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Broadening Participation of Hispanics in Computing: The CAHSI Includes Alliance

Dr. Elsa Q. Villa, University of Texas, El Paso

Elsa Q. Villa, Ph.D., is a research assistant professor at The University of Texas at El Paso (UTEP) in the College of Education, and is Director of the Center for Education Research and Policy Studies (CERPS). Dr. Villa received her doctoral degree in curriculum and instruction from New Mexico State University; she received a Master of Science degree in Computer Science and a Master of Arts in Education from UTEP. She has led and co-led numerous grants from corporate foundations and state and federal agencies, and has numerous publications in refereed journals and edited books. Her research interests include communities of practice, gender, transformative learning, and identity.

Dr. Sarah Hug, Colorado Evaluation & Research Consulting

Dr. Sarah Hug is Director of Colorado Evaluation & Research Consulting. Dr. Hug earned her PhD in Educational Psychology at the University of Colorado, Boulder. Her research and evaluation efforts focus on learning science, technology, engineering, and mathematics, with a special interest in communities of practice, creativity, and experiences of underrepresented groups in these fields across multiple contexts.

Dr. Heather Thiry, Golden Evaluation
Dr. David S. Knight, The University of Texas at El Paso

David Knight is Associate Director of the Center for Education Research and Policy Studies and assistant professor in the department of Educational Leadership and Foundations at The University of Texas at El Paso. His research examines educator labor markets, school finance, and cost-effectiveness analysis. He received his PhD in urban education policy and MA in economics from the University of Southern California and bachelor's degrees in economics and anthropology from the University of Kansas.

Mrs. Elizabeth Fomby Hall, The University of Texas at El Paso

Elizabeth Hall, M.A., serves as manager for the CAHSI INCLUDES Alliance, as well as assistant director in the Office of Research and Sponsored Projects at The University of Texas at El Paso (UTEP). As manager for the CAHSI INCLUDES Alliance, she works on a national basis to coordinate and motivate regional leads; facilitate CAHSI's External Advisory Board; and serve as a liaison to CAHSI's policy team, all so that CAHSI's 60 partners can collectively realize the Alliance's vision of Hispanics representing 20% or more of those who earn credentials in computing by the year 2030. In her role in UTEP's Office of Research and Sponsored Projects, Elizabeth assembles interdisciplinary project teams and embeds herself within them in order to conceptualize, write, and submit large, institutional grant proposals. Prior to her time at UTEP, she served for four years in the offices of the President and the Provost at Cameron University, and for three years at Boston University in the Office of Religious Life.

Andrea Tirres, University of Texas at El Paso

Broadening Participation of Hispanics in Computing: The National CAHSI INCLUDES Alliance

Introduction

According to data from the Bureau of Labor Statistics, employment in computer occupations grew by nearly a factor of 20 between 1975 and 2015 [1]. In spite of the boom in computer science degree programs that has tripled enrollments in Ph.D.-granting institutions since 2006, these enrollments are not enough to fill available jobs now or in the distant future. To address this demand for computing professionals, the National Science Foundation (NSF) selected the Computing Alliance of Hispanic-Serving Institutions (CAHSI) in 2018 to serve as the lead partner and backbone of a national INCLUDES alliance. The Inclusion Across the Nation of Communities of Learners (INCLUDES) initiative is one of NSF's Ten Big Ideas with the goal of broadening participation in STEM fields by creating networked relationships among organizations and across sectors, using a collaborative approach across stakeholders who share a common agenda. The CAHSI INCLUDES Alliance is comprised of over 60 Hispanic-Serving Institutions (HSIs), industry partners, and other stakeholders who are committed to growing and sustaining a networked community to recruit, retain, and accelerate the progress of Hispanics in computing.

The Formation of CAHSI

To ensure our nation's economic and social health, it is imperative that the U.S. maintain a globally competitive computing workforce by expanding its engagement of individuals from all sectors of our society, in particular Hispanics, the nation's largest minority group. Representing less than 6% of postsecondary institutions in the U.S., Hispanic-Serving Institutions (HSIs) enroll almost half of Hispanic students attending college [2]. Further, while Hispanics represent 18% of the U.S. population, the percentage of core CS bachelor degrees conferred to Hispanic students in 2015 was 8.6% at public 4-year institutions while graduate degrees conferred were less than 2% [3].

To meet the challenge of increasing participation of Hispanics in computing, the Computing Alliance of Hispanic-Serving Institutions (CAHSI) was formed in 2004 with seven founding institutions: California State University, Dominguez Hills (CSUDH), Florida International University (FIU), New Mexico State University (NMSU), Texas A&M University-Corpus Christi (TAMU-CC), University of Houston-Downtown (UHD), University of Puerto Rico Mayaguez (UPRM), and The University of Texas at El Paso (UTEP). The core purpose established by the CAHSI institutions was to create a unified voice to consolidate the strengths, resources, and concerns of HSIs and other groups committed to increasing the number of Hispanics in all computing areas [4, 5, 6, 7].

CAHSI focused much of its energy on retention and graduation efforts, and over the years it became known for certain proven practices, called signature practices, which consistently demonstrated to be beneficial for Hispanic students. Three of these signature practices are the Affinity Research Group (ARG) model, Peer-Led Team Learning (PLTL), and Fellow-Net.

The **ARG model** [8, 9, 10] is a set of practices built on a cooperative team framework imbued with cooperative-learning principles, which have been shown to increase student achievement

and self-esteem [11, 12, 13]. ARG supports the creation and maintenance of dynamic and inclusive groups in which students learn and apply the knowledge and skills required for research and cooperative work, emphasizing the conscious and explicit development of skills. Designated by the U.S. Department of Education (DoEd) as a promising and practical strategy to increase post-secondary success, **PLTL** is a model of instruction for introductory STEM courses that introduces a peer-led workshop as an integral part of the course. In PLTL, a student who was previously successful in the course is recruited to lead students in weekly workshops to problem solve and discuss course content. PLTL is known for its ability to help minority students succeed [14, 15, 16]. As a Signature Practice, PLTL is used in introductory CS courses [17, 18, 19]. CAHSI's **Fellow-Net** [7] is a powerful strategy to assist students in preparing competitive fellowship applications to support doctoral studies. In anticipation of applying for a fellowship, it is essential that students are aware of the need to be involved in co- or extra-curricular activities, and engage in meaningful research activities, including presenting and publishing research results. Another aspect of the strategy is a workshop in which experienced faculty coach students on how to develop a competitive packet, in particular how to write compelling essays that describe and present evidence of one's assets and experiences that prepare them for success in the graduate program. Beyond the workshop, applicants receive iterative, constructive review of packets.

CAHSI's success in increasing the representation of Hispanics in computing can be seen in part in its graduation rates. Since its formal establishment in 2006 through funding from NSF's Broadening Participation in Computing program, CAHSI's graduation rates have consistently surpassed national trends, when comparing CAHSI departments against other long-standing Computer Science and Computer Engineering departments.

