

# CAHSI External Evaluation Report, 2015-16

Promoting Success for Hispanic Computing Students and Faculty

**GOLDEN EVALUATION, COLORADO EVALUATION & RESEARCH  
CONSULTING**

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## Executive Summary

### Individual Outcomes

The CAHSI model provides broad support to students throughout all of the stages of their education. In the past year, CAHSI recruitment techniques were particularly successful. The number of CAHSI students enrolled in CS-0 courses increased 28% in the past year, from 351 to 449 students, possibly reflecting the growth in undergraduate enrollments in CAHSI departments. In the 2015-16 academic year, CAHSI students received:

- **19,845 hours of introductory computing content delivered to 441 students**, almost 3/4 were Hispanic or other underrepresented minority students.
- **11,520 hours of undergraduate-led supplemental instruction through PLTL to 768 students**, over half were Hispanic or other underrepresented minorities.
- **26,145 hours of coursework using the Affinity Research Group model provided to 685 students**; over half were Hispanic students.

Graduation rates in CAHSI departments have also increased substantially. In part, this may be due to increased enrollments in CAHSI departments—*undergraduate enrollment in CAHSI departments increased by 25% last year* alone—as well the recent addition of new institutions (e.g., NEIU) and the growth of new major degree programs (UHD GIS program and CSU-DH Computer Technology). Even though NEIU was also included in the 2014 tabulations for last year’s annual report, the graduation rate within that department nearly doubled in 2014-15.<sup>1</sup> Overall, in 2015, *CAHSI increased its total number of baccalaureates by 106 students*. The number of women granted BS degrees in CAHSI departments rose from 39 to 53 women. Twenty-eight graduates in 2015 were African-American or Native American. The number of Hispanic BS graduates declined slightly from 205 in 2014-15 to 191 students in 2015-16, most likely because CAHSI institutions are becoming more broadly diverse.

CAHSI has consistently graduated a high proportion of Hispanic MS degree recipients. CAHSI departments granted substantially more master’s degrees in 2014-2015 than in 2013-2014, increasing from 127 to 175 students. Excluding UPRM, 23% of CAHSI MS graduates in 2015 were Hispanic. CAHSI has increased its number of women master’s degree recipients from 33 to 42 women. Nationally, CAHSI mainland schools graduated 40 of the 406 Hispanic MS degree recipients in CS/CE/CIS in 2014-15. In other words, *CAHSI granted nearly 10% of all of the MS degrees in CS/CE/CIS to Hispanic students in the mainland US in 2014-15*.

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<sup>1</sup> The most recent year that data are available.

In the past year, CAHSI transitioned away from co-locating their annual meeting with SACNAS and held the CAHSI Summit in Puerto Rico in September, 2015. The CAHSI Summit provided mentoring for students and facilitated their academic and career advancement. Most student attendees of the CAHSI Summit reported that they had applied for academic scholarships, fellowships, or internships in the past year (51%, or 29 out of 57 students). Most importantly, 100% of these students' applications were successful. Most students (64%) responded that the Summit was somewhat, a good deal, or a great deal helpful in assisting students in finding a mentor. Notably, the proportion of students who were able to find a mentor has increased 20% from when the CAHSI annual meeting was held at SACNAS. Additionally, 93% of students reported that the Summit increased their knowledge of career options in computing. The same number of students (93%) also reported that their experience at the CAHSI Annual Summit had increased their interest in graduate school.

Through ARGs, students gain technical skills and knowledge and are socialized into the computing research community. The majority of ARG students (59%) engaged in out-of-class research reported that they attended a professional conference—slightly less than in past years—compared to 23% of a national sample of REU students who had done so. Additionally, ARG students published in refereed journals at rates higher than the national REU sample: 17% of ARG students and 5% of the national sample authored papers. These differences in conference attendance and presentation are statistically significant ( $X^2=27.864, =.000$  and  $X^2=15.708, p=.001$ , respectively).

Computing has often been described in the research literature as an isolating academic field, yet CAHSI students interviewed at the CAHSI Summit described their learning environments as supportive and close-knit. Focus group participants from each school highlighted the support they get from CAHSI staff and faculty as signs of departmental-level support for students. Faculty approachability and direct encouragement were also highlighted by students. Students reported mentoring relationships with CAHSI staff and faculty that went beyond the specifics of helping students with content-related computer science questions—they also received advice related to their career and educational goals. Research experiences continued to create a sense of accomplishment for students and were a motivating factor for staying in the major and elevating their computing practice. Barriers to furthering their education are viewed by students as external rather than internal—in other words CAHSI students have confidence in their abilities to persist, but realize outside factors may prohibit graduate work (e.g., the need to make a living, the need to support family).

Three CAHSI students earned the prestigious National Science Foundation Fellowship this year, and one student received an honorable mention for her application to the award. This is particularly noteworthy given the tradition of students from elite schools receiving these awards (23 to Harvard students, 25 to Yale students, 32 to Stanford students, 32 to Princeton students in 2016). CAHSI students are representing Hispanic Serving Institutions well, and in so doing, building the academic reputations of students who attend CAHSI institutions.

## **Organizational Capacity Outcomes**

CAHSI's efforts at improving the computer science pipeline have shifted earlier along the "pipe" –all schools participated in K12 outreach activities that support youth in learning computer science with the added benefit of best practices cultivated through CAHSI initiatives. For example, New Mexico State University, UHD, and TAMUCC capitalize on the efficacy of adding near peer facilitators for summer outreach opportunities to increase engagement and provide role models for younger youth to emulate. The majority of institutions have a faculty member innovating around the CAHSI initiatives—supporting competitions through the university and community college feeder schools, designing interdisciplinary courses for students, and scaling ARG to reach a large number of students are three ways that faculty continue to build on CAHSI's best practices.

## **Alliance Impact**

CAHSI dissemination has become distributed, with more CAHSI leaders serving to promote the organization in new venues with regional, national, and international membership each year. This shift parallels the rise of CAHSI on the national stage—CAHSI was honored with a "Bright Spots in Hispanic Education" acknowledgment. CAHSI held a round table during the CAHSI summit in support of developing innovative strategies for supporting diversity in computing—the round table was well attended by university leadership, industry, and the non-profit sector.

CAHSI has built new relationships with members of an organization with the potential to collaborate for meeting space and travel logistics support, serve as a funding generation partner, and provide mutually beneficial professional development content for faculty and students engaged in computing. The burgeoning relationship with Great Minds in STEM creates an opportunity to sustain the CAHSI meeting without the strain on human capital that the CAHSI Summit causes.

CAHSI has also successfully spread its practices to other disciplines. In the past year, NEIU has fully implemented ARG and PLTL within its Physics, Chemistry, Earth Science, and Mathematics departments. In these modified courses, peer leaders guide students in multi-week research modules during course lab sections (called PEERS courses). The integration of the ARG and PLTL models in introductory, gateway STEM courses is one way in which CAHSI is continuing to innovate and disseminate its educational practices. In all, 311 students were enrolled in NEIU STEM course sections using the combined ARG/PLTL model in academic year 2015-16. Over one-third (35%) of these students were from underrepresented minority groups and 52% of these students were women. Students in the reformed courses cited the research modules as the second most helpful aspect of the class to their learning. Compared to students in traditional sections, students in the PEERS sections made statistically significant gains in feeling prepared for graduate school and in their ability to identify the strengths and limitations of research designs. Finally, PEERS courses resulted in a 15% reduction in course withdrawals and failures in important, introductory courses that are essential to student persistence in STEM majors. This translates to an extra 22 students who passed the course when it

was taught using the PEERS model. Thus, NEIU has served a successful test site for the integration of the ARG and PLTL models and the expansion of CAHSI practices to other STEM disciplines.

## **Recommendations**

### **Expand Student Professional Development**

Over the past few years, CAHSI departments have moved away from providing professional development that influences a large proportion of students. If CAHSI is to continue its effort to “Mainstream mentoring” for all students, rather than for those already selected for research and other specialized roles like peer leader, some efforts could be made to add career and graduate school professional development opportunities directly into the curriculum, or into other co-curricular programming that affects a large proportion of upper-level students. Two CAHSI schools have provided evidence of innovating in this area—UHD developed a partnership with the career center to create course content and assignments that involved mock interviews and resume development. Partnering with experts can alleviate the burden of adding additional assignments to courses, while making such assignments mandatory normalizes the use of career services, for example. UTEP has over time created a university-wide resource by implementing Fellownet through the graduate school. This practice has lessened the burden on CAHSI members and also created greater influence on campus. Systematizing and institutionalizing career and graduate school success initiatives reinforces the message that all HSI students are capable of succeeding in their chosen field with the right support.

### **Training CAHSI Faculty**

CAHSI is in a time of transition as it reflects on its work and successes of the last decade and plans for a future with reduced financial support from the National Science Foundation. There have also been recent transitions in leadership within the Alliance as new faculty and co-PIs have come on board over the last several years. This is a natural time for CAHSI to reflect on its mission, vision, and goals as it looks forward, as it has done through its work with the expert organizational consultants, the Shinobi Group. Because there have been transitions in departmental leadership within several CAHSI departments, it is also a fortuitous time to document the faculty within CAHSI departments who have completed training in key initiatives and to consider whether any other faculty (e.g., instructors of introductory courses, new faculty, new leaders, etc.) may need training in CAHSI initiatives in order to sustain the human capital necessary to implement CAHSI initiatives within each department.

### **Increase Faculty Involvement**

Given CAHSI’s longevity, many new faculty, whether tenure-track faculty or instructors, have joined CAHSI departments since its inception. Some of these faculty have been trained in CAHSI initiatives and many of them are active in their local departments in implementing CAHSI practices.



However, aside from the Annual Summit, there are not many ways for education-oriented CAHSI faculty to interact, share, and network across campuses. As CAHSI begins to renew its focus on creating regional hubs for collaboration and dissemination, the Alliance may consider involving more faculty within CAHSI departments in a deeper and more substantial way across the Alliance, including in leadership roles. In this way, CAHSI can grow its regional networks and ensure that a full cadre of CAHSI-trained faculty are active and involved within every department.

### **Orientation for new faculty, instructors, and staff**

Following from the previous two recommendations, CAHSI may consider providing more of a CAHSI-specific orientation at its local sites to new faculty members, instructors, advisors, or support staff within CAHSI departments, especially those who will be interacting closely with students on a frequent basis, whether through teaching, research, or advising. This orientation could include an introduction to CAHSI as an organization, its initiatives, as well as its mission, vision, and goals. Most importantly, this informal orientation could provide an overview of the multiple ways that CAHSI supports student and faculty throughout all educational and career stages. This may not only increase faculty involvement and interest in CAHSI, but may increase student support throughout the department as all personnel become more aware of all of the student opportunities available through CAHSI. The Regional Hubs initiative that CAHSI is considering adopting in the coming years may be one venue in which to provide this type of orientation for newcomers.

### **Expand Sharing of Practices within the Alliance**

As collaborations across CAHSI are more than 10 years in the making, there is a great sense of familiarity with one another's work among members. However, over time practices have shifted and faculty innovate in new ways. New faculty have joined CAHSI institutions and may not have a strong understanding of the nuance of CAHSI practices. Providing more opportunities for internal sharing of practices, troubleshooting new concerns, as well as engaging faculty in cross collaboration in educational practices would support fidelity of CAHSI practices at the institutional level and could create an opportunity to develop and test new practices across institutions. The CAHSI social science research effort could support such practice sharing by testing their effectiveness using qualitative and quantitative measures of success across institutions.

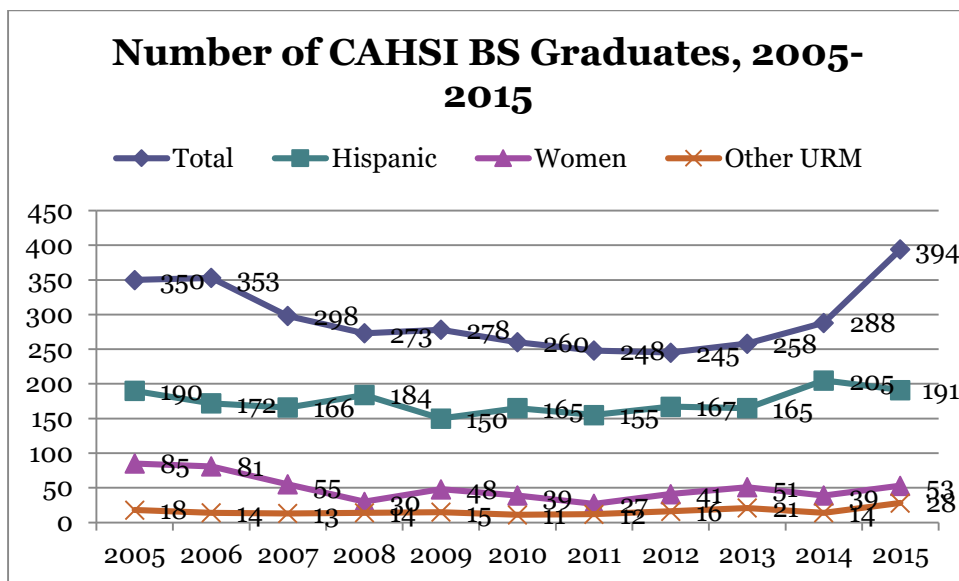
## Introduction

This report is divided into sections that align with the common core indicators used by the external evaluation of the NSF BPC-A program. The common core indicators measure the progress of the alliance in promoting positive individual student outcomes, building organizational capacity to advance its mission, and creating impact by disseminating its practices and mission to a wider audience. The common core indicators measure CAHSI's development in these three critical areas: 1) *Individual Participation and Outcomes*, including student and faculty outcomes, 2) *Organizational Capacity* to maintain and sustain activities to support Hispanics in computing, and 3) *Alliance Impact* to create new partnerships and communities, and extend its reach beyond original members.

