Broadening Participation in Computing Research and Education

Report of a Workshop October 20–21, 2004

Introduction

The National Science Foundation's Computer and Information Science and Engineering Directorate is undertaking a major initiative to ensure that our diverse population participates fully in computer science education and research. This effort has been entitled "Broadening Participation."

In October 2004, the Computing Research Association organized a workshop to clarify the principal issues involved and to identify potential solutions. Each of the groups traditionally underrepresented in computing—African Americans, Hispanics, Native Americans and Indigenous People, Persons with Disabilities, and Women—was represented.

The goals of the workshop were to:

1. Identify community-specific critical issues.
2. Catalyze a larger community engagement in efforts to broaden participation.
3. Identify intra- and inter-community common ground.
4. Promote the formation of alliances to address issues of common ground.

The workshop organizers wanted to identify issues that exist on the individual group level as well as across all underrepresented groups. And we hoped that showcasing common issues would ultimately lead to joint efforts to address them. Because the motivation behind this initiative is to increase the participation of all underrepresented groups, it will be necessary to focus on large-scale systemic efforts and change; thus, common ground.

To open the workshop, NSF staff (Tom Windham, Peter Freeman, Greg Andrews, and Jan Cuny) provided the context for the initiative and the workshop. Most of the workshop time was spent in a series of break-out and report-out sessions, first in community-specific groups and then in more general, cross-community groups.

This report focuses on conclusions reached during the workshop. The Participant List and Agenda are attached.

Results: Common Ground

Much of the discussion focused on the development of common ground: What are the issues that cut across groups? Can we address these issues more effectively by working together to avoid duplication of effort? The groups identified a number of common issues—so many, in fact, that they joked about being able to use each other's slides in

the report-out sessions. The most important cross-cutting issues were found in a number of areas, listed below with some suggested actions.

***Image/Understanding of Computer Science*.** The common stereotype of the computer scientist as a loner, staring at a terminal 24-7 without any human interaction, is inaccurate and is a deterrent to many students. The common belief that computer science *is* programming is equally damaging. We need a broader and more accurate definition to make students aware of its relevance to society and to their lives.

Retaining Students in Computer Science. For a variety of reasons, bright and motivated students may find themselves under-prepared as they enter more rigorous undergraduate or graduate programs. We need to provide encouragement and support for these students by creating bridge/transition programs that help retain their interest in computer science.

***Mentoring*.** Faculty are not trained as mentors; as a result, they often work best with students who are much like themselves. We need to make training available to help faculty become more effective in mentoring a diverse population.

***Institutional Change*.** Institutions must increase the participation of underrepresented groups by reducing bias in processes for recruitment, retention, promotion, tenure, and awards. Senior-level, majority faculty must be involved in these efforts.

Relationships Between MSIs and Majority Institutions. A large percentage of degrees earned by minority students are awarded by the Minority-Serving Institutions, yet these schools are often ignored or undervalued by mainstream institutions. We need to develop real, two-way partnerships between major research universities and the MSIs.

Effective Practices Repositories. Often diversity programs are not well evaluated and their results are not widely disseminated. Consequently, we do not have an adequate body of knowledge about successful interventions, and time and resources are spent reinventing the wheel. We need to collect data that documents the need for change, provide implementers with resources for evaluation and assessment, and make successful models available through repositories.

Outreach to K-12. We lose many of our brightest students before they even get to our colleges. We need to engage students, their families, and their communities during the K-12 years; we need to build partnerships with industry and with organizations (Girl Scouts, Boys and Girls Club, Urban League, etc.). We need to ensure that the curriculum and teaching materials used in K-12 go beyond mere programming to more accurately reflect the intellectual problem-solving aspects of computer science.

Undergraduate Education. Many issues in undergraduate education were common to all groups: the importance of providing research experiences and internships, the need to have critical masses of underrepresented students (or to build cohorts) to protect against isolation, the need for mentors and role models, the need for pathways from IT (or other fields) to move into CS, and the need to provide comprehensive financial aid for low-income students,

Graduate Education. All graduate students need to be brought into the research life of their departments as soon as possible; this is especially true for students with fellowships or teaching assignments who may not have the normal avenues of contact with research groups. Students should be provided with mentors and role models and the support they need to begin making networks of professional contacts.

Funding. To broaden participation in CS, we will need long-term, stable funding.

