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CRA-W/CDC Alliance Broadens Participation in Computing

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ABSTRACT

Since 1994, the Committee on the Status of Women in Computing Research (CRA-W) has offered the Distributed Research Experience for Undergraduates (DREU) program to increase gender diversity in the computing research community. DREU gives undergraduate women the experience of conducting summer research with a professor of computer science or computer engineering (CSE). In 2006, CRA-W joined with the Coalition to Diversify Computing (CDC) to form an alliance with the goal of increasing participation of underrepresented minority women and men in CSE doctoral programs. This paper documents the CRA-W/CDC Alliance’s progress toward that goal in the DREU program. We find that deliberate efforts to recruit underrepresented minorities into the DREU program are meeting with success.

Keywords

Computer science, DREU, race, gender, undergraduate research experience.

INTRODUCTION

Efforts to diversify computing seldom produce the substantial impact that computing professionals wish. Data from the Taulbee survey show persistent decline in women’s representation despite years of effort to reverse the trend. Women’s share of computer science and computer engineering Bachelor’s degrees from Doctorate-granting institutions fell from 18% in 1994 to 12% in 2008 (Vege 2008). Likewise, minority representation in computing remains low. For example, all minority groups totaled only 9 percent of students receiving computer science bachelor degrees from Doctorate-granting institutions in the 2006-2007 academic year (Zweben, 2008). Despite the apparent difficulty, members of the computing community persistently work to increase the participation of women and minorities, and sometimes they enjoy success.

The Committee on the Status of Women in Computing Research (CRA-W) has offered the Distributed Research Experience for Undergraduates (DREU), a research experience and mentoring program for undergraduates in computer science and computer engineering (CSE), for 14 years. The DREU program places students from underrepresented groups with CS faculty mentors at various institutions for a summer research project. Until recently, the program targeted only women students, but in 2006, CRA-W and the Coalition to Diversify Computing (CDC) formed an alliance with the goal of increasing women’s and minority men’s participation in CSE doctoral programs by increasing the diversity of DREU participants.

The Coalition to Diversify Computing is a joint organization of the ACM, CRA, and IEEE-CS. The CDC seeks to develop a diverse community of computing professionals by increasing the number of minorities entering and succeeding in computing careers in academia, federal laboratories, and industry. This goal made joint sponsorship of the DREU program a natural step for the CDC.

In this paper, we track progress toward the goal of diversifying computing by comparing DREU demographics with the national demographics for women and minority men graduating from CSE undergraduate programs pre- and post-Alliance. These comparisons show the progress made by the CRA-W/CDC Alliance; minority representation in DREU approached or exceeded their representation in the national pool of minorities in computing.

MENTORING AND RESEARCH EXPERIENCES IMPROVE RETENTION & ADVANCEMENT

The CRA-W/CDC Alliance assumes that by creating diversity in a program that successfully prepares and attracts students into computing research careers, the diversity in those careers will increase.

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1 The DREU program was formerly known as the Distributed Mentor Project (DMP).

2 The National Science Foundation’s Broadening Participation in Computing (BPC) program funded the Alliance.
Certain practices are generally effective for recruiting, retaining, and advancing women in computing (NCWIT). For example, research shows that mentoring for diversity can improve the retention and advancement of women in computing (Cohoon, Gonsoulin, and Layman, 2004). Likewise, research experiences are a generally effective retention tool (Dahlberg Barnes, Rorrer, and Powell, 2008; Astin and Astin 1992), as is same-sex peer support (Cohoon, 2006). Several programs, including DREU, capitalize on these positive effects to increase diversity in computing (For example, see Walker and Rodger, 1996), although few carefully document their outcomes.

Mentoring involves a personal relationship in which a more experienced person shares their experience and network connections with a less experienced person; it is a well-documented practice for promoting success in a variety of settings. In the case of computing, evidence shows student-faculty mentoring relationships, which include activities promoting involvement in computing professions, helping students establish their careers, and providing personalized advice and encouragement, can be very beneficial. Student mentees tend to earn higher grades, persist beyond doubts or difficulties they encounter, and continue on to graduate school, all to a greater extent than students not in mentoring relationships with faculty (Tashakkori, Wilkes, and Pekarek, 2005; Cohoon et al. 2004; Campbell & Campbell 1997). A nationwide study of undergraduate computing programs found that when faculty members specifically intend their mentoring to improve minority representation in computing, the result is equalized retention of men and women within their undergraduate program (Cohoon, 2004). For these reasons, mentoring is used by DREU and is often a cornerstone of intervention programs that attempt to support and advance students from underrepresented groups in computing.

