Reflections: The Computing Alliance of Hispanic-Serving Institutions

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The Computing Alliance of Hispanic-Serving Institutions (CAHSI) celebrates its ten-year anniversary in 2016, providing an ideal opportunity to reflect on the organization, its accomplishments, and the future. The inspiration for CAHSI originated from discussions at the 2004 National Science Foundation's (NSF) biennial Minority Institutions Infrastructure (MII) meeting, which centered on the need for a grassroots effort to unify and strengthen computing research and education among Hispanic-Serving Institutions (HSIs). In particular, the discussion focused on how to address the under-representation of Hispanics in computing, dissemination of best practices, and development of future Hispanic leaders. Computer science (CS) departments across the country had shown large declines in enrollment between 2002 and 2007 [25], while the MII HSIs experienced dramatic increases in overall undergraduate student population at their institutions and the opportunities for recruiting Hispanic students into computing. With the projected growth of Hispanics, it is essential to ensure that Hispanics attend college, graduate, and seek advanced degrees because of their potential impact on the economic and intellectual growth of the United States. The MII core group of seven institutions (see Figure 1) came together
success and the human infrastructure to support its initiatives by training faculty in effective practices. To provide context regarding the students served by CAHSI institutions, Figure 2 summarizes students’ responses to survey items in a widespread study.

CAHSI students’ backgrounds reflect trends across the nation of undergraduate populations—increasingly beginning their studies in community colleges, more likely to be ethnically diverse, and working to a greater extent to support their educational pathways. Economic hardships cause almost a quarter of CAHSI students to stop out, i.e., suspend their studies. CAHSI computing departments embody the HSI mission to support all students towards success and, with that goal, support systems have been established within departments to bolster student retention. CAHSI’s educational innovations have increased student retention and success. Two exemplar practices are the Peer-Led Team Learning (PLTL) [1,2,13,17] and the Affinity Research Group (ARG) models [9,27]. PLTL, a proven practice for retention [4], provides an active learning experience for students and creates leadership roles for undergraduates [1]. PLTL targets the first three CS course sequence. Peer leaders are selected from students who have successfully completed the course recently and undergo coaching on how to work with groups of students using cooperative learning techniques. Peer leaders meet with students weekly outside of class time to solve problems that align with the lab assignments and/or content that was taught over the past week. The PLTL model engages teams of students through hands-on activities guided by a peer leader. CAHSI is now piloting efforts to extend PLTL to two-year feeder colleges with the intent to increase the computing pipeline to 4-year colleges [5].

To ensure our nation’s economic and social health, it is imperative that the US maintain a globally competitive computing workforce by expanding its engagement of Hispanics, the nation’s largest minority group. In its effort to impact change in this area, CAHSI incorporates three overarching strategies: (1) promote dialogue by involving a broader community to impact change, (2) promote social science research to understand issues and interventions related to underrepresentation of Hispanics in STEM fields, and (3) promote field-tested strategies to support students at critical stages in the academic pipeline. CAHSI has mainstreamed mentoring and built structured, academic networks for students that prepare them for success in course work from entry level through graduate school and thereafter into the STEM workforce [6,7,8,12,24]. CAHSI’s efforts have resulted in student
al students. Peer leaders guide peer-led activities through voice and screen visualizations and interact with students via voice, chat, or text messaging. This new approach requires a lot of questioning on behalf of the peer leaders and asking students to reconcile differences in responses. UHD peer leaders have become adept at ensuring that the online format remains student centered and continues to support students’ success.

PLTL has significantly contributed to students’ persistence in their chosen major. Prior to the implementation of PLTL in “gate-keeper” courses in the major, merely 77% of the enrolled students finished the course, while 87% of students completed the course after PLTL implementation. This ten percent increase in course completion rates is statistically significant ($\chi^2 (1, N=5195) = 53.07, p<.01$) [23]. Likewise, Hispanic students showed a six percent increase in course completion ($\chi^2 (1, N=2716) = 17.4, p<.01$) after PLTL was implemented, also statistically significant [23]. A reflection from a CAHSI peer leader describes its impact on students [21]:

“I came to college from parents who never finished high school and basically being the black sheep of family. It’s really hard having a lot of confidence in yourself. I started as a major in microbiology, saw friends that were doing computer science and math... I’m always a nervous wreck and panicking about everything that I do, but when I saw friends getting into PLTL and getting to have that reinforcement that they know what they are talking about and knowing what they just learned can help other people. I was like, ‘I’m going to hang out in the (computer science tutoring) lab.’ Slowly but surely, I took C++. It changed me... because [now] I’m not afraid to try new things even though I think I may fail. [I] think maybe I might want to get a Master’s.”