Results: Community-Specific Critical Needs

African American Community

The African American breakout group identified seven critical issues that have an impact across the pipeline (see Table 1). They added a number of issues that affect African American students more often than majority students. African Americans were, for example, more likely to have the increased economic pressure of supporting families. They may feel a stronger need to give back to their community. In addition, they are more likely to suffer from isolation in academic programs because of their minority status, because they were nontraditional students, or because they were on fellowships. (Fellowships at the graduate level reduced the likelihood that the students would be immediately drawn into the same kinds of research group/environments as the more usual Research and Teaching Fellows.) The Hispanic breakout group mentioned all of these as issues for their students as well.

Critical Issue	K-12	Undergrad	Grad	Faculty	Profession
First-generation students		X	X	X	X
Low numbers led to isolation	X	X	X	X	X
Low expectations from faculty and advisers	X	X	X	X	
Low early involvement in CS		X	X		
Lack of exposure to research opportunities		X	X	X	
Low number of tenured & full professor AA faculty (role models)		X	X	X	X
Need for focus on non-academic issues (environment)		X	X	X	

Table 1

NSF's Louis Stokes Alliances for Minority Participation and AGEP programs were deemed successful in building alliances that provide students with mentoring, peer connections, internships, and formal exposure to research and the graduate school process/culture.

The group suggested a number of similar programs that could be broadened:

- Extend local programs to a national level, institutionalizing components to become part of the systemic infrastructure.

- Extend the National Center for Women and Technology (NCWIT) model to be an umbrella for a NCBP. This would require making contacts with industry, academia, and the community, and would need to have key people with resources and staff in order to get started.

- Extend the Institute for African American E-Culture (iAAEC, http://www.iaaec.org) model, extending beyond CS, consciously building on culture in IT.

- Extend programs that have worked from one group to other groups. As an example, the CRA-W Career Workshops contain much common material (time management, always being asked to serve on committees, etc.) and could be augmented with additional, community-specific material (being connected with a community, bringing culture into the academic environment, economic background, etc.).

- Intra-community efforts in conjunction with, for example, the Boys and Girls Clubs, the Urban League, and the United Negro College Fund (UNCF, which has new leadership from academia).

- Inter-community efforts aimed at the linkages between HBCUs and Majority Institutions. [Note: It is important that this linkage be a two-way, rather than the traditional one-way, street. Faculty incentives might be able to change the culture to value such a relationship.]

In addition, the group advocated a focus on inclusion, cross-community efforts, and mentoring, as well as the need to promote African American candidates for national leadership positions (in both academia and industry) and for national awards. They noted that we need to avoid competitive environments among the under-represented groups, and focus instead on working together to transform the system.

Hispanic Community

The Hispanic community identified a large number of critical issues, and then voted on the most important. The top four were:

1. Migration of many Hispanic students away from the STEM disciplines. This includes low recruitment into undergraduate programs, poor graduation rates from those programs, and poor rates of subsequent matriculation in graduate programs.
2. Low overall levels of funding for CS within NSF and elsewhere.
3. Lack of Hispanic Ph.D.s in CS, which makes it hard to hire Hispanic faculty as role models and mentors.
4. Difficulty of finding resources to support students.

Problems/critical issues that ranked lower in the vote were (not in any order):

5. The Hispanic community itself is ethnically and regionally diverse, and there is a need for community-building. One program will not address issues for all Hispanics.
6. Support is needed for minority faculty to sustain their research beyond the Ph.D.
7. Need to build early awareness of STEM in the Hispanic community.
8. There is a particularly low rate of transition of Hispanic women from M.S. to Ph.D. programs.
9. Hispanics have strong family ties and they are under to pressure to remain local.
10. There is a low perception of HSIs by HSI and nonHSI faculty, as well as HSI students. This contributes to low expectations for both students and faculty and a "reverse halo effect," which makes it harder for faculty to get funding, etc.
11. The attraction and retention of strong students and faculty (in competition with the R1 schools) is difficult even for those HSIs that have been successful in getting considerable research funding.
12. Infrastructure and student support must go together, but are often decoupled by funders.
13. There is a lack of collaboration between HSIs and nonHSIs.
14. HSIs feel used by majority institutions, citing the "day before deadlines" proposals for collaborations that never materialize. HSIs do not want to be merely "feeder" schools contacted at "harvest time."
15. Open admissions schools have difficulty preparing students at the proper level for grad school.