Experience with research also promotes student success and retention (Hunter et al. 2006; Russell 2005). It can increase the rates at which women and under-represented minorities persist and enter research careers because research experiences lead to greater understanding of research methods, increase confidence in research skills and general mastery of the discipline, and create awareness of career paths requiring an advanced degree (Barker & Cohoon, 2007). For these reasons, programs designed to retain and advance women into computing research careers often include a guided research component.

Same-sex peer support is often assumed to benefit women’s retention in computing, and this assumption has received some empirical support. Cohoon’s nationwide study of 209 undergraduate CS programs in the United States found that women’s retention approached that of men’s when women had access to more female peers. Focus groups at 18 of the study departments persistently found that students attributed their persistence as computing majors to having someone in class they felt comfortable calling on for help. This finding resonates with Astin and Astin’s observation that within-field friendships correlate with student retention in science, technology, engineering, and mathematics majors (1992). It motivates interventions that build affinity groups, a strategy that DREU employs.

Recruiting for increased diversity has been investigated in a variety of settings resulting in numerous recommended methods. One recommendation is to take advantage of established networks that include members of underrepresented groups. For example, an NSF ADVANCE-supported program at the University of Wisconsin recommends that female faculty be recruited to the sciences by contacting schools and colleagues for names of potential candidates. Going beyond that recommendation, social science research indicates that minority underrepresentation likely stems from their exclusion from the networks that afford access to job opportunities, for example (Petersen, Saporta, and Seidel, 2000). This information suggests the importance of communicating about opportunities through social networks that include underrepresented groups. The CRA-W/CDC Alliance seeks to do just that.

DREU combines mentoring, research experiences and peer support for an intervention program that has documented success with advancing women in computing. It was therefore an excellent candidate for expanding to include minority social networks and promote racial as well as gender diversity in computing. The CRA-W/CDC Alliance was formed for that purpose. In this paper, we examine the effectiveness of this initiative over its first two years.

METHODS FOR COMPARING DREU DEMOGRAPHICS

CRA-W/CDC Alliance programs seek to exceed the national representation of minority students in computing in order to maximize their positive impact. To assess progress toward that goal, we compare past and recent DREU demographics with demographics for U.S. recipients of bachelor degrees in computing (the DREU applicant pool). Data limitations, however, make all comparisons close approximations.

To illustrate the overall trend in minority representation among DREU participants, we compared two snapshots – one from an earlier program evaluation and one from a recent program evaluation. The earlier evaluation was conducted by the LEAD Center, a research center based out of the University of Wisconsin Madison. The more recent assessment was conducted with data routinely collected each year. National data from the NSF IPEDS provide context on the distribution of racial and ethnic groups across recipients of undergraduate degrees in Computer Science General (CIP code 11.01) and Computer Science (CIP Code 11.07).
To shed light specifically on any impact from formation of the Alliance, we also compare DREU demographics from the two years preceding the formation of the Alliance, 1994-2006, with those from the two post-Alliance years thus far, 2007 and 2008. National data are also provided for context.

The comparisons are close, but imperfect The LEAD Center closed in 2006, which resulted in loss of DREU data for 2001 and 2002, and makes it impossible to look at disaggregated data prior to 2001. As a result, the past–present comparison of DREU racial and ethnic composition covers seven years before 2001, leaves a gap of 2 years and then covers the six years from 2003-2008. All comparisons with DREU data aggregate at least 2 years in order to minimize the distortions introduced by small numbers; DREU participants numbered an average of about 35 students/year. The data from NSF IPEDS also has limitations in that it was only available through 2007 at the time of this analysis, and 1994 data showing racial or ethnic distribution were also unavailable. Finally, imperfections could arise if there was any inconsistent reporting of race by the DREU participants. People might have varied in how they chose to represent themselves when their ethnicity was mixed, or when they felt more or less disposed to provide demographic information at all. This variability could affect percentages calculated for categories with small numbers of cases. To the extent possible, the effect of small numbers was minimized by averaging over several years.