## Common Core Indicator #1: Individual Participation and Outcomes

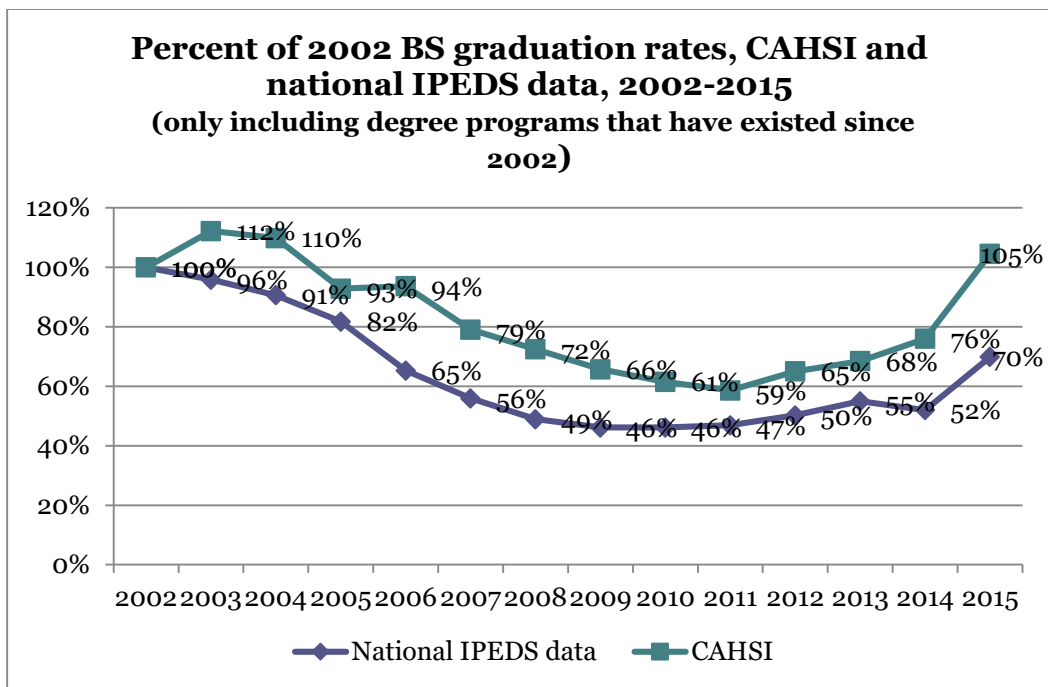
In the past year, graduation rates in CAHSI departments increased substantially. In part, this may be due to increased enrollments in CAHSI departments, as well the recent addition of new institutions (e.g. NEIU) and major programs (UHD GIS program and CSU-DH Computer Technology). Although NEIU was included in the 2014 tabulations from last year's report, the graduation rate within that department nearly doubled in the past year. Overall, in 2015, CAHSI increased its total number of baccalaureates by 106 students. The number of women granted BS degrees in CAHSI departments rose from 39 to 53 women. Twenty-eight CAHSI graduates in 2015 were African-American or Native American. The number of Hispanic BS graduates in the past year declined slightly from 205 to 191 students.

**Figure 1. Number of CAHSI BS Graduates, 2005-2015**



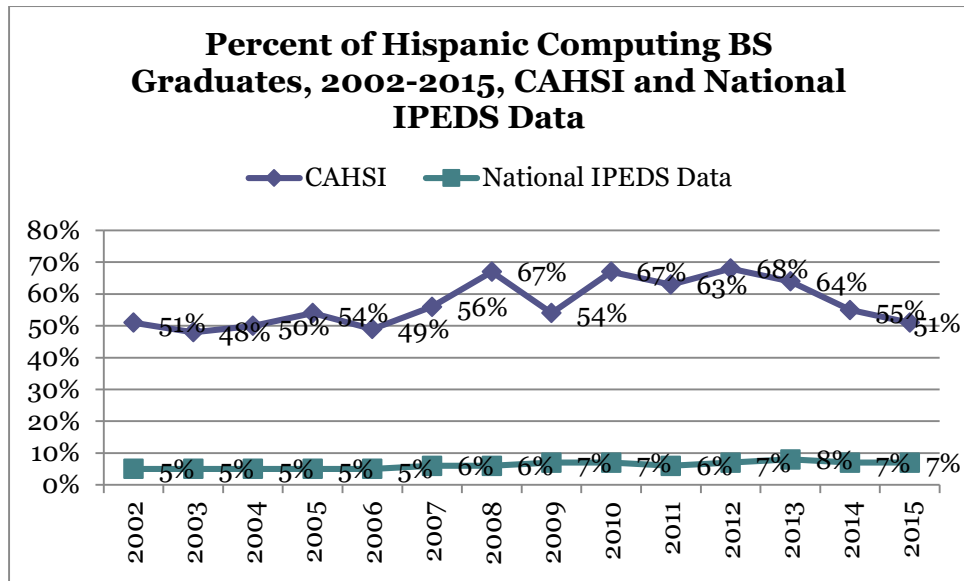
For many years of CAHSI's existence, national enrollment rates in computing plummeted, yet enrollment across the nation has increased substantially in the past several years. The nation is now producing more computing graduates and compensating for deficits in the past decade. Since its inception in 2006, CAHSI's graduation rates have consistently surpassed national trends, when comparing CAHSI against other long-standing departments that have existed since 2002. This adjustment was made—to include long-standing departments and exclude the many new departments created each year—because many colleges and universities have added computing programs in the past decade so a more accurate comparison of peer departments can be derived from comparing CAHSI to the cohort of Computer Science and Computer Engineering departments in public and private not-for-profit institutions that have existed since the original CAHSI departments began to collaborate. Nationally, in 2015, this comparison set of departments graduated 70% of the number that they graduated in 2002, while CAHSI graduated 105% of its 2002 total. Most CAHSI departments increased their BS graduation rates in 2014-15.

**Figure 2. Percent of 2002 BS Graduate Rates, CAHSI and National IPEDS Data, 2002-2015**



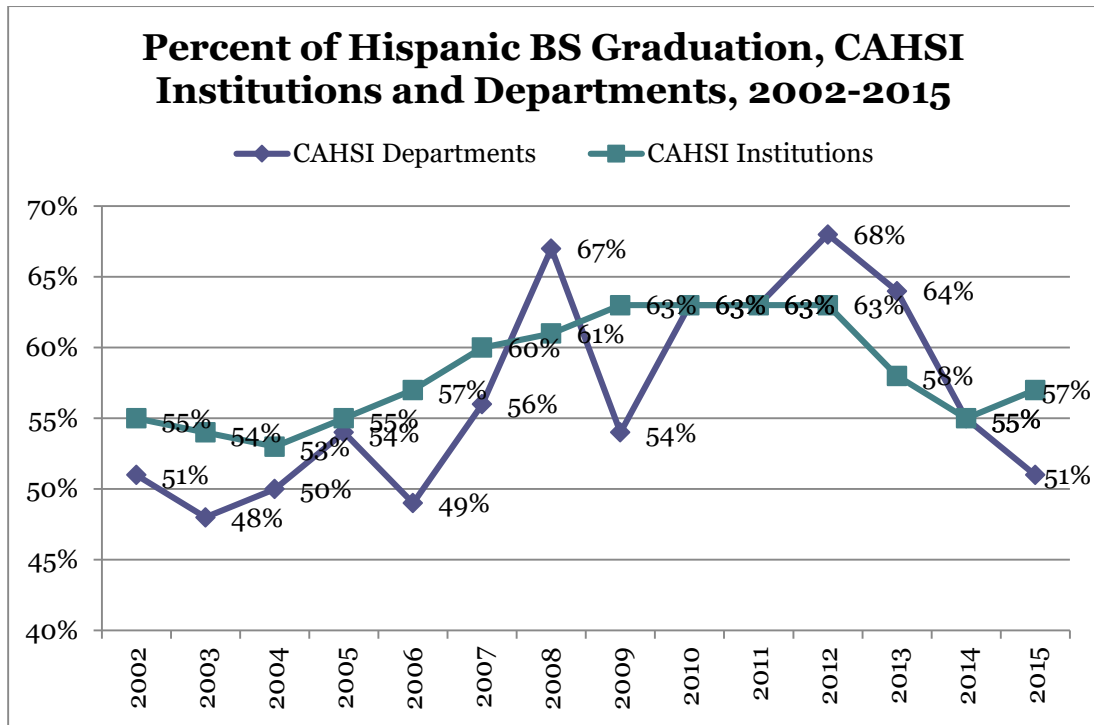
CAHSI graduation rates of Hispanics took a sharp fall in 2009, perhaps due to the economic recession, and have continued to decline in recent years. In part, this may be due to declining Hispanic enrollment in CAHSI institutions overall (see figure 3). This trend has continued in the most recent academic year that graduation data are available (2014-15) as 51% of all BS graduates in CAHSI departments were Hispanic, excluding the Hispanic students from UPRM. Nationally, the Hispanic graduation rate in CS/CE/CIS has remained steady at about 7% of all graduates in those majors.

**Figure 3. Percent of Hispanic Computing BS Graduates, CAHSI and National IPEDS Data, 2002-2015**



While CAHSI has consistently graduated more Hispanic baccalaureates in computing than the nation, it is possible that this could be attributed to their status of Hispanic-Serving Institutions. CAHSI has higher enrollments of Hispanics at each of its institutions than the national average, although Hispanic enrollment is declining at almost all CAHSI institutions as they are becoming more broadly diverse, including more Asian, International, and other underrepresented minority students, especially African-Americans. We compared CAHSI's graduation rate of Hispanics from its departments to its institutional graduation rate of Hispanics to determine whether CAHSI departments have achieved parity with institutional averages. The figure below demonstrates that before the inception of CAHSI in 2006, CAHSI departments consistently graduated fewer Hispanics than their institutions overall. However, the graduation rate of Hispanics in CAHSI departments has trended upward, and in 2012, CAHSI's Hispanic graduation rate surpassed the institutional average. This past year, however, CAHSI departments' Hispanic graduation rates dipped below the institutional average for the first time since 2011. Several departments graduated far fewer Hispanic students in the 2014-15 academic year, but this may be a single-year anomaly, as the long-term trend indicates that CAHSI departments surpass their institutional graduation rates of Hispanic students.

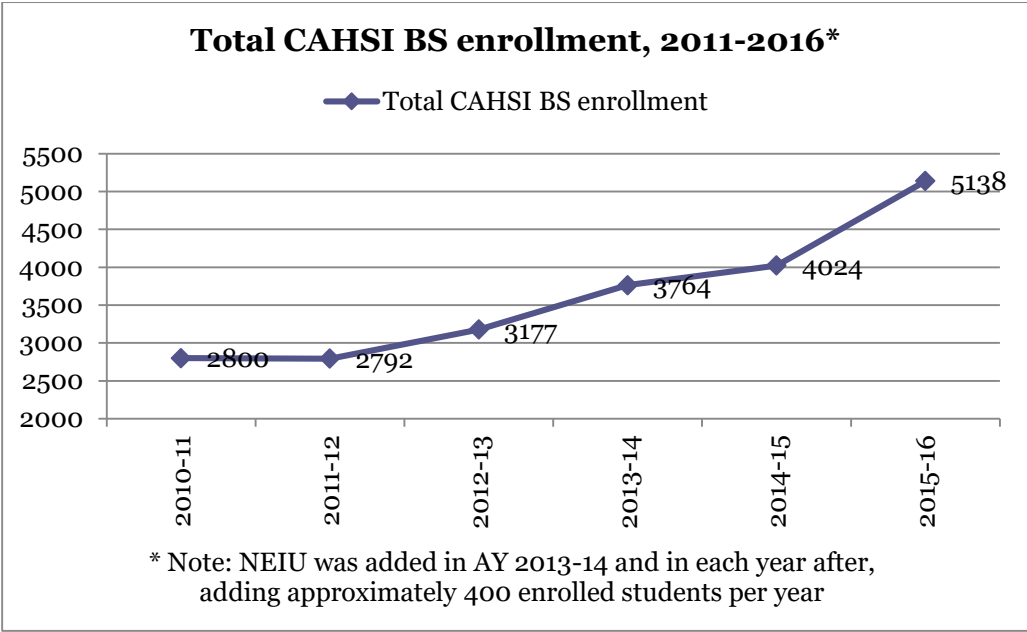
**Figure 4. Percent of Hispanic BS Graduation, CAHSI Institutions and Departments, 2002-2015**



### BS enrollment trends

After years of decline, computer science departments across the country have seen sharp increases in enrollment in recent years. This trend has also affected CAHSI departments. Even though NEIU was added as a CAHSI member in academic year 2013-14, CAHSI enrollments in original departments have also increased substantially in the past two years (see figure 5). These enrollment increases have created challenges and opportunities within computing departments in Hispanic-Serving Institutions which will be highlighted through a case study in the Organizational Capacity section.

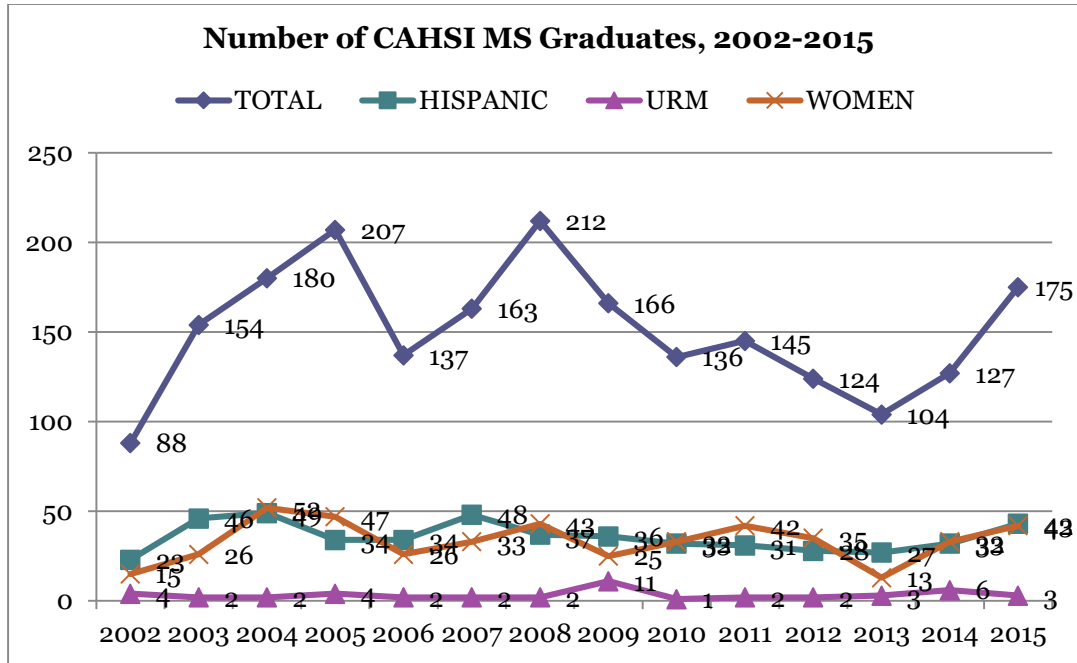
Figure 5. Total CAHSI BS Enrollment, 2011-2016



### MS degrees

CAHSI has consistently graduated a high proportion of Hispanic MS degree recipients. The figure below (figure 6) shows all CAHSI MS graduates. CAHSI departments granted substantially more master’s degrees in 2015 than in 2014, increasing from 127 to 175 students. Additionally, excluding UPRM because it has 100% Hispanic enrollment, 23% of CAHSI MS graduates in 2015 were Hispanic. In contrast, in 2014, 18% of all CAHSI MS graduates were Hispanic. Likewise, CAHSI has increased its number of women master’s degree recipients from 33 in 2014 to 42 in 2015. Nationally, CAHSI mainland schools graduated 40 of the 406 Hispanic MS degree recipients in CS/CE/CIS. In other words, CAHSI graduated nearly 10% of all of the Hispanic MS degrees in those fields in the mainland US.