The group supported broadening participation efforts aimed at improving collaborations between HSIs and majority institutions, making those collaborations two-way, giving incentives for the R1 schools to participate in meaningful ways, and providing the resources to sustain them. They proposed a closer integration of education and research to improve the image of CS and student motivation. They lauded the REU program as providing personal empowerment. Again, this comment was repeated by all of the groups.

The Hispanic group also recommended programs that achieve critical mass by building community (cohorts) across departments. Like all groups, they believed that mentoring and mentor training were crucial. They recommended programs to address the fact that high school and undergraduate students are under-prepared, especially with respect to math, and it was suggested that strong high school students be encouraged to pursue math training at universities.

Native American and Indigenous People

The Native American community focused more on the role of CS and IT education within native culture and communities. They emphasized that any attempts to engage Native American youth must be made in the context of that culture. Specific issues they addressed were:

- Native students have strong family ties and do not want to leave their communities for education or employment.
- Young people in Native and Indigenous Communities are familiar with (and taken with) technology, but they tend to see it superficially in its commercial

applications without seeing its relevance to major issues in their lives, such as language and culture preservation or ecological sustainability.
- Native youth must be engaged within a cultural context.
- There is a critical lack of teachers with the necessary CS background, both at the high school and Tribal College level.
- There is a growing body of Native and Indigenous students graduating with CS degrees from majority institutions, but they do not see graduate school as an option and need to be engaged.

Persons with Disabilities

This breakout group stressed the complexity of their problems, which could be broadly thought of as:

Access/Awareness
Comunications
Connections
Expectations
Support
Scholarship

The problems of the disabled cut across all underrepresented groups, as well as the majority. The most critical issues identified are:

- Disabilities have been an invisible problem; there is a need for national awareness.
- The small numbers of persons with disabilities have affected the level of awareness and funding.
- The disabled community is, in itself, splintered.
- There is competition between subgroups.
- There are no real advocacy groups for the disabled.
- There is a lack of support for training teachers teaching the disabled, for example, in such things as communication skills (Braille or ASL).
- Assistive technologies exist in many cases, but they are not deployed.

The disabled population often has a lack of confidence that “I” can do it, and this is compounded by the generally held low expectations of the abilities of disabled professionals.

The group suggested some approaches to consider, including:

- More generalized (horizontal) emphasis in the K-12 arena, including the funding of research and implementation efforts to prime the pipeline.
- More vertical integration in higher education.
- Better alignment with other educational activities such as math fairs.
- Increased awareness of what disabilities mean—both problems and solutions. This could be both local and national. Locally, work could be done with parents and support groups. Nationally, it could be done through awareness videos and/or Web distribution. The news media could do reports on success stories, and professional journals could have special issues.

- Increased finding. It might be possible to tie funding for research and delivery projects to national needs such as security. The community should lobby for legislative support and for the involvement of industry.
- Better coordination with ATIA.
- Creation of a MentorNet for disabled persons.
- Collection of better data on the stumbling blocks for disabled students to help build programs that work.
- Support for "best practices" projects such as a clearing house (making sure that it works for the various subgroups).
- Support for projects that will lead to better transportation and independent living.
- Support for the development and deployment of tools to help persons with disabilities; that is, NSF should provide additional money for accessibilities (technologies, interpreters, etc.).
- More internships (stipends) for high school or college students in industry and academia.
- Work with agencies (state and private) and schools to identify the intended beneficiaries of BP efforts.
- Make universal design for accessibility a requirement in grants and ABET.
- Institute BP Supplements for existing research grants that are human resources related (e.g. support for disabled RA or Postdoc).
- Develop transition or bridge programs, and expertise, perhaps in a center, that people can go to for assistance.

Women

Although there have been changes over the past ten years—the number of women taking math in high school has increased, the perception of CS as the domain of older males has changed to one of younger males, and the number of highly placed women has increased—there has not been much of a difference for the field. The group listed a number of critical issues:

- K-12 CS teachers often have no training and there are no standards, so they do not inspire students. In addition, CS is usually not a requirement and the classes are filled with males. These factors make it unattractive to girls who are more likely to do well in required courses such as biology and chemistry.
- Entering college students (maybe students in general) are not aware of the range of career opportunities in CS.
- The way we educate at the undergraduate level is often inappropriate: usually courses use math or games to motivate discussions, but undergraduate women may be more interested in applications-oriented course content.
- We need more creativity in degree programs, including more of a focus on HCI and societal applications.
- CS departments often have a poor image. Frequently they are seen as service departments as is math. Math, however, "looks" better to students who may see all of the details of programming as dull, just plumbing—and may be turned off by all of the male-oriented games.
- Some students from smaller colleges do not have access to research experiences.