Despite the imperfections, some clear trends emerged from the data showing increased participation of minority students over time.

MINORITY PARTICIPATION IN DREU INCREASED

Between 1994 and 2000, a strong majority of the women participating in DREU were White (80% of those who indicated their race), as shown in Table 1. Asian women were the largest minority group at 13%; Hispanics women and African American women were each 3% of the DREU population. Over the entire seven-year period, only one Native American woman participated in the DREU program. Compared with the 1995-2000 national data in Table 1, we see that the women in DREU were less diverse than the pool of women computer science undergraduates in the United States. These data show there was little diversity among the women in the DREU program during that time covered by the LEAD Center report.

Despite the poor baseline results, Table 1 also illustrates an increase in the average representation of almost every minority group in DREU over the years since the LEAD Center report. African American women and Hispanic women both went from 3% to 6% of the women in DREU. Of the three underrepresented groups, only the average representation of Native American women’s did not increase since the last assessment of the DREU program. Although average racial and ethnic diversity among women in the DREU program still lagged behind national levels, it grew at a much faster rate than nationally over the past six years.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>African American</td>
<td>3%</td>
<td>17%</td>
<td>6%</td>
<td>19%</td>
</tr>
<tr>
<td>Asian</td>
<td>13%</td>
<td>17%</td>
<td>20%</td>
<td>21%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>3%</td>
<td>7%</td>
<td>6%</td>
<td>8%</td>
</tr>
<tr>
<td>Native American</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>White</td>
<td>80%</td>
<td>59%</td>
<td>67%</td>
<td>51%</td>
</tr>
<tr>
<td>Total</td>
<td>100% n = 116</td>
<td>100% n = 45,600</td>
<td>100% n=220</td>
<td>100% n=77,976</td>
</tr>
</tbody>
</table>

Table 1. Diversity among DREU participants 1994-2008 and women Bachelor’s degree recipients in CS and CS General 1995-2006, calculated with IPEDS data using the NCES population

3 IPEDS data were not available for 1999, so this year is not included in the calculated national averages. Only women are represented in this table.
4 CIP codes 11.01 and 11.07 were totaled for number of degrees in computer science.
THE CRA-W/CDC ALLIANCE IS ACHIEVING ITS GOAL OF GREATER MINORITY PARTICIPATION IN DREU

As Table 1 makes clear, racial and ethnic diversity among computing undergraduates has increased slightly over what it was in the past. As a result, it is possible that the increase in the DREU program’s diversity might be attributable to national trends, rather than impact of the CRA-W/CDC Alliance. To investigate which explanation is more likely, we looked at the two years before and after the Alliance took part in the DREU program.

The marked increase from pre- to post-Alliance diversity in the DREU program, shown in Table 2, strongly suggests that the Alliance, not national trends, deserves credit for the change. In the two years that the CRA-W/CDC Alliance jointly offered the DREU program, there was a 200% increase in African American participation and a 133% increase in Hispanic participation over the representation of these groups in the two years prior to the Alliance. In the same short time, Native American participation went from none to 3% of DREU participants. These substantial increases in a short period of time are most likely due to the Alliance.

For context, Table 2 also shows minority representation among CS Bachelor’s degrees nationally and among women only in 2007 (the most recent year available). Comparing the representation of women and minority men in DREU with their representation in computer science as a whole (CIP 11.01 plus CIP 11.07), shows that the DREU program exceeded those levels also.

After formation of the CRA-W/CDC Alliance, the DREU program included both men and women, so the national data in Table 2 show diversity among all computer science Bachelor’s degree recipients in 2007, not just women. To facilitate comparison with the data in Table 1, however, we added a final column showing national diversity among only women computer science Bachelor’s degree recipients. These data show that women in computer science are more diverse than are men in computer science because the participation of African American women is relatively high.

<table>
<thead>
<tr>
<th>ETHNICITY</th>
<th>DREU 2 Years Pre-Alliance (women only) 2005-2006</th>
<th>DREU 2 Years Post-Alliance (men &amp; women) 2007-2008</th>
<th>% of all National 2007</th>
<th>% of Women only National 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>African American</td>
<td>6% (4)</td>
<td>15% (12)</td>
<td>10%</td>
<td>21%</td>
</tr>
<tr>
<td>Asian</td>
<td>22% (14)</td>
<td>15% (12)</td>
<td>11%</td>
<td>13%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>6% (4)</td>
<td>9% (7)</td>
<td>8%</td>
<td>9%</td>
</tr>
<tr>
<td>Native American</td>
<td>0% (0)</td>
<td>3% (2)</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>White, non-Hispanic</td>
<td>66% (43)</td>
<td>58% (46)</td>
<td>70%</td>
<td>56%</td>
</tr>
<tr>
<td>Total</td>
<td>100% (n=65)</td>
<td>100% (n = 79)</td>
<td>100% (n=23785)</td>
<td>100% (n=3889)</td>
</tr>
</tbody>
</table>

Table 2. Pre and Post- CRA-W/CDC Alliance racial & ethnic demographics compared with national demographics of bachelor degrees in CS (CIP 11.01 + 11.07)\(^5\) 2007 (the most recent year available). Comparing the representation of women and minority men in DREU with their representation in computer science as a whole (CIP 11.01 plus CIP 11.07), shows that the DREU program exceeded those levels also.

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<table>
<thead>
<tr>
<th>Before Alliance</th>
<th>After Alliance</th>
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<tbody>
<tr>
<td></td>
<td>2005-2006</td>
</tr>
<tr>
<td>URM(^6)</td>
<td>12%</td>
</tr>
<tr>
<td>Majority(^7)</td>
<td>88%</td>
</tr>
<tr>
<td>Total</td>
<td>100% (n = 65)</td>
</tr>
</tbody>
</table>

Table 3. Minority and Majority Representation in DREU

\(^5\) Men are included in this table, which has a substantial impact on the national percentages because African American women are better represented among women than African American men are represented among men in undergraduate computing programs.

\(^6\) Underrepresented Minority—African American, Hispanic, Native American

\(^7\) Majority—White, non-Hispanic and Asian
To summarize, the data in Table 3 show that there was a substantial increase in the participation of underrepresented minorities among DREU participants that was likely due to the formation of the CRA-W/CDC Alliance.

**ACCESS TO ESTABLISHED SOCIAL NETWORKS**

A likely explanation for the Alliance’s positive impact on the diversity of the DREU program is that the Alliance brought together the DREU program and the CDC’s established network of minority groups in computing. After the Alliance, DREU was led by representatives of both CRA-W and CDC, and used CDC listservs, which contain over 800 contacts. This expanded network effectively spread the word about DREU through communication channels that reached African American and other minority students in computing. In addition, the Alliance advertised DREU at historically black institutions and other schools serving large percentages of minority students.

Increased minority participation in DREU came about only after both a conscious decision to work toward that goal, and adoption of recruiting strategies designed to accomplish that goal. Prior to the Alliance, there was no intention to exclude racial or ethnic minorities from DREU; the program welcomed students from all demographic groups. Nevertheless, the data show that the absence of formal barriers is insufficient. Reform requires deliberate action; without the intention to create diversity, the status quo is likely to persist.

The evidence presented here contributes to previous findings that generally beneficial practices available to all students, like mentoring and personal recruiting, only work to improve the representation of women and minorities in computing when that is the explicit goal for their use (Cohoon, et al. 2004; Cohoon, 2007). Without the intention of increasing women’s representation, for example, men are more likely than women to receive mentoring, and thus get its benefits. Likewise, the benefits of specifically teaching graduate students how to get papers published and apply for grants more often goes to male than female graduate students in the sciences (Fox, 2001). Both intention and action seem to be important for broadening participation in computing.

**CONCLUSION**

In sum, deliberate effort to recruit underrepresented minority students into the DREU summer research experience and mentoring program for undergraduates in computing resulted in increased minority participation. Through the CRA-W/CDC Alliance, the program gained better access to networks of ethnic or racial minorities in computing. Demographic data comparing diversity over time in the DREU program suggests that formation of the Alliance contributed to increased minority participation.

This small study is not without limitations. In particular, there are some mismatches in time, and some data gaps that make the comparisons imperfect. Despite these imperfections, the data strongly suggest that the CRA-W/CDC Alliance is successfully diversifying the DREU program. If they are correct in their assumption that diversity in DREU will prepare and attract diverse students into computing research careers, the upward trends in minority representation among computing professionals should accelerate.

**ACKNOWLEDGMENTS**

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**REFERENCES**