**Figure 6. Number of CAHSI MS Graduates, 2002-2015**



### PhD degrees

Hispanics remain severely underrepresented in computing doctorates. In the past, CAHSI has contributed to the number of Hispanic computing PhDs in the US. However, in 2014-15, CAHSI mainland departments did not graduate any Hispanic U.S. citizen PhDs in CS or CE. The University of Puerto Rico graduated 9 Hispanic doctorates in CE in 2014-15, including 3 Latinas. The rate of Hispanic doctoral degree completion in computing in the mainland U.S. is still stubbornly low. In 2014-15, only 12 out of 924 CS doctorates in the mainland U.S. were awarded to Hispanic US Citizens. Likewise, only 13 out of 332 CE doctorates in the mainland U.S. were awarded to Hispanic US Citizens.

As CAHSI departments are becoming slightly less Hispanic and increasingly broadly diverse, CAHSI is starting to graduate higher numbers of other underrepresented minority students. Last year, Florida International University graduated a female African-American doctoral student in Electrical/Computer Engineering, one of only 9 African-American women in the nation to receive a doctorate in CE in 2015.

### CAHSI Course Enrollment

Over the years, CAHSI has consistently provided extensive support to students throughout their degree programs. In the past year, CAHSI continued to enroll high numbers of students in ARG and PLTL courses, although the total number of students fell slightly from academic year 2014-15. The number of CAHSI students enrolled in CS-0 courses increased 28% in the past year, from 351 to

449 students, possibly reflecting the growth in undergraduate enrollments in CAHSI departments. In the 2015-16 academic year, CAHSI students received:<sup>2</sup>

- **19,845 hours of introductory computing content delivered to 441 students**, almost 3/4 were Hispanic or other underrepresented minority students.
- **11,520 hours of undergraduate-led supplemental instruction through PLTL to 768 students**, over half were Hispanic or other underrepresented minorities.<sup>34</sup>
- **26,145 hours of coursework using the Affinity Research Group model provided to 685 students**; over half were Hispanic students.

CAHSI’s representation of women in its signature initiatives (table 7) outpaces the national average of women undergraduates in computer science. One-quarter of the participants in CAHSI initiatives were women. Female participation in CS-0, PLTL and ARG surpassed the national average of 17% in CS/CIS (NCWIT, 2016).

**Table 7. CAHSI Course Enrollments, Academic Year 2015-16**

Initiative	Total Students	Total Women	Percent Female	Total Hispanic	Percent Hispanic	Total Other Underrep. Minorities (URM)	Percent Other URM
<b>CS-0</b>	449	123	27%	329	73%	20	4%
<b>PLTL</b>	768	171	22%	411	53%	47	6%
<b>ARG</b>	581	139	24%	317	55%	11	2%
<b>TOTAL</b>	<b>1738</b>	<b>433</b>	<b>25%</b>	<b>1057</b>	<b>61%</b>	<b>78</b>	<b>4%</b>

## Overview of the CAHSI Annual Meeting

### Description of the event

This past year, CAHSI changed the way it holds its annual meeting as it discontinued its relationship with SACNAS. Instead, CAHSI returned to its original strategy of holding its own annual

<sup>2</sup> Assuming a 15 week semester and a 3 hour course session per week

<sup>3</sup> Assuming a 15 week semester and a 1 hour supplemental PLTL session per week. Only the supplemental session is used to calculate total contact hours.

<sup>4</sup> Note that in the past year, NEIU offered two courses that used both ARG and PLTL. These students were counted in the ARG and PLTL initiative, respectively. Thus, 92 students were double counted as both ARG and PLTL.



meeting that is specific to Hispanics in computing. The CAHSI Annual Summit was held at the Caribe Hilton in San Juan, Puerto Rico in September, 2015. In addition to its original goals of supporting and developing students and junior faculty, CAHSI also sought to more strongly engage industry and other professionals to generate dialogue and action to advance its mission. Despite the greater financial and resource burden of holding its own meeting, there were advantages for students and faculty in attending a Summit more explicitly designed to support Hispanics in computing, promote dialogue, and forge relationships.

### **Data collection for evaluation**

Six weeks after the Summit, the evaluators sent a survey to all undergraduate and graduate student registrants, as well as faculty and other professional attendees. The survey was not sent immediately after the Summit to allow time for attendees to reflect on what they had learned and to follow up on information or contacts that they might have gained at the Summit. The survey was sent electronically to all Summit participants. Three reminders were sent at five-day intervals. In all, 60 out of 115 students completed a survey for a response rate of 52%, while 30 out of 58 faculty and professionals completed a survey for a response rate of 52%.

### **Student and Faculty Demographics**

This year, 90 Summit participants completed the follow-up survey. This number represents 52% of those who registered for the conference. Exactly 2/3 of survey respondents were students and 1/3 were faculty or industry professionals. CAHSI Summit survey respondents represented the following 15 universities. Additionally, three non-profit or corporate entities were represented.

- University of Houston, Downtown
- University of Puerto Rico, Mayaguez
- University of Puerto Rico, Rio Piedras
- University of Puerto Rico, Bayamon
- University of Puerto Rico, Arecibo
- University of Puerto Rico, Humacao
- Texas A & M University – Corpus Christi
- University of Texas at El Paso
- New Mexico State University
- Northeastern Illinois University
- California State University, Dominguez Hills
- Florida International University
- Whitworth University
- California State University, Northridge
- Glendale Community College

Forty-two percent of respondents who answered the gender survey item (20 students, 9 faculty) were female, while 54% (13 students, 9 faculty) were male. The proportion of women at the CAHSI annual Summit was much larger than their representation in the field of Computer Science overall, which hovers at 17% for female undergraduate degrees in Computer and Information Sciences (NCWIT, 2016).

The majority of attendees who identified their ethnicity, according to survey results, identified themselves as Hispanic or Hispanic and another ethnicity: 48% of faculty and professionals and 85% of students, or 74% overall.

Nine faculty/professional respondents selected a non-Hispanic ethnic category to identify themselves: eight respondents answered that they were White/Caucasian and one was from the Asian/Indian sub-continent. Twelve students also identified non-Hispanic ethnicities, including 2 students who identified themselves as from the Asian/Indian sub-continent, and 10 students who identified as White/Caucasian.

The majority of student attendees were from Computer Science departments (71%), with 18% from Computer/Electrical Engineering, and 6% from Mathematics/Applied Math. One student was from Computer Information Systems and one was a Biochemistry major with a minor in Computer Science.

## **CAHSI Annual Summit Outcomes**

### **Meeting met, exceeded attendees' expectations**

The vast majority of survey respondents stated that their expectations of the CAHSI annual meeting were met (57% of faculty, 48% of students) or exceeded (37% of faculty, 34% of students). No faculty or students responded that their expectations were not met. Some reported that their expectations were only somewhat met, although only one faculty/professional and five students marked this response.

### **Students were satisfied with the poster session**

Overall, most of the students were very satisfied (43% of respondents) or somewhat satisfied (24%) with their experience of the poster session. One student was very dissatisfied, three students were somewhat dissatisfied and eight did not participate in the poster session.

Almost all of the student comments were very positive about the poster session; however, four students noted that the poster session felt too crowded and three students were disappointed because they thought that people did not show as much interest in their poster as they had hoped. Additionally, three students hoped that the posters would be evaluated with possible awards for best poster as they

had experienced in previous CAHSI events. Nevertheless, almost all students had positive experiences with the poster session, as reflected in this comment from a student:

*This was my first [poster session] and it was a great experience. Interacting with others and letting them know about my research was amazing and interesting.*

## **Expanding the CAHSI Community through the Annual Summit**

### **Students and faculty enhanced their networks**

The CAHSI Summit increased the amount of student and faculty networking among and beyond CAHSI departments. Many students (38% or 23 out of 57) contacted a student they met at the 2015 CAHSI Summit, similar to rates for previous years of annual meetings. Additionally, sixteen students (29%) had contacted a faculty member or industry/non-profit professional they had met at the Summit, and another 32% planned to do so.

Faculty members and professionals also enhanced their networks. For instance, 16 respondents (59%) had contacted a faculty member that they met at the CAHSI Summit. Additionally, 12 respondents (46%) had contacted a student that they met at the Summit. And 14 respondents (52%) had contacted an industry professional that they met at the Summit.

### **Faculty and professionals explored CAHSI initiatives after the Summit**

Faculty and professionals were interested in learning more about CAHSI's activities and interventions after the Summit. Most faculty and professional participants (62%, 16 out of 26 faculty/professionals) read or searched for research articles or materials related to or written by Summit presenters or speakers.

### **Student Academic Advancement from the CAHSI Summit**

Most student attendees noted that they had applied for academic scholarships, fellowships, or internships in the past year (51%, or 29 out of 57 students). An additional 5% said that they had not yet applied but planned to do so. However, 1/3 of students (20 out of 57) indicated that they did not plan to apply for a scholarship, fellowship, or internship. Five students (8%) answered that they were not eligible.

Of the 29 students who applied for academic scholarship, fellowship, or internship, 100% of them were successful in their application. Students applied for the following opportunities: HENAAC scholarship, Hispanic Scholarship Fund, REU programs at UHD and Texas Tech, internships at IBM and Verizon, Jack Kent Cooke Scholarship, HYAA Scholarship, Xerox scholarship, STEM Advantage internship, Women's opportunity award, Metropolitan Water District internship, Edison scholarship and CSU Trustee Award.

Students were also asked about their plans for graduate school. Nine students (16%) had already taken the GRE, and another 11 students (20%) planned to take the GRE within the next six months. These rates are much higher than in previous years.

Students were asked whether they have applied to graduate school for a professional degree program (law, medicine, etc.). Nearly one quarter (22%, 12 students) of the 55 respondents answered that they had. Another seven students (13%) responded that they plan to apply for graduate school this year. Again, these rates of graduate school application are much higher than in previous years where typically only a few students had applied for graduate school.

Students were asked about their post-graduation plans, which varied by their current level in school. Undergraduates were most likely to have plans to attend graduate school (54%, or 7 of 13 undergraduate respondents) or work and then attend graduate school (31%, or 4 of 13 undergraduate respondents). One undergraduate student plans to work after graduation, and one is unsure as to whether to pursue work or graduate school. Two Master's students responded to this question, one of whom plans to work after graduation and the other plans to pursue a doctorate. All three doctoral students plan to work in industry after they graduate.

### **CAHSI Summit Influenced Students' Educational and Career Pathways**

CAHSI students advanced their academic careers across the academic computing pipeline following their participation in the CAHSI Summit. Students gained information about future opportunities and confidence to follow through on this information. In fact, 38% of students inquired about graduate school opportunities based on information that they had gained at the Summit. The same number of students (38%, 21 students) inquired about career opportunities based on their experiences at the Summit. Additionally, 44% of students (25 students) looked into internship opportunities from information they received at the Summit.

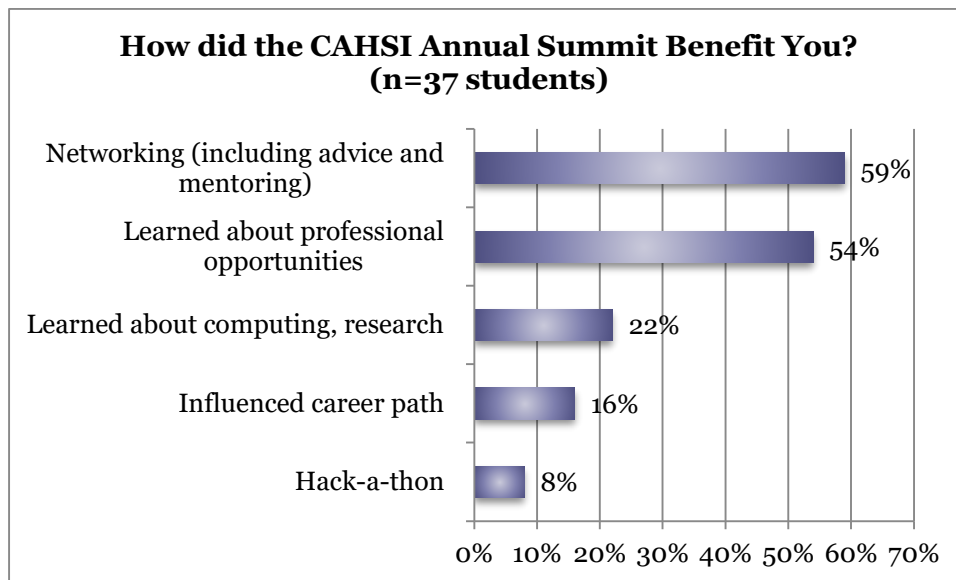
Students reported that they agreed somewhat (27% of respondents), a good deal (37%), or a great deal (31%) in that attending the CAHSI Annual Summit was an opportunity to get career advice. Most students (64%) responded that the Summit was somewhat, a good deal, or a great deal helpful in assisting students in finding a mentor. Notably, the proportion of students who were able to find a mentor has increased 20% from when the CAHSI annual meeting was held at SACNAS. Additionally, 93% of students reported that the Summit increased their knowledge of career options in computing. The same number of students (93%) also reported that their experience at the CAHSI Annual Summit had increased their interest in graduate school. And 95% of students felt that they had opportunities to get career advice at the CAHSI Summit.