- Cultural attitudes in the CS environment remain a challenge. Faculty attitudes—the internships/jobs they recommend, how they teach their classes, and how they represent the field—are often chilling to women.
- Because of the small numbers, women may not have appropriate social networks that would encourage them to stay in CS.
- Senior women do not get the recognition they deserve for their accomplishments.
- Senior women are overworked, and yet are expected to participate in broadening participation efforts.
- Industry, outside of a few competing industries, is not engaged/concerned enough even though IT is the driving force in the economy.

The group suggested a number of promising responses.

- Educational changes, including looking at cohort effects (such as pair programming), changes in curriculum at the undergraduate level (degree programs, the introduction of research software into the curriculum, and a focus on interesting applications), and a broadening of entry criteria at the graduate level.
- The introduction of bridging programs for the high school to undergraduate and undergraduate to graduate transitions.
- An effort to redefine the popular image of computer science.
- Improvements in mentoring at all levels.
- Long-term funding.
- The development of partnerships and collaborations (such as K-12, GS-USA, the PRIME Project, lead-the-way, and teach-the-teachers efforts).
- Strengthening the application of NSF Merit Review Criteria 2; perhaps researchers who do not include broadening participation efforts should have to explain why not.

The group discussed two approaches to broadening participation in computing—a collaborative model for working with other under-represented groups, and a carrot-and-stick model for promoting change. They proposed collaborating by sharing information and expertise. In addition, they proposed using the carrot of advice, information, and support, together with the stick of no funding without adequate and documented representation of BP efforts. Finally, they acknowledged that their assumption itself—that bringing more women into research positions would help to bring more women into computing—needs to be verified.

Conclusions

In summary, the workshop was successful in finding common ground that could be addressed in a larger context, and in setting agendas for specific communities. Further, it was noted that all of the suggestions put forward would be good, not only for underrepresented minorities, but for everyone.[1]

[1] See David Patterson's President's Letter, "Minority-Minority and Minority/Majority Technology Transfer," *CACM*, January 2005.

CRA Workshop on Broadening Participation
October 20-21, 2004
Washington, DC

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Caroline Wardle (National Science Foundation)
Tom Windham (National Science Foundation)
Bryant York (Portland State University)

Agenda: Broadening Participation Workshop

Wednesday

8:00-9:00 **Continental Breakfast**
Lobby of Salon A

9:00-10:20 **Opening Session**
Senate Salon A
Andy Bernat, Executive Director, CRA
Tom Windham, Senior Advisor, NSF
Peter Freeman, Assistant Director for CISE, NSF
Bryant York, Professor, Portland State University
Jan Cuny, Program Director CISE, NSF
Roosevelt Johnson, Program Director EHR, NSF

10:20-10:35 **Break**

10:35-12:00 **Session 1 (Breakout)** Community-Specific Issues: The Local Picture

12:15-1:30 **Lunch**
Senate Salon B

1:30-2:30 **Session 2 (Breakout)** Community-Specific Issues: The Larger Context

2:30-3:00 **Break**

3:00-4:30 **Session 3** Community-Specific Issues, Group Report Out
Senate Salon A

Dinner Participant Sign Up
Dinner reservations have been made for the group at
Harry's Tap Room, 2800 Clarendon Blvd., for 6:30

If you do not plan on dining with the group, please feel free to make your own arrangements.

Thursday

8:00-9:00 **Continental Breakfast**
Lobby of Salon A

9:00 **Opening Session**
Senate Salon A
Greg Andrews, CISE/CNS Division Director, NSF
Lecia Barker, Evaluation and Research Group, ATLAS

9:15-10:45 **Session 4 (Breakout)** Common Ground

10:45-11:00 **Break**

11:00-12:00 **Session 5** Common Ground, Group Report Out
Senate Salon A

12:00-1:15 **Lunch**
Senate Salon B

1:15-2:45 **Session 6 (Breakout)** Next Steps

2:45-3:00 **Closing Remarks**
Senate Salon A