPC program. The Capacity Center found the 11 BPC Alliances are implementing various methods to attract, nurture, and retain students, using innovative practices and strategies.[2] Four approaches are demonstrating success:

▸ *Reforming statewide systems*. Alliances work across different institutions and systems (for example, K–12, two-year, and four-year) to develop a common data framework enabling them to focus on students and educational systems as well as operate on various levels of the education pathway.

▸ *Focusing on undergraduates*. Alliances employ varied methods, such as introductory computer classes designed to attract majors and bolster underprepared students; peer-facilitation in the gatekeeper courses; undergraduate professional socialization and research experiences; mentoring; developing undergraduates' technical excellence, leadership skills, and civic engagement around computing; and, partnering undergraduates with younger students so that both are motivated to reach their personal best in computing.

▸ *Connecting unlike institutions/Creating new partnership models*. Alliances build productive relationships between dissimilar institutions (for example, the University of California, Los Angeles with the Los Angeles Unified School District; Historically Black Colleges and Universities with top research universities). These models feature novel research collaborations, team learning, and multiple educational pathways.

▸ *Creating national, interlocking networks*. Alliances socialize computer science students at all levels, providing students and educators with opportunities to share experiences and develop professional skills and knowledge.

Regardless of approach, the Alliances are committed to collaboration, serving on each others' boards, conducting face-to-face meetings of senior personnel, contributing to the BPC Portal, and disseminating results. Virtually all of the Alliances work with AccessComputing to increase their inclusion of persons with disabilities, send students and faculty to the annual STARS Celebration, and encourage their students to join the Empowering Leadership (EL) Alliance and participate in the CRA/CDC's programs. Together, they are forming a national infrastructure for change. This includes devising a common core of indicators to measure and monitor Alliance progress (see BPC Common Core Indicators[1]).

A Snapshot of the Alliances

Each BPC Alliance has a storyline that conveys the excitement of its work. We encourage readers to visit the Alliance

b The AAAS Center for Advancing Science & Engineering Capacity is a fee-for-service consulting group that provides institutions of higher education with assistance in improving delivery of their educational mission, especially in science, technology, engineering and mathematics fields. Details can be found at www.aaascapacity.org.

Web sites listed in the accompanying table to obtain in-depth and updated information.

While seeking to increase African-Americans' entry into computing research careers, the Alliance for the Advancement of African American Researchers in Computing (A^{4}RC) and the Advancing Robotics Technology for Societal Impact (ARTSI) connect students at Historically Black Colleges and Universities with the resources of top research institutions. A^{4}RC covers a range of research topics; ARTSI focuses entirely on robotics.

The AccessComputing Alliance strives to increase the number of students with disabilities who complete postsecondary computing degrees and enter the computing work force. The program leads capacity-building institutes for computing departments. The Computing Alliance of Hispanic-Serving Institutions' (CAHSI) interventions center on undergraduates and the gateway of introductory courses, as well as the power of peer groups, to increase the number of Hispanic students entering the computing professoriate and work force.

With a goal of increasing women's participation in information technology, the NCWIT has programs in K–12 education, college-level outreach and curriculum reform, corporate recruitment and retention, and entrepreneurial endeavors.

Other Alliances work to increase the numbers of all minorities. For example, Students & Technology in Academia, Research & Service (STARS) targets undergraduates and directs its efforts toward all underrepresented groups, including those with disabilities. Its centerpiece is the STARS Leadership Corps, a program that draws students from all member institutions in yearlong, team-based leadership projects. Also working to increase the number of minorities is the EL Alliance, a program that provides a safety net to its participants by fostering networking opportunities, ongoing communication, and a shared learning experience.

Using community colleges as its centerpiece, the Commonwealth Alliance for Information Technology Education (CAITE) focuses on women and minorities in groups that are underrepresented in the Massachusetts innovation economy, that is, economically, academically, and socially disadvantaged students. Georgia Computes! works to attract women and minorities into computing by building a computing education pipeline across the state of Georgia. Into the Loop aims to increase the computer science learning opportunities of students in the Los Angeles Unified School District and broaden the participation of African Americans, Hispanics, and girls in computing via the Computing Science Equity Alliance.

The BPC Alliances have made the field of computing more real and more attainable for many students.

Looking Ahead

The BPC Alliances have made the field of computing more real and more attainable for many students. In accomplishing this feat, BPC Alliances highlight at least two key characteristics of good alliances: the ability to collaboratively adjust approaches, structures, and practices; and the ability to develop new communication infrastructures to more effectively plan, implement, evaluate, and broadly disseminate effective practices.

In FY 2011, the NSF's Division of Computer and Network Systems is investing in a comprehensive Education and Work Force (EWF) Program. The BPC Alliance Program, Computing Education for the 21st Century (CE21), and the Graduate Research Fellowship Program will be funded as part of that activity. The Computing Education for the 21st Century (CE21) program seeks to increase competencies for *all* students, regardless of gender, race, ethnicity, disability status, or socioeconomic status. By promoting and enhancing K–14 computing education, it will enhance interest in and student preparation for careers in computing-intensive fields. CE21 will support Type I (smaller-scale studies of the effectiveness of new instructional materials and interventions and strategies to develop K–14 teaching expertise), Type II (proven effective implementations taken to scale), and Planning proposals (support for the establishment of new partnerships and collaborations to develop Type I and Type II proposals)[5].

Through the EWF program, NSF seeks to build on the foundation of the BPC Alliances to reach more students and illuminate pathways into computing. An important stated goal of the EWF program, in fact, is to "transform computing education at all levels and on a national scale to meet the opportunities of a world where computing is increasingly essential to all sectors of society." Considering the multiple stakeholders involved, the importance of cultivating interpersonal relationships, forging and embracing shared values, and using process and outcome data to monitor and evaluate Alliance contributions to computing, the BPC Alliances are fulfilling the expectation of how transformative models of intervention in a STEM discipline look and function. C

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