Almost all students (97%) reported that the Summit increased their interest in conducting computing research. Nearly all students (95%) also felt that the Summit increased their commitment

to their major. Most students (83%) reported that the Summit increased their knowledge of a particular area of computing.

In an open-ended question, students were asked how the CAHSI Annual Summit had most benefited them. The most common responses were networking opportunities, especially the opportunity to receive mentorship, to get career advice, and to meet people with similar research interests. Students also noted that they learned about professional opportunities, including graduate school, career and internship opportunities, and scholarship and fellowship opportunities. A smaller number of students noted that they learned more about specific aspects of the field of computing or research areas within computing. Some students noted that the Annual Summit influenced their career path. In particular, several students commented that they were more likely to pursue graduate school. A few students mentioned that the hack-a-thon was the greatest benefit they received from attending the Annual Summit.

**Figure 8. How did the CAHSI Annual Summit Benefit You? (n=37 students)**



CAHSI students commented on the networking, career development and technical aspects of the CAHSI Summit, as indicated in the following comments.

*The CAHSI summit really persuaded me to continue my education once I graduate, which is a huge benefit.*

*I learned about fellowships, and that they can help pay for grad school.*

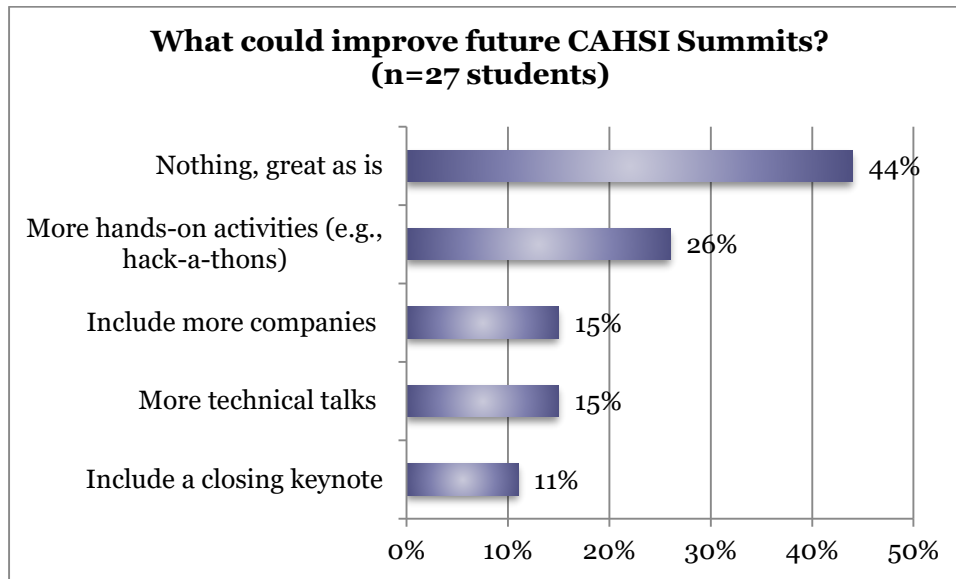
*I learned about new research areas and CS stuff I didn't know about much, like Machine Learning and Big Data.*

*I think that the CAHSI annual summit broadened my knowledge of computer science and technological opportunities. It allowed me to make connections with others interested in similar areas of study and those in the industries I am interested in.*

## Suggestions for future CAHSI conferences

Survey respondents were asked to provide suggestions for future CAHSI events based on their experiences at the 2015 annual Summit.

**Figure 9. What Could Improve Future CAHSI Summits? (n=27 students)**



Faculty also commented on how the Summit might be improved in the future. Thirteen faculty/professionals provided responses to this question and no suggestion was mentioned more than twice. Briefly, faculty and computing professionals suggested (listed in order of frequency):

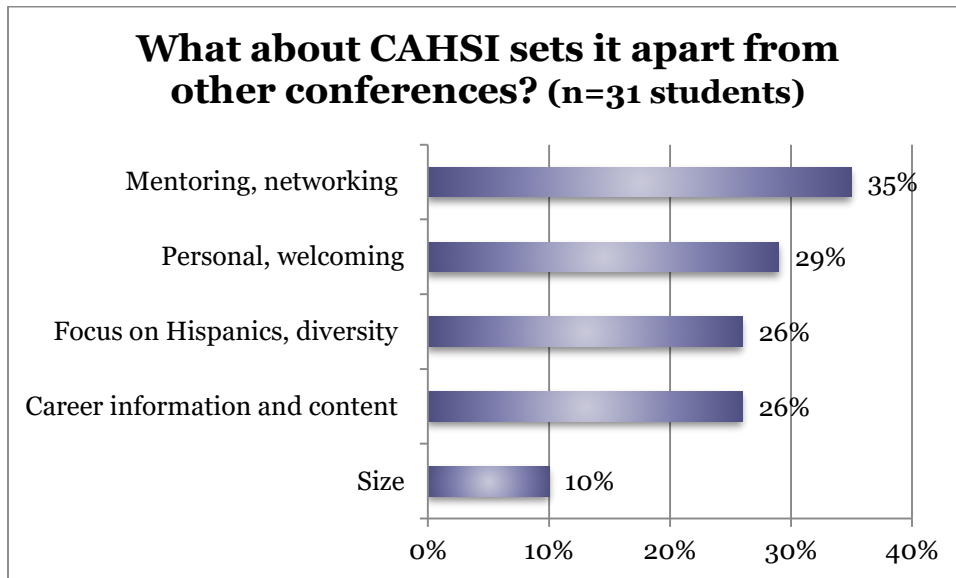
- more opportunities for networking, including student-student and student-faculty
- longer conference with more sessions
- more focus on industry careers
- attract more companies
- split the poster session into 2 sessions
- more interaction with the other BPC alliances at the Summit

## CAHSI Summit provides an inclusive computing environment

When asked in an open-ended question what sets the CAHSI Summit apart from other conferences, participants noted that CAHSI focuses more on mentoring, networking and diversity than other computing conferences. Students and faculty provided similar answers, both emphasizing

the focus on student development and diversity at the CAHSI Summit. Students also emphasized the welcoming, inclusive atmosphere while faculty/professionals emphasized the involvement of industry.

**Figure 10. What About CAHSI Sets It Apart from Other Conferences? (n=31 students)**



In response to a question about what sets the CAHSI Summit apart from other conferences, students focused mainly on the inclusive, welcoming atmosphere, mentoring, and emphasis on diversity, as suggested in the following student responses.

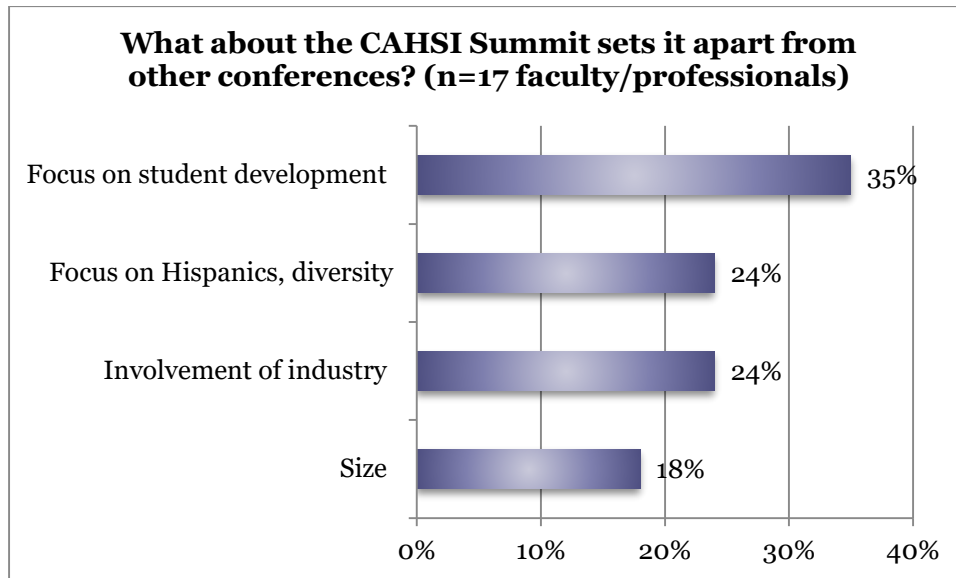
*Everyone from the CAHSI Summit was very welcoming. There were not a large number of people which allowed students to talk to professionals and professors.*

*The fact that it brings together multiple Latinos and Latino serving institutions provides an awesome atmosphere. It allows me to actually express myself and my culture.*

*The CAHSI conference is different from other conferences I have attended in that this conference was easier to meet people since it was not as huge and I got to meet people that struggle or have shared ethnic/gender experiences.*

*This was my first STEM conference. But I would say it was very organized, they made us feel very welcomed and had interesting content throughout the whole conference.*

**Figure 11. What About the CAHSI Summit Sets it Apart from Other Conferences (n=17 faculty)**



In 2015, CAHSI returned to its original model of providing its own annual meeting, focused specifically on the advancement of Hispanics in computing. Attendees, especially students, commented on the welcoming, inclusive atmosphere for Hispanics in computing at the CAHSI Summit. In contrast, CAHSI attendees reported in previous surveys that this sense of community was not present at the SACNAS conference. CAHSI also integrated industry professionals into the meeting to a greater extent than in the past. Overall, faculty/professionals and students both reported that networking was one of the greatest benefits of the conference and that they had followed up with contacts made at the Summit. Students also felt that they received the mentoring and career information to advance their careers, especially in terms of applying for graduate school or fellowships/scholarships. In turn, students had applied for scholarships, fellowships, and graduate school at higher rates than in previous years.

### **Affinity Research Groups: Learning through Professional Practice**

In all, 106 CAHSI students completed the Undergraduate Research Student Self-Assessment (URSSA) survey in spring, 2016. URSSA is a statistically reliable and validated survey that was developed to measure students' cognitive, personal, and professional gains from apprentice-style research experiences. Several scales on the URSSA survey were adapted for use in classroom contexts, notably the intellectual gains scale and skills scale to reflect the differences in the way the ARG model is structured within a course in contrast to an apprentice-style, hands-on research experience.

### **ARG Student Demographics**

In the past academic year, CAHSI students participated in ARG coursework and out-of-class apprentice-style research experiences under the guidance of a mentor facilitating the ARG model. In fact, more students participated in ARG courses than out-of-class research experiences as CAHSI has



expanded ARG course offerings in recent years. Overall, 82 survey respondents participated in ARG courses and 24 participated in out-of-class research experiences.

Many students (43 students, 41%) were from University of Texas, El Paso. Four other institutions were represented: California State University, Dominguez Hills (12 students, 11%), Northeastern Illinois University (16 students, 15%), University of Puerto Rico, Mayaguez (28 students, 26%) and Texas A&M University, Corpus Christi (7 students, 7%).

The respondents were primarily seniors/4<sup>th</sup> year students (56% of respondents or 59 students) and juniors (26% of respondents; 25 students), but a small contingent of freshman and sophomores were represented (10% of respondents, 10 students combined). Additionally, Ph.D. students (3%), and Master's students (7%) also participated in ARGs and completed the survey.

Women were represented in CAHSI ARG groups in higher proportions than they are nationally in undergraduate computing programs. Women represented 26% of ARG students, while women comprised only 17% of CIS bachelor's degree recipients in the nation (NCWIT, 2016). Nevertheless, the number of women participating in ARGs in the past year has decreased from 52% in academic year, 2014-15. This reduction in the proportion of women is most likely because ARG courses have been included in the survey this year and so respondents are more representative of the overall enrollment in CAHSI departments. The proportion of women participating in out-of-class research was slightly higher at 37%. Still, CAHSI undergraduate women are participating in research groups in relatively high numbers for the field of computing.

Hispanics were also represented in ARGs at much higher rates than their national representation in computing (approximately 7% nationally). In contrast, 64% of ARG survey respondents were Hispanic. Additionally, 7% of ARG students were African-American.

A significant minority of ARG students were first-generation college students. In fact, 39 students, or 41% of all survey respondents reported that they were the first member of their family to attend college. This number is higher than in past years as typically about 25% of ARG students have been first-generation college students.

### **ARG Students Are Active in the Computer Science Research Community**

CAHSI students involved in Affinity Research Groups (ARGs) continue to outpace their national peers in NSF research experiences for undergraduates (REUS) in rates of academic presentation and publication. The majority of ARG students (59%) reported that they attended a professional conference—slightly less than in past years—while only 23% of a national sample of REU students had done so. Only students who had engaged in out-of-class research experiences were asked about professional activities, such as conference attendance and publications, because these activities are not a part of a typical ARG course. Fewer students attended professional conferences

this part year, such as Grace Hopper or Tapia, perhaps because more students attended the CAHSI Annual Summit in Puerto Rico. In the past year, ARG students attended the following conferences:

- Grace Hopper (3 students)
- SACNAS (3 students)
- Tapia (1 students)
- SHPE (1 student)
- HENAAC (2 students)
- FIE (1 student)
- CAHSI Summit (9 students)

Additionally, ARG students published in refereed journals at rates higher than the national REU sample: 17% of ARG students and 5% of the national sample authored papers. These differences in conference attendance and presentation are statistically significant ( $X^2=27.864$ ,  $p=.000$  and  $X^2=15.708$ ,  $p=.001$ , respectively). Frequencies and percentages of student conference attendance and paper authoring for both the ARG sample and the national REU sample are presented in Table 12.