The ARG model emphasizes the deliberate and intentional development of technical, professional, and team skills, as well as the knowledge required for research and cooperative work [7,27]. ARG is structured to broaden student participation by giving students opportunities to learn, use, and integrate these skills and knowledge. CAHSI has disseminated the ARG model quite broadly. To date, faculty at 25 higher education institutions in eleven states and provinces within the United States, Puerto Rico and Canada have adopted the ARG model. These adopters represent ten academic disciplines—Computer Science, Psychology, Computer Engineering, Computer Information Systems, Teacher Education, Nutritional Science, English, Mechanical Engineering, Nursing, Geography—and campus administration. In all, adopters involved 678 students in ARG activities in a single academic year, 2013-14. From 2009-2014, ARG students at CAHSI institutions have attended professional conferences at a rate more than three times the rate of a large, diverse national sample of students in Research Experiences for Undergraduates (REU) programs [16] (63% for ARG students versus 18% for a national sample of REU students). Note that these differences are statistically significant: (conference attendance: $\chi^2 (1, N=728) = .98, p<.001$; conference presentation: $\chi^2 (1, N=736) = 77.78, p<.001$) [23]. Additionally, in the past academic year, 2014-15, CAHSI served 850 students in courses at its own institutions using ARG modules—over two-thirds of these students were Hispanic [21].

CAHSI has disseminated its practices most effectively through personal and professional networks of CS and STEM educators, both in the higher education and K-12 arenas. Half of the ARG adopters learned about CAHSI initiatives through a CAHSI member or a colleague. Additionally, some adopters became aware of CAHSI through conferences, such as the Grace Hopper Celebration of Women in Computing [10] or those of the Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS) [19], or through e-mail invitations to attend CAHSI workshops at Hispanic Engineer National Achievement Awards Conference (HENAAC) [11]. Providing training in person along with support and resources available to adopters afterward helped to facilitate the uptake of the ARG model among faculty.

New adopters reported [23] a strong belief in CAHSI educational practices, yet some adopters were still novices in their pedagogical understanding of CAHSI initiatives. In an open-ended survey question, new adopters were asked why they had adopted CAHSI initiatives. ARG adopters noted that ARGs are beneficial for faculty-student interaction and team communication. A majority of adopters also want to improve outcomes for Hispanic students or other underserved student populations. In addition, CAHSI is spreading beyond Hispanic-Serving Institutions. Professors valued the ways in which ARG practices benefit all underrepresented populations. An adopter at a predominantly white university with many first-generation college students commented [23]:

“I wanted to create a bridge to build the capacity of Hispanics in students in computing to do research and have successful careers. Although in the area there is not a large population of Hispanics, the problems faced by the Hispanics seemed similar to the students at my institution.”

Adopters have also found innovative ways to implement ARG within their own departments and curriculum. For instance, a nursing professor in Puerto Rico has used the ARG...
model in her nursing practicum courses, similar to a clinical internship. Additionally, she has also implemented the model in an interdisciplinary research group conducting secondary analysis on the characteristics and major determinants of osteoporosis in Puerto Rican women who live on the western side of the island. The group includes students from Biology, Nursing, Chemical Engineering, Electrical Engineering, and Business Administration. She reported that she has fully implemented all of the cooperative learning aspects of the ARG model and the training has led to a positive outcome—the group is “extremely active and dynamic.” [14]

Faculty who used ARG practices in their research groups or courses reported increased student confidence, communication skills, and greater effectiveness in creating a community of learners. One respondent also noted that the culture of her department had changed since her adoption of the ARG model. She commented on outcomes for students and her department at large [23].

The first result was building students’ confidence and ability to succeed in applying to REUs and presenting at conferences. There was a radical change in the culture of undergraduate students as their posters were showcased in the department and a newsletter featured the students’ success. The culture of the department has changed and students are organizing groups for competition. ARG is a powerful model that goes beyond the research towards generating a community of students and faculty who share the same values and interests [emphasis added].

CAHSI new adopters have demonstrated that CAHSI is reaching new faculty in a variety of institutional contexts, disciplines, and through different venues [23]. CAHSI new adopters are reaching sizeable numbers of students. Most of all, CAHSI adopters report positive student outcomes that extend beyond the research experience, such as enhanced learning, increased confidence, and the creation of learning communities as described in [18]. Throughout its history, CAHSI has produced large numbers of Hispanic baccalaureates in computing. As shown in Figure 3, CAHSI’s graduation rates have consistently surpassed the national graduation rates even during the decline in computing BS degree graduates [21]. The graph shows the percentage of the BS degree production with respect to the 2002 BS degree production, which is representative of the height of BS graduation in computing departments in the United States. For example, CAHSI graduated 76% of its 2002 total in 2014, while the comparison set of departments graduated 52% of its 2002 total.