**Table 12. Professional Activities of ARG Students**

	<b>Number of ARG respondents (n=24)</b>	<b>Percent of ARG respondents</b>	<b>Number of national REU sample (n=464)</b>	<b>Percent of national REU sample</b>
<b><u>In the past year, I have attended a professional conference.</u>**</b>	18	75%	106	23%
<b><u>In the past year, I have authored or co-authored a journal paper.</u></b>	4	17%	25	5%
<b><u>In the past year, I have presented a conference poster or paper.</u></b> **	13	59%	70	15%

**\*\*significant difference,  $p<.01$**

**ARG students' academic advancement**

Affinity Research Groups are designed to introduce students to collaborative teamwork and other professional skills, develop their knowledge of their field and understanding of research, and to support students' preparation and pursuit of graduate school. ARGs are designed to prepare students for the cognitive and collaborative demands of computing careers and to facilitate students' advancement in the profession. ARG students who would be graduating within one year (68 of the 106 total respondents) reported on the steps they had taken to reach graduate school. Four students (6%) reported that they had taken the GRE, yet 21 students responded that they plan to take the GRE. On the other hand, five students (7%) had already applied to graduate school, and 29 students reported that they plan to apply to graduate school. ***All five students who had applied to graduate school were accepted and planned to enroll in the following year.***

ARG students attribute their interest in graduate school to their experiences in their research groups. For instance, ***51% of ARG students reported that they were more likely to attend graduate school because of their research experience.*** The percentage of students who were more motivated to attend graduate school declined this year from past years where typically 65% to 75% of students reported increased interest in graduate school. However, this is the first year that data have been collected from students in ARG courses who have very different motivations and goals than students who choose out-of-class research experiences. Students in out-of-class research experiences are more likely to explore research, in part, to discover whether graduate school may be the right path for them. It is doubtful that students in ARG courses would have this motivation for enrolling in a course that may be a requirement in the computer science major. There were no statistically significant differences in graduate school aspirations among sub-groups in the sample, such as race, ethnicity, gender, or length of time in the research group. Thus, students seem to gain an equivalent level of interest in graduate school from participating in ARGs, including ARGs in computer science courses, although many ARG students with graduate school aspirations have not yet taken action to achieve their educational goal.

### **ARGS Help Students to Develop the Skills and Traits of a Computer Science Professional**

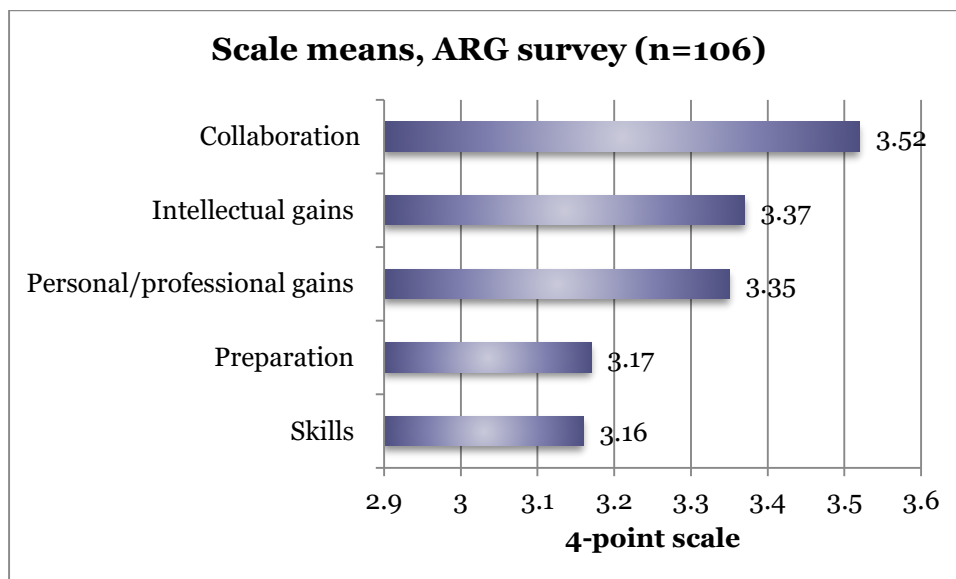
Through ARGs, students gained the skills, knowledge, and confidence from ARGs that they will need to succeed in graduate school and the computing workforce. Students reported positive outcomes on all the Undergraduate Research Student Self-Assessment (URSSA) gains scales (between 3.0 and 4.0 on the 4.0 point scale, or between "good" and "great" gain). The survey measures students' reflections on their growth in the following areas:

- Collaboration: Teamwork skills, shared leadership, mentoring
- Intellectual gains: Understanding of the discipline, problem-solving
- Personal/professional growth: Self-efficacy, interest in computing, professional identity

- Skill development: Presentation and communication skills, organizational skills
- Preparation: Perceived preparation for graduate school and career

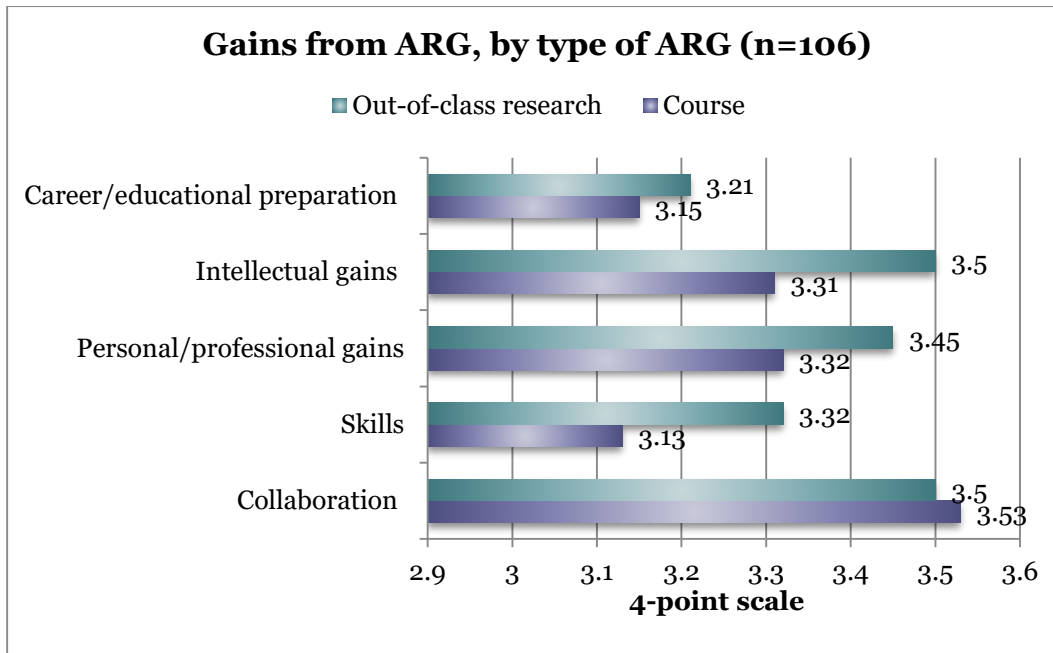
Similar to results in the past, students' highest reported gains were in collaboration/teamwork and intellectual gains, such as improved problem-solving abilities and understanding of the discipline. The collaboration scale also measures the extent to which leadership is distributed, the research group works cooperatively and other markers of a high-functioning Affinity Research Group. Students' reported scores on the collaboration scale indicate that CAHSI Affinity Research Groups are operating with distributed leadership, individual accountability, positive interdependence and other hallmarks of the ARG model. Figure 4 below illustrates the scale means for the gains scales (4-point scale in which 1=no gain, 4=*great gain*).

**Figure 13. Scale Means, ARG survey (n=106)**



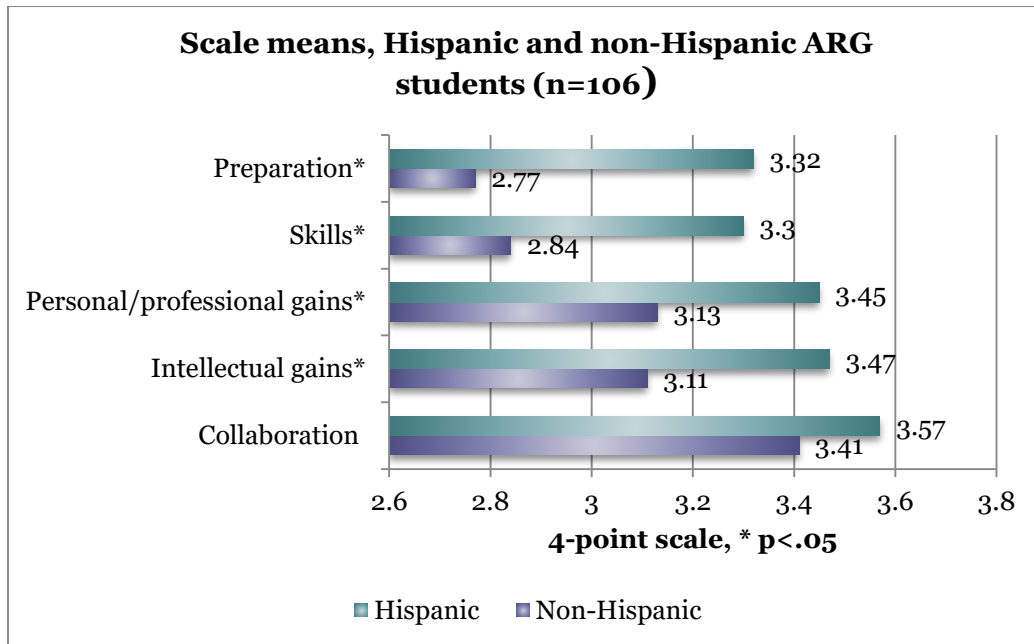
There were almost no differences among groups in students' perceptions of their gains from ARGs, suggesting that all students benefited from their ARG experience. For the most part, men rated their gains slightly higher than women, although these differences were not statistically significant. Additionally, out-of-class research students reported slightly higher gains than students in ARG courses yet these differences were not significant. Nevertheless, out-of-class research students reported more gains from research than students in ARG courses, with the exception of teamwork skills, suggesting that the cooperative elements of the ARG model are well suited for CS courses.

**Figure 14. Gains from ARG, by Type of ARG (n=106)**



The only notable and statistically significant difference among all groups—including gender, first-generation college status, parental education, and major—was between Hispanic and non-Hispanic students. Hispanic students rated their gains significantly higher than non-Hispanic students on almost all measures, including preparation ( $t=3.34$ ,  $df=94$ ,  $p=.002$ ), skills ( $t=3.189$ ,  $df=94$ ,  $p=.009$ ), personal/professional gains ( $t=.091$ ,  $df=94$ ,  $p=.042$ ), and intellectual gains ( $t=3.833$ ,  $df=94$ ,  $p=.012$ ). The only non-significant difference was in collaboration, yet Hispanics still rated their gains in teamwork higher than their non-Hispanic peers. Figure 15 details the scale means for Hispanic and non-Hispanic students.

**Figure 15. Scale Means, Hispanic and non-Hispanic ARG Students, (n=106)**



In conclusion, ARG students reported that participating in research—whether in out-of-class research experiences or CS courses—increased their knowledge of the discipline, their feelings of preparedness for graduate school, and their ability to collaborate on productive teams of computing professionals. Student responses on the collaboration scale indicate that CAHSI ARGs are implemented in accordance with the ARG model, including distribution of expertise, positive interdependence, and individual accountability. ARG students also engaged with their disciplinary research community by attending conferences at significantly higher rates than typical undergraduate research students.

### **Case Study: CAHSI Students’ Educational Experiences and Pathways**

At the CAHSI Summit in September 2015, nine focus groups were held with students to better understand their experiences in CAHSI departments. Students described their impressions of the departments in which they study, their ideas about computing, understanding of CAHSI, and their goals for the future. Students had recommendations for CAHSI to consider moving forward.

#### **Computing Impressions**

Participants described what first interested them in computing as well as what motivates them to continue pursuing computer science/computer engineering. While many students described being influenced at an early age to become fascinated by computers, others came to the field later in life. Those with early interests in computing became interested because of family member mentoring, gaming hobbies, fascination with “the next great invention” in technology, or because of the applied nature of computing.

*I went into computer science, because I thought everyone at one point will need technology. All industries will need technology. So I wanted to do something that will open that door, so that's why I chose computer science.*

As students become more adept at the field, they described what they enjoy about their growing expertise in computing. Many explained that the challenge they experience in their field is motivating—the experience of working hard on a particular program and the great satisfaction when it is completed.

A student described her favorite project thus far in computing: *We were making a rail gun-like from the transformers movie. ...it took us forever, and our group worked so hard. When I finished, I felt like on top of the world. The whole class cheered when it worked.*

Another student described the process of learning in computer science this way: “I always learn more from my mistakes than my successes.”

Students described qualities of computer science that defy the many stereotypes regarding computer scientists, identifying professionals in the field as collaborative, curious, entrepreneurial, and well-rounded with interests in many areas. Regarding their future careers, they are often pragmatic—they note a desire to get paid well in a job they love. A few described aspirations to become experts in other disciplines in which their computing expertise would enhance their careers (e.g., bioinformatics, petroleum engineering, mechanical engineering, art, and music).

## **Impressions of CAHSI**

The students’ knowledge of CAHSI varied from school to school and student by student. For many at the Summit, the conference in Puerto Rico was the first they had heard of the CAHSI organization. Others, however, understood that CAHSI supported their research efforts and some made the connection to PLTL as well. The major theme across students with varying recognition of CAHSI was that CAHSI supports students, particularly Hispanic students, in computing fields primarily through research opportunities, mentoring, and conferences in which students learn and network with peers.

*What I know is that they help undergrads and grad students that are like minority, majoring in their majors, basically computer science. That's what I know, and they help you with research, they fund the school to pay you for research or conferences.*

For many, the conference was a highlight of their CAHSI experience. They described in particular a relaxed, warm setting conducive to networking. Many noted the great importance of networking for finding a good job, locating new mentors, and making progress on research goals.

While networking was key, students also learned quite a bit from their peers and from more experienced students in paper sessions and posters. The experience of presenting findings also was important to their development as computer scientists and engineers.

Role models abound at CAHSI, particularly for students who are traditionally underrepresented in the field. A Latina undergraduate said:

*This conference is helping me see Hispanics in computer science that are not in most schools. I think that's encouraging. For me, it's refreshing to know of more people that are great at the same thing and they're like me.*

Students see value in spending time with peers who do research at the conference. Specifically, a student said:

*An important thing is getting new ideas. Not always when you're doing research, but you can look at things that other people are doing. Maybe it's not the same area, but you can apply some of their strategies to your own research.*

Another student indicated attending the conference was a privilege. He said: "I give to myself a sense of importance as to what I'm doing. The work that I did last semester wasn't in vain. I got here, I said to myself, hey I'm here, I nailed it."

A participant with conference experience noted the quality of the CAHSI conference in this way:

*"I'd say at least my personal goal was to actually come and learn. It's not the first time I've come to a conference. I had some expectations of what I should walk away with and I'd say it was more than I anticipated. People that talked, speakers were bright, really involved students and faculty that was here. No matter the major, even if you weren't from computer science, you still felt like you belonged here."*

### **Benefits of PLTL, for leaders and for students**

One student described the careful, continuous preparation he received to be a peer leader. Training can be essential to peer leading, as it makes explicit the role of the peer leader as a guide, not a provider of correct answers. Students learn questioning strategies to support student learning.

*I was working under [my professor] for two semesters as a peer leader for PLTL. The program is designed really good. [Professor] put us through a training for the whole semester, like one hour, I remember that and after that we have to go read the chapter, do assignments and have group discussions,*



*once a week. Through that, I also worked on the, basically a peer mentor, because she trained us before we actually interact with the students.*

Often students move from the role of learner to the role of peer leader. One leader reflected on that transition: *“I’ve been a peer leader for three years. I really love that because when I was taking my first classes, I really, really had a hard time understanding the professors, like every student does. When the peer leader, and sometimes they were peer leaders that speak Spanish or stuff like that, it’s easier (to understand) because some stuff, it seems really complicated.”*

As in previous work regarding peer leading, we found students for the most part appreciate the peer leaders as more approachable guides with time to assist them and with whom they share a common language.

One student described the peer leader/student relationship like this: *“Usually those courses, when they’re led by a peer leader as well, the advantage is those courses, there’s a person that has time for you to go study with them, versus a regular course where it’s just the instruction that the professor gives and then you have to find tutoring assistance on your own. I think that courses that are led by peer leader, they are in there in the class with you.”*

Another student described learning benefits to serving as a peer leader: *“As a student you often forget what you know. While you’re explaining (as a peer leader), you’re like, “Oh, yeah. I know this.” You just tend to forget ... That’s just really refreshing being able to explain it. That’s when you know that you know it.”*

### **Departmental Impressions**

Students at the CAHSI conference described their impressions of their departments. It is important to note that the students interviewed are highly engaged in their departments—doing research with professors and serving as peer leaders to others. This certainly positions them, among their peers, in a relative place of power, and so their experiences should not necessarily be viewed as representative of all students in the major.

Students, particularly in the smaller schools, described the peers in their departments as close-knit and supportive of one another. Students from larger departments described their research groups in similar ways, indicating a sense of community within the sub-group spending time together on collaborative research projects.

Each departmental focus group highlighted the support they get from CAHSI staff and faculty as signs of departmental-level support for students. Faculty approachability and direct encouragement were highlighted. Also, many students discussed a mentoring relationship with CAHSI staff and faculty that went beyond the specifics of helping students with content-related computer science questions—they also received advice related to their career and educational goals.

One student gave a comparative account—as a student who transferred from another department, he contrasted the opportunities and encouragement between another engineering department and his CAHSI computer science department:

*They say schools are like ‘oh no matter where you go to school, you just go to the school’, but it’s also dependent on the department itself. I know that I did not have the same relationship with my engineering department as I do with my computer science department now. So I know this is a nice positive aspect, like there’s more potential for you as far as what you are exposed to and what you can do.*

Another student compared her department to elite schools favorably—she notes it is a shame that elite schools focus so much on theory that they don’t have opportunities to apply what they know hands-on—she was grateful her department took an applied approach because she saw it as helping her learn better.

While most students described neutral to positive relationships with department staff and faculty, one Latina described overt and implicit bias she endures as a woman in computing in her department. More than one faculty member shows favoritism towards men, including differing grading practices, overtly sexist language in class, and sharing a clear message to the women in the class that they do not belong. Male students in the focus group corroborated the experience of the women, yet had little idea about how they could combat the professors’ words and actions.

### **Good teaching**

Participants said remarkably similar things about the quality pedagogy in their coursework in all of the focus groups. They appreciate active learning strategies in coursework, approachable professors who make time to discuss problems with them, and enthusiastic delivery of material. They want to think about the content during class, interact with their peers, and receive timely feedback on their work that can influence their performance on quizzes and tests. They appreciate partial credit for work that is close to correct with a few problem areas, and they also appreciate consideration and acknowledgement of novel or creative approaches to a problem.

Regarding class group work, one student said: “*It makes you be involved when you’re working with people, instead of just being quiet in class, trying to pay attention. You have to work together and talk and be involved.*”

Another student said: “*Hands-on, small group activities are good in class, especially ones that are interesting to the students. If you’re interested in something you’re going to obviously remember it a lot better.*”

As students talked about quality teaching and learning, they often reverted the discussion back to research and their experiences learning CS content in an applied, deep, and rich way. A few indicated that involvement in research re-energized them within their major because they gained a deeper understanding of concepts through research. Many of the students interviewed made realizations about their field through their research experiences with CAHSI.

A student noted how fast he can learn a field of inquiry when given the dedicated time to do so through research: *“It's amazing how fast you can learn a whole new area just because that's what you're topic is this time, so you have to learn that whole field, start writing your stuff here, and it's interesting because you just go all over the place.”*

Another group of students spoke about the quality of learning through research because of its applied nature, authentic problems that must be solved to move forward, the goal setting involved in research as individual or group based rather than dictated by course content, and the reflective nature of research work.

### **Barriers**

Students were asked to provide information about barriers they face to their success and to their participation in graduate school. When discussing barriers, it is important to consider students' impressions of the barriers as internal (based on ability, or lack of ability or drive) versus external (situational, related to external forces or circumstances).

One young woman described barriers she perceived along her path in CS:

*I had a lot (of doubt). Yeah. That just comes on my end, like personal development. Like I said, there were many times that I felt like I wasn't ever going to be the smartest, or everyone else is smarter than me and they were all natural geniuses and I'm struggling just trying to study for a test. I felt like the one who had to study the most just to be at the same level. Throughout trying with the support and I think even with experience, like doing internships and going to conferences and how we realized, 'Okay. It's not about being the smartest person in the room. It's about learning at your own pace.*

One of the barriers faced by students, particularly in smaller departments, is limited course offerings which constrains their opportunities to retake courses they failed. The ways in which students describe these barriers focused on the context, not on the initial failing of the course, which for other students might signal an internal deficiency. CAHSI students do not report feeling like a failure when they need to retake courses. In part, this may be because within their peer groups, they are able to normalize the struggles of succeeding in computer science.

With regard to graduate school, the most pressing barriers CAHSI students face are time, money, and family obligations. Two students described specifically a need to return home to care for and support aging parents, and thus not having the time to devote to additional schooling. Funding was a major obstacle for students interested in Master's degrees, and many indicated a need to start making money sooner rather than later. With high salaries at the Bachelors level in computer science, it is tempting to many to get a job in industry before pursuing graduate work.

One student described how barriers faced by family members serves as a motivator for the student: *"It was more of a family push (to go to graduate school), not because my family told me "Hey, go masters", but because, I don't know for the rest of you, but my family, before when they were kids, when they were younger, things were harder. And despite the fact, my family and all, my mom, uncles, managed to get a career despite the abrasive circumstances. So I just felt the responsibility to just go up at least one step."*

### **What CAHSI can do to improve departmental culture**

CAHSI is in a good position to improve the interactions among students and across departments, and to improve the departmental culture at each school. The following suggestions are based on the data reported from focus group information:

- CAHSI brings together diverse groups of students, faculty, and staff across CAHSI departments—no two CAHSI schools have similar demographic profiles. All participants of CAHSI, regardless of ethnic/racial identity, need support in developing strategies to combat bias in the classroom and in the department, whether it is directed towards them or another group. CAHSI attendees are diverse, yet each has a role in creating an environment supportive of Hispanics in computing. The example above of Hispanic men who were unsure of how to support their female colleague and friend in the face of sexism and bias highlights the need for discussion of how to empower Hispanics and support all groups in creating a positive climate.
- Students who attend CAHSI appreciate rich conversations about research with peers. They want more opportunities throughout the year to learn from one another, regardless of the research interest or project. Creating student associations with explicit links among institutions, along with technical infrastructure to meet virtually would fill this need. This might need a bit of social engineering to make sure that occurs—if faculty or staff take the lead to initiate connections, students may take up this responsibility once virtual connections are more established. They also requested a related resource: a research team online forum that spans different CAHSI departments and has active faculty/graduate student participation.

- Students asked for industry mentors and career connections. These are in line with current plans for industry connections and regional partnerships planned for the next phase of CAHSI.
- After entry level courses, peer leader support is often no longer available. Students asked for a structure to support their learning from peers in more advanced coursework—e.g., near peer leadership, low stakes in class activities, or opportunities for one-on-one help.
- CAHSI students are particularly inspired by stories of upward mobility, yet the endpoint of a role model should vary. Having access to role models with highly aspirational careers (professors, working at high power tech firms, etc.) *as well as* role models who are local professionals who enjoy their careers at small and mid-size firms should be highlighted by CAHSI. Alumni who return to campus to talk about their careers can be leveraged by the CAHSI student associations to provide guidance to a larger group of students.
- Peer leaders also would find it helpful to meet across campuses, both through a “birds of a feather” type conference meeting and online. Again, some social engineering may be needed to start up these collaborations, along with PLTL faculty support to engage with other leaders. The PLTL international society meeting held annually could also support student CAHSI collaboration, and in so doing elevate the CAHSI identity at the student level.

## **Common Core Indicator #2: CAHSI Organizational Capacity**

In this section, we highlight the current organizational capacity of CAHSI and assess how CAHSI has made progress towards creating change in computing education for Hispanics within its membership. This rubric was developed to measure organizational capacity via a healthy pipeline of interested and qualified students, resource development and training, faculty/staff engagement, and financial sustainability.

### **CAHSI Organizational Capacity rubric**

As in each year of the current funding cycle, the evaluators employ a research-based rubric of organizational capacity. CAHSI’s sustainability depends on the development of capacity to support activities as well as Alliance-level abilities to continue and advance the organizations’ goals.

**Figure 16: Organizational Capacity Rubric**

**CAHSI Organizational Capacity Rubric: Blue color indicates school or department is achieving the goal, yellow indicates partial fulfillment; and black indicates no progress towards fulfillment; for sustainability: black indicates no additional funding, yellow indicates partial fulfillment via other means, and Blue indicates fully “other” funded. Pink indicates the cell is N/A.**

Indicator v	School >	S1	S2	S3	S4	S5	S6	S7	S8
<b>Healthy Pipeline:</b> K12 outreach using CAHSI initiatives (e.g., CS-0)		Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
<b>Healthy Pipeline:</b> faculty staff or students have continued to innovate in course pedagogy (e.g., experimenting with new initiatives, finding new ways to study initiatives underway)		Blue	Black	Black	Black	Blue	Blue	Blue	Blue
<b>Healthy Pipeline:</b> formal graduate school preparation (goal is 15% of departmental students) <sup>5</sup>		Yellow	Yellow	Yellow	Yellow	Yellow	Blue	Yellow	Yellow
<b>Healthy Pipeline:</b> shift in CAHSI graduate school intentions (as defined by intent to attend graduate school, measured across departments, above baseline for 2010 annual meeting rates)		95% of CAHSI Summit survey respondents said their interest in graduate school increased because of the Summit.							
<b>Resource Dev Train:</b> host training in 1 or more CAHSI initiatives		Blue	Black	Blue	Blue	Black	Blue	Blue	Blue
<b>Resource Dev Train:</b> lead training in 1 or more CAHSI initiatives		Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
<b>Fac/staff engagement:</b> undergraduate faculty CAHSI awareness measured every other year (75%) fac survey		Funding constraints prohibited this evaluation							
<b>Fac/staff engagement:</b> fac CAHSI participation (33%) fac survey		Funding constraints prohibited this evaluation							
<b>Fac/Staff engage:</b> undergraduate faculty participating in CAHSI during the 2014-2015 year (25%)		Blue	Yellow	Yellow	Yellow	Blue	Blue	Blue	Blue
<b>CAHSI Alliance sustainability:</b> funds for CAHSI supplemented at the department/institutional level- <u>CS0 outreach</u>		Blue	Black	Blue	Blue	Blue	Blue	Blue	Blue
<b>CAHSI Alliance sustainability:</b> funds for CAHSI supplemented at the department/institutional level- <u>CS0 undergrad</u>		Blue	Pink	Pink	Pink	Blue	Blue	Blue	Blue
<b>CAHSI Alliance sustainability:</b> funds for CAHSI supplemented at the department/institutional level- <u>PLTL</u>		Blue	Pink	Pink	Pink	Blue	Yellow	Yellow	Blue
<b>CAHSI Alliance sustainability:</b> funds for CAHSI supplemented at the department/institutional level- <u>ARG</u>		Pink	Pink	Yellow	Yellow	Pink	Pink	Yellow	Yellow
<b>CAHSI Alliance sustainability:</b> funds for CAHSI supplemented at the department/institutional level- <u>mentorgrad/fellownet/femprof</u>		Pink	Yellow	Black	Black	Pink	Pink	Yellow	Pink

**Healthy pipeline**

All of the CAHSI departments reported K-12 activities that built upon CAHSI initiatives. They did so in many ways—for example, CS-0 course content was provided to younger students, peer mentoring occurred with high school students leading middle school students, high school students mentored middle school students, or collaborative undergraduate research practices were incorporated

into summer camp opportunities. This is the first year that all institutions described K-12 outreach that they linked to their experience in CAHSI. Over half of the institutions (5 of 8) described innovations that occur on their campus, either by using existing CAHSI initiatives or in initiating new ways of educating youth. Some examples include: creating competitions for youth as a part of K-12 and community college outreach, developing a cohort model for ARG, and designing highly interdisciplinary courses for entering college students. With careful cultivation, these innovations could add to the body of work of CAHSI. CAHSI could capitalize on funds allotted to social science research efforts to better understand the capacity of other CAHSI institutions to take up these practices.

The CAHSI summit improved student interest in graduate school—nearly all eligible survey respondents said they were more interested after engaging with the CAHSI community in September (95%). To sustain, CAHSI departments must have the internal human, material, and fiscal resources to host and lead professional development. While many of the trainings have been internal (e.g., peer leader trainings) most of the schools had the capacity to train relevant community members in the 2015-16 school year. Human capital in the form of engaged faculty is vital to sustaining reformed educational practices—most (5 of 8) departments have a situation in which a critical mass of faculty (25% or more) have a role in CAHSI activities.

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*A new CAHSI faculty member developed a series of career-ready assignments for a required senior level course in collaboration with the career placement office. The career office assessed the student work, including resume development, resume revision based on feedback, and provided the feedback to the faculty member, who included the feedback in a course grade. Creating career and graduate school preparation within courses can better prepare students, particularly first-generation college students, for their next steps in computing.*

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Last year, two FIU students and two UPRM students with ties to computing and to CAHSI earned National Science Foundation Fellowships. One student from the University of Houston- Downtown received an honorable mention in the competition. This is a great achievement, yet the extent to which CAHSI students have formalized training and support around fellowship writing has declined over time, with only one school achieving 15% of students receiving such professional development.

### **Two practices show promise for greater adoption across institutions**

- a) **Creating a connection to the graduate school, and developing a college or institution wide program that utilizes CAHSI's FellowNet resources and graduate school personnel to recruit, organize, and potentially implement the workshop.**
- b) **Creating co-curricular/curricular innovations that intentionally link students to resources on campus that support their career readiness.**

Funding issues remain in terms of CAHSI's long-term sustainability- in fact, not much has changed in terms of funding for initiatives through CAHSI versus other sources since last year. While course development and outreach is nearly always internally-funded, additional resources are usually needed for peer led team learning and research, as well as MentorGrad when the program exists at the college. The new model for industry funding may create alternative funding sources for CAHSI initiatives, particularly those related to research.

### **Case Study: Challenges and Opportunities Resulting from Enrollment Growth**

CAHSI's challenges in terms of funding, sustainability and the continued professional development of faculty within its departments may be exacerbated by pressure from enrollment growth. CAHSI departments have experienced CS enrollment growth rates that range from modest to large. Five departments reported high growth rates, ranging from 10-25% per year in recent year, two departments have experienced a "modest increase" and one university has experienced a decline in growth. This decline was in a computer engineering department, rather than computer science, and the decline was attributed to the fact that the university had added two new majors in computing and some students are now choosing one of those majors over the traditional computer engineering degree. To better understand enrollment growth within CAHSI departments, the evaluators convened a focus group with CAHSI PIs in spring, 2016 to collect data on the challenges and opportunities faced by CAHSI departments in a time of high enrollment growth in computer science departments nationally.

#### **Causes of recent enrollment growth**

CAHSI faculty noted multiple contributing factors to increased undergraduate enrollment, including adding new programs or majors in computing fields, such as the Computer Technology degree program at CSU-DH. Other departments, such as NMSU, have seen an increase in students seeking a minor in Computer Science. These students come from both STEM and non-STEM fields, including social science and the arts. Another contributing factor is an increase in students seeking master's degrees and potentially dual enrolling in upper-level undergraduate courses, while they are also seeking postbaccalaureate degrees, as has occurred at UTEP and TAMU-CC. Some departments in large urban areas have enrolled students at higher rates because other departments in the area cannot accommodate growth and these departments, such as CSU-DH, pick up the overflow of students.

Some populations of students are enrolling in CAHSI departments at higher rates, also accounting for enrollment growth. International undergraduate students, and non-Hispanic underrepresented minority students, such as African-Americans are enrolling in CAHSI courses at higher rates. The number of white students in CAHSI departments has remained steady. The growth in these populations is evident in enrollment data collected from institutional research offices and from the observations of CAHSI PIs. Some campuses, such as TAMU-CC and CSU-DH have seen a decline in community college transfer students and an increase in traditional-age college students



enrolling in degree programs straight from high school. Other campuses with strong relationships with local community colleges and articulation agreements to facilitate transfer, such as UTEP and UPRM, have seen increases in the number of transfer students from community colleges. Student pathways through college are also changing as some students may transfer from a community college to a 4-year institution, but continue to take some credits at the community college because tuition is less expensive, as has been the case with some UTEP students.

### **Challenges of CS enrollment growth**

As more undergraduates enroll in CAHSI degree programs and courses, departments and faculty have faced several challenges. Departments have struggled with a lack of introductory courses/sections and may find themselves unable to accommodate such rapid growth. Almost all CAHSI PIs agreed that there are not enough faculty to teach key courses and they are unable to secure new faculty lines in their departments, jeopardizing their ability to manage enrollment growth. As undergraduate enrollment impinges on faculty time, faculty are less able to advise and mentor graduate students. Faculty also have less time to develop curriculum and carry out other essential duties, as noted by four PIs.

Departments are not the only sites that may face pressure from increasing enrollments; indeed, institutions may also face unique pressures from increasing computer science or computer engineering enrollments. For instance, campus revenues are declining, particularly with recent decreases in state support, and resources are scarce. Increasing enrollments in a few departments on a campus may place an undue burden on institutional resources. Institutional budget cycles and decision-making also move too slowly to adapt to rapidly increasing enrollments, creating a weak link between departmental enrollments and actual resources allocated to those departments. Administrators and others with financial authority may also be doubtful that increasing enrollments will be sustained, making them less likely to grant extra resources to single departments. For instance, UTEP may only be able to fill two out of six needed faculty positions because they do not have the lines for the other four faculty positions. Finally, computer science and computer engineering degrees have high credit loads which may conflict with recent institutional and national initiatives to decrease time-to-degree.

As undergraduate enrollments increase, the expanded population of students may include students with less preparation that may, in turn, impact retention rates. Several PIs mentioned that preparation was an issue for some students as they are not ready for college-level coursework and may be at risk of leaving the institution entirely. At least four PIs noted that increased enrollments have actually negatively affected retention rates as students are less prepared for computing coursework, less informed about the computer science degree, and may struggle to pass introductory courses, even with the supports offered in CAHSI courses. This lack of information coupled with lack of preparation can create issues with student retention, particularly in sophomore-level courses. For instance, CSU-DH has observed that students leave the major, or even the CS minor, after they learn about the

Calculus and math requirements. An increase in commuter students can also raise challenges in offering appropriate student support because commuter students generally spend limited time on campus. Increased enrollments also contribute to larger class sizes and a lack of teaching assistants which will affect the quality of teaching, student learning, and student retention. Finally, five PIs noted that it may be harder to get resources to address increased enrollments at Hispanic-Serving institutions.

### **Strategies to address enrollment growth**

CAHSI departments have implemented multiple strategies to address the challenges inherent in increased undergraduate enrollment. CAHSI departments have increased the number of sections in introductory courses, especially CS1, CS2, and Data Structures. Three departments have also increased the number of students enrolled in lecture sections of introductory courses while keeping lab sizes consistent. All PIs discussed strategies for providing enough instructors to teach the increased number of sections of introductory CS courses, including hiring part-time adjunct instructors, requesting more faculty lines, adding visiting faculty, and adding teaching faculty. Staffing has also created challenges for CAHSI departments in terms of finding enough teaching assistants (TAs) to accommodate introductory sections. Some departments, such as UTEP, have added undergraduate TAs in addition to the typical graduate student TAs. Other departments have added more graduate teaching assistants or re-directed TAs from upper-division to lower-division courses.

Student retention is another significant challenge which CAHSI departments have faced. Departments have used multiple strategies to address student persistence and retention issues. Several departments have changed their placement or advising practices. For instance, NMSU has begun to use a placement exam to determine the most appropriate introductory course in which to place students. Two other departments, TAMU-CC and CSU-DH are considering adopting a placement exam for introductory courses, yet noted that this change can be costly and difficult. Other departments, such as UTEP, have adapted their advising strategies to monitor student progress to ensure that they have completed required courses in a timely manner and sequence. While UTEP has always provided these advising services, increased enrollment creates extra challenges in advising students.

Another strategy to improve student retention is to create new programs so that students can move between programs as meets their needs and interests. Some programs may be more theoretical, while others are more applied. Some programs may be more math-oriented, while others have less of a focus on math. Some programs may also be interdisciplinary or work with other departments on campus. For instance, a new program at UPRM works closely with the business school on entrepreneurship. The Computer Technology degree at CSU-DH has been highly successful in allowing students to stay in a computing-oriented major without the full span of requirements of a traditional computer science degree. NMSU has also added a B.A. in C.S. with fewer math requirements. Several universities, including UTEP and NMSU, have implemented core university

courses in computational thinking that serve as general education requirements for non-majors. Finally, some institutions, such as UTEP and CSU-DH, are using institutional data to examine student pathways through the major and to identify trouble spots. For instance, CSU-DH discovered that students who received Bs or above in CS1 and CS2 had a 75% chance of receiving a degree in Computer Science, while students with Cs in those two courses had a 50% chance of receiving their degree. This type of intensive institutional data analysis can foster actionable findings that are tailored to specific CAHSI sites.

### **Opportunities created by enrollment growth**

Faculty noted far fewer opportunities compared to challenges in relation to enrollment growth, although CAHSI PIs mentioned several opportunities. For example, there is the opportunity to increase graduation rates with increased student enrollments. Additionally, as CAHSI departments have worked to create more pathways through the major, there is the possibility of receiving more community college transfer students. More course sections may also benefit CAHSI students as it will allow for more flexibility in scheduling for students who hold off-campus jobs or have families or other commitments. CAHSI PIs also noted that they had supportive deans or administrators within their university, including UTEP, NMSU, CSU-DH and UPRM. The increased student enrollment in CS courses also offers the opportunity to better position and highlight the department within the university and to bring national attention to the field of computer science. CAHSI PIs hope that enrollment growth will eventually translate into more resources and support for faculty and the department as a whole.

### **Enrollment growth and Hispanic-Serving Institutions**

Enrollment growth offers the opportunity to increase the number of Hispanics in computing because of the large Hispanic student enrollment at HSIs. If course enrollments are increasing, CAHSI faculty will need to reconsider their classroom practices to reflect larger course enrollments. Effective teaching practices may need to change with larger enrollments. There is an increased need for more alliances and consortia to share best practices in computing for serving underrepresented students; specifically how to adopt and adapt practices and to measure their success. Finally, growth must reflect the needs of diverse students. Departments must be aware of the culture created by increased enrollment, there is the possibility that increased growth could lead to a more competitive departmental climate. Students will continue to need support systems because there is the danger that more students may leave the major if appropriate support systems are not in place.

### **Common Core Indicator #3: Alliance Impact**

In this section, CAHSI activities from 2015-16 are documented and presented that involved partners outside of the core Alliance or that took place on a national or regional scale. Alliance Impact refers to dissemination, policy, events, and other activities that occur outside the basic Alliance of core CAHSI departments.

## Alliance Impact Rubric

IMPACT INDICATOR	Beginning/needs substantial improvement	Moderate/needs some improvement	Proficient
<b>1. CAHSI Alliance impact: CAHSI annual meeting resourced through other organizations/funding sources</b>	Travel scholarships for some students covered; else CAHSI funded	Site collaborations lead to shared costs for annual meeting site, some travel covered by scholarships, funding from industry, related grants	Annual meeting speakers, faculty and student travel scholarships, and site costs covered by non-profits, industry support, endowments, or institutional funds
<b>2. CAHSI Alliance impact: social science engagement</b>	<b>Evaluation report data</b> focusing on social science elements of CAHSI disseminated (baseline practice)	<b>One to two social scientists</b> well versed in higher education, Hispanics in education, and or STEM education collaborate with CAHSI and produce <b>1-3 disseminated works</b>	<b>Three or more social scientists</b> well versed in higher education, Hispanics in education, and or STEM education collaborate with CAHSI and <b>produce 4 or more disseminated works</b>
<b>3. CAHSI Alliance impact: policy voice [annual activity]</b>	<b>1-2 national or regional venues</b>	<b>Less than 5 national or regional venues</b>	Multiple CAHSI PIs <b>served as CAHSI delegates</b> to higher education and STEM education organizations in leadership roles in 5 or more national or regional venues across a spectrum of organization types. PIs discuss lessons learned from CAHSI rather than focusing on own institution specifically
<b>4. CAHSI Alliance impact: faculty dissemination – education</b>	<b>0-4 engaged PIs/faculty</b> publishing or presenting in 1-2 venues	<b>5-9 engaged PIs faculty</b> publishing or presenting in two or fewer venues	<b>10-15 engaged PIs/faculty</b> publishing or presenting in more than 3 total venues
<b>5. CAHSI Alliance impact: cyber infrastructure to support broader educational impact via web dissemination [CSO PLTL ARG mentorgrad fellownet =5 initiatives]</b>	<b>0-40% of initiatives</b> available for <b>deployment</b> in new settings (0-2)	<b>41%-99% of initiatives</b> available for <b>deployment</b> in new settings (3-5)	<b>100% of initiatives</b> available for <b>deployment</b> in new settings
<b>6. CAHSI Alliance impact: cyberinfrastructure national impact via web dissemination</b>	<b>0-32%</b> of all website downloads/views occur outside of original CAHSI regions	<b>33-49%</b> of all website downloads/views occur outside of original CAHSI regions	<b>50% or more</b> of all website downloads/views occur outside of original CAHSI regions (website analytic data)

<b>7. CAHSI Alliance impact: cyberinfrastructure to support collaboration</b>	Cyberinfrastructure metric to be determined: focus is on research collaboration, usability, and quality of communication – survey of users to be developed		
<b>8. CAHSI Alliance impact: cross institutional funding-technical/scientific research</b>	<b>1-3 CAHSI institutions</b>	<b>4-6 CAHSI institutions</b>	<b>Each CAHSI institution is involved in a collaborative research grant/grant proposal</b> that supports continued contact and scholarship among students and faculty
<b>9. CAHSI Alliance impact: cross institutional funding-educational initiatives</b>	<b>1-3 CAHSI institutions</b>	<b>4-6 CAHSI institutions</b>	<b>Each CAHSI institution is involved in a collaborative research grant/grant proposal</b> that supports continued contact and scholarship among students and faculty
<b>10. CAHSI Alliance impact: leveraging CAHSI for new institutional funding</b>	<b>1-3 CAHSI institutions</b>	<b>4-6 CAHSI institutions</b>	<b>Each CAHSI institution is involved in a research grant/grant proposal</b> that leverages CAHSI results, outcomes, and/or initiative strategies to develop new programs
<b>11. CAHSI Alliance alignment of goals within institutions**:</b> 6	<b>0-40% of member institutions</b>	<b>41%-99% of member institutions</b>	<b>All CAHSI institutions</b> have documented engagement from vertical or horizontal colleagues that indicates acknowledgement of how CAHSI aligns with institutional efforts that span departments/colleges/schools.
<b>12. CAHSI alliance impact: promoting CAHSI in policy arenas</b>	<b>0 meetings</b>	<b>1 meeting and or public activity</b> (e.g., CAHSI collaborates with Excelencia at their conference, publishing a white paper, writing letter to the editor	<b>CAHSI established more than 2 meetings or public activities with multiple national stakeholders</b> and local leaders to describe and promote its goals and achievements; CAHSI was <b>positioned as a national leader</b> in 2 or more instances this year
<b>13. CAHSI Alliance impact: collaboration beyond original 7 CAHSI institutions</b>	<b>8 or fewer departments</b> with documented implementation of initiatives (baseline is 6 in 2010)	<b>9-15 departments</b> with documented implementation of initiatives (baseline is 6 in 2010)	<b>16 or more departments</b> with documented implementation of initiatives (baseline is 6 in 2010-2011)

**CAHSI Summit**

In 2015, CAHSI supported two fall events and made plans to align with another non-profit organization in 2016 to better suit CAHSI’s needs to reduce the cost and labor of organizing a

<sup>6</sup> This rubric indicator has been revised to show how alignment is acted upon within institutions, rather than to show how alignment is promoted through documentation and publicity.

conference, while continuing to provide a quality professional development experience for faculty and students. CAHSI has continued to remain involved with SACNAS to provide computer science content and mentorship for participants, as well as advisory support on the program committee. CAHSI student attended SACNAS to a limited degree. This past September CAHSI held an annual Summit in San Juan, Puerto Rico to revive the original meeting so that students could receive the community, skill development, and opportunity to meet Hispanic mentors that was occurring in the past. CAHSI is attracting industry funders to support and provide content to CAHSI students (e.g., specific industry training that occurs with limited scope in CAHSI institutions already like IBM initiatives at UTEP). In the future, CAHSI will hold annual meetings in conjunction with HENAAC/Great Minds in STEM. This shift will provide greater direct access to potential industry funders through events organized through Great Minds in STEM to meet with industry and pitch the CAHSI program.

### **Social Science Network**

Two new social scientists have become engaged with CAHSI faculty in the last year, creating new relationships and opportunities for academic scholarship related to Hispanics in computing education. While these partnerships have yet to bear disseminated works, the beginnings of new partnerships are a hopeful sign for reinvigorating a social science effort within CAHSI. The extension of budgets over additional years has meant no opportunity to publish social science work from evaluation data, yet the shift to include social science research in the CAHSI goals moving forward will allow for additional growth in knowledge of the factors that contribute to the educational and career success of Hispanics in computing.

### **CAHSI Advocacy**

Leadership and support of CAHSI in higher education and STEM education organization has remained consistent over the past few years, at a high rate of dispersion across campuses and faculty. Ten faculty and staff members from 7 institutions served as CAHSI delegates to national and regional organizations interested in improving and diversifying the computing workforce, and/or in improving educational opportunities for Hispanic students. CAHSI has continuously scored 3 out of 3 on this metric, having representation additions this year with venues related to broadening participation in STEM (e.g., Tapia, Grace Hopper, SACNAS, BRAID, XCEDE) improving higher education locally or regionally (e.g., California Hispanic Serving Institution consortium, Peer Led Team Learning International Society), research collectives at the regional level (Lone Star Unmanned Aircraft System Center for Research and Innovation) policy advocacy (e.g., presentation to the National Academies of Science) national initiatives to improve computer science education (Computer science principles, National Endowment for the Humanities course development) and local research efforts (e.g., CREST interdisciplinary work).

### **CAHSI academic dissemination**

Over the last year, published and presented works were very limited in academic settings (RESPECT, PLTIS, Frontiers in Education). Students are involved in this educational dissemination—for example—the peer led team learning students presented at the international conference in May. Faculty, however are less involved, and instead are alternatively representing CAHSI in multiple venues for workshops and presentations about the CAHSI model benefit in academic venues. As computer science educational research becomes more prestigious and a more viable pathway for students interested in academia, CAHSI can continue to promote students’ discovery of new educational best practices. The evaluation team could assist in partnering with PIs to conduct research on the educational efforts of CAHSI.

### Web dissemination

Creating materials that would support the direct download and implementation of CAHSI initiatives by others has been an ongoing challenge. K-12 outreach and CS-0 are nearly fully implementable online, based on partner organization web resources. Affinity Research Group (ARG) practices have been well documented in a handbook, and many resources are available online as well. Peer led team learning includes sample lessons, but no information regarding training or construction of a peer leader cohort, how to structure the time within the course schedule, tips regarding how peer leaders and faculty should communicate, and other related information vital to developing a vibrant and effective peer leading community within target courses. Mentorgrad and Fellownet are described in brief and do not include related resources needed to implement the initiatives. CAHSI initiatives have materials available online that would support at least initial implementation of CAHSI initiatives in new locations, though the default has been to include materials primarily from the lead institution, which was the case in previous years as well. CAHSI scores a 2 out of 3 on this metric. As was recommended previously, slides developed for the newer initiatives could be shared online to improve the ways in which CAHSI disseminates to larger audiences virtually (e.g., fellownet presentations, FemProf workshops). Alternatively, a link to an email address needed to request resources could allow for greater access to implementation beyond CAHSI.

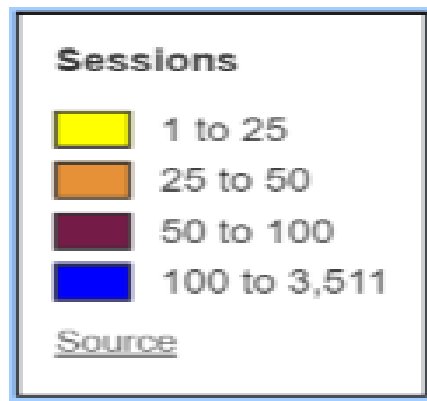
### Online Reach

Regions with more than 15 website views	Sessions
Texas	1189
California	499
(not set)	263
Florida	229
New York	188
New Mexico	114
Virginia	96
Illinois	90

Massachusetts	86
Maryland	84
Georgia	68
North Carolina	53
Colorado	51
Washington	47
New Jersey	40
Pennsylvania	33
District of Columbia	32
Indiana	31
Oregon	29
Kansas	27
Tennessee	26
Arizona	24
Michigan	23
Nevada	17
Connecticut	16
Ohio	16
Wisconsin	16
Minnesota	15

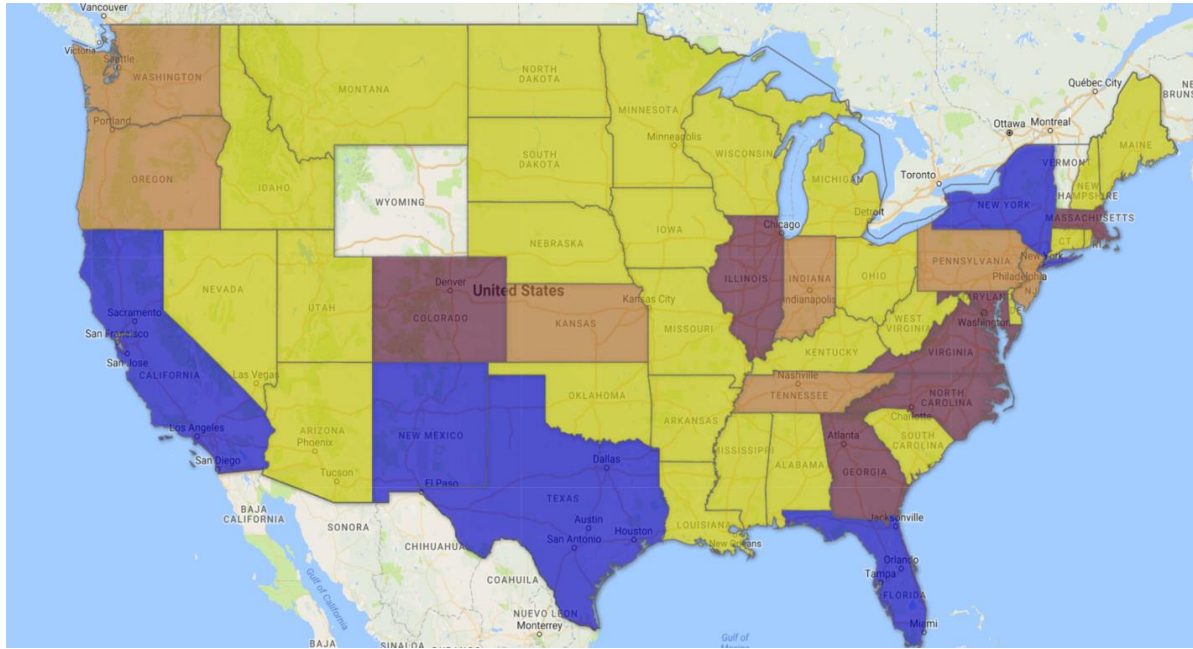
conservatively in relation to state data, to allow for hits coming from adjacent cities unknown to the evaluation

As in past years, much of the activity for the CAHSI website comes from CAHSI regions (60% from CAHSI states). However, when looking directly at CAHSI cities, it appears only 32% of website views come from CAHSI cities, indicating greater outside reach than the state data would suggest. Google analytics does not include Puerto Rico in the United States, and so the data from Puerto Rico (697 website views, 24% from Mayaguez, where UPRM is located) must be reported separately. The rubric is scored



team.





## Education Funding

All CAHSI institutions participated in the writing of the new CAHSI proposal, and in addition five of the current CAHSI institutions are involved in an INCLUDES proposal recommended for funding. As such, the team met the goal of all institutions participating in education initiatives. In the next phase, the educational focus will include regional opportunities to provide professional development for current and future CAHSI students, their faculty, and create opportunities to showcase the work of students with local industry.

## Collaboration on Technical Efforts

This year, as in past years, only two institutions were successful at collaborating on technical research grants, though multiple attempts to develop proposals were described by pairs of faculty. **Interview data indicate faculty, particularly junior faculty, would like additional opportunities to pursue this type of collaboration, which is typically not part of all-hands meetings nor feasible within the CAHSI Summit.** Lack of faculty opportunity to meet, via all hands, CAHSI, or conference meeting opportunities, may be stifling these efforts. As CAHSI moves towards a new phase of funding, in which industry support may prove crucial to local and national programming, it is vital to make time among CAHSI faculty members at each institution to consider joint areas of expertise and interest.

## Leveraging CAHSI

Nearly all schools had developed a proposal that leveraged CAHSI- many of them in a collaborative proposal recommended for funding in August, 2016. In addition, CAHSI PIs collaborated to receive funding for expert consultants to conduct a branding workshop to move CAHSI forward into its new era of funding and industry connection, receiving a grant from Prudential for that effort. As in the past, some proposals would extend CAHSI initiatives like PLTL to other

departments within an institution, would promote student researchers through ARG, or introduce proven mentoring strategies to undergraduate and graduate education environments. Many of the grants are still pending review.

### **CAHSI in Policy**

Public acts are valued for the ways in which they make CAHSI visible, show its success as an Alliance, and indicate that others deem CAHSI to be a united voice for Hispanics in computing. The Atlantic recently ran a feature story on Latinas in computing that highlighted UTEP's CAHSI students and Dr. Gates' involvement in mentoring. The White House Initiative on Educational Excellence for Hispanics honored CAHSI in September 2015 with the "Bright Spot in Hispanic Education" acknowledgement. Also, a joint initiative of the National Center for Women & Information Technology and Google education asked CAHSI to participate in a workshop for leaders in educational initiatives that engage youth in peer learning. At the CAHSI Summit in San Juan Puerto Rico in September of 2015, the executive council took the opportunity to hold a round table on Hispanics in Computing, inviting leaders from current and potential members of CAHSI, industry leaders, and nonprofit innovators in STEM education. This round table produced the report entitled: Diversity and Workforce for Business Success: Changing Business as Usual.

### **CAHSI Growth in Adoption**

CAHSI met this goal early in its new grant cycle. Regional events in California in the past grant year showed promise for developing regional dissemination cohorts for CAHSI practices in similar institutions. These efforts have piqued interest among external institutions and have contributed to these institutions' negotiations with CAHSI for membership- in fact, two regional institutions in California have received grant funding to collaborate with CAHSI in the coming year. Deep collaborations at the community college level, including the development of cooperative training and a pathway for student leadership across institutions for those engaging in the academic initiatives, suggest practices that support pathways from community college to four-year transfer and retention (see "Using Peer-Led Team Learning to Build University," Gates, Casas, Servin, and Slattery, in *Frontiers in Education 2015* proceedings). Continuing to monitor regional growth and adoption of CAHSI practices will be important for making decisions about full membership in CAHSI in the future, and to envision what membership entails when regional participants agree to adopt CAHSI practices.

CAHSI has also facilitated the adoption of its practices outside of computing. In the past year, NEIU fully implemented the adoption of CAHSI ARG and PLTL practices within its Physics, Chemistry, Earth Science, and Mathematics departments. In these courses, peer leaders guided students in extended research modules during course lab sections (called PEERS courses). This integration of the ARG and PLTL models is one way in which CAHSI is continuing to innovate in its educational practices. In all, 311 students were enrolled in course sections using the combined ARG/PLTL model in academic year 2015-16. Over one-third (35%) of these students were from underrepresented minority groups and 52% of these students were women. Students in the reformed courses cited the research modules as the second most helpful aspect of the class to their learning.

Compared to students in traditional sections, students in the reformed sections made statistically significant gains in feeling prepared for graduate school and in their ability to identify the strengths and limitations of research designs. Finally, PEERs courses led to a 15% reduction in course withdrawals and failures. This translates to an additional 22 students who passed essential, introductory STEM courses that are necessary for persistence in STEM majors. Thus, NEIU has served a successful test site for the integration of the ARG and PLTL models and the expansion of CAHSI practices to other STEM disciplines.