In 2013, CAHSI increased its total number of baccalaureates by 5% and its graduation rate of women baccalaureates by 19% [21,28]. As a point of reference, only 849 Hispanic students received bachelor’s degrees in computer science from all mainland US institutions in 2013, and 167 of these students came from CAHSI schools. Moreover, only 99 Latinas received bachelor’s degrees in computer science that year from all mainland US institutions and 15 of those women were CAHSI students.

CAHSI has consistently graduated a high proportion of Hispanic master’s (MS) degree recipients, in particular those who are women. Furthermore, in 2013, 26% of CAHSI MS graduates were Hispanic (US mainland schools only). In 2013, CAHSI graduated 27 of the 316 Hispanic MS graduates in CS/CE/CIS, constituting 9% of all the Hispanic MS degree recipients in the mainland US [21,28]. In other words, seven CAHSI institutions graduated nearly 10% of all Hispanic master’s degrees in computing out of the entire population of 1,936 private and not-for-profit universities in the mainland US that are graduate-degree granting and bachelor’s degree-granting colleges and universities.

Although Hispanics remain severely underrepresented in computing doctorates, CAHSI has contributed to the number of Hispanic computing PhDs in the US. In 2013, 14 doctorates were awarded in CS to Hispanic US citizens, and CAHSI produced 3 of those graduates. CAHSI produced 25% of the nation’s Hispanic doctorates in CS in 2013, although this is a statement of the persistent dire underrepresentation of Hispanic US citizens at the doctoral level [22]. CAHSI was recognized in 2015 as a Bright Spot in Hispanic Education by the White House Initiative on Educational Excellence for Hispanics [28]. In addition, it is included in Excelencia in Education’s What Works database [20].

Looking forward to the next ten years, CAHSI’s bold vision is to achieve parity in the number of Hispanics who complete baccalaureate and graduate degrees across the US. CAHSI will pursue this vision through an extended networked community of strategic partnerships that collectively extend proven practices and apply them throughout the higher education system, from two-year colleges to research universities. In particular, CAHSI has begun to place more emphasis on the following elements.

Community Connections: Community connections are essential for building and strengthening involvement of individuals and organizations outside of the current CAHSI membership. The specific focus will be on estab-
lishing partnerships with early-college high schools, two-year colleges, local and regional workforce development efforts, school districts, and other efforts that connect our youth to computing, e.g., Girls Who Code, Code.org, and Code2040.

**Strategic Partnerships:** Strategic partnerships with industry and non-profits are defined to secure funding and exchange resources that support research, education, and workforce development. Partnerships are essential to coordinate and disseminate field-tested strategies that collectively recruit, retain, and advance Hispanics in computing. Examples of CAHSI efforts include its recent formal partnership with Great Minds in STEM to promote STEM career pathways for Hispanic students and professionals through joint events; and its partnership with Prudential Foundation to engage in a local collective impact effort to advance K-16 students in STEM fields and develop CAHSI’s strategic plan.

**Student Connections:** Student connections are essential to develop future leaders who can sustain the ecosystem. The connections provide social and academic support and raise awareness about their role in contributing to diversity in computing. Students will become informed about the strategic areas of critical need to our nation within the discipline of computing through newly formed CAHSI student chapters and will inform CAHSI via advisory roles.

**Structures and Networks:** Essential elements of the CAHSI ecosystem are the structures and networks for adopting effective practices and communicating across different sectors resulting in mutually beneficial exchanges. Professional networks support students from entry level coursework through graduate school and beyond, as well as faculty advancement. Creating a culture that supports student growth through mastery experiences, critique, and reflection is essential for student success. CAHSI will be creating regional networks to disseminate and support adoption of CAHSI practices.

In order to thrive—and even survive—in the globalized marketplace of ideas and innovation, the US must aggressively meet the challenge of increasing the number of students who complete degrees in computing areas. Meeting the workforce demand for scientists, engineers, and computer scientists requires partnerships that can catalyze synergistic exchanges of knowledge and effective practices that target women, Hispanics, and other underrepresented groups. Indeed, increases cannot be attained without the integration and coordination of deliberate efforts by industry, government, and other non-profits. CAHSI has been and will continue to be a leader in the computing community in explicitly and deliberately defining and implementing impactful actions and aligning national efforts for the recruitment, retention, and advancement of Hispanics in computing.

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**References**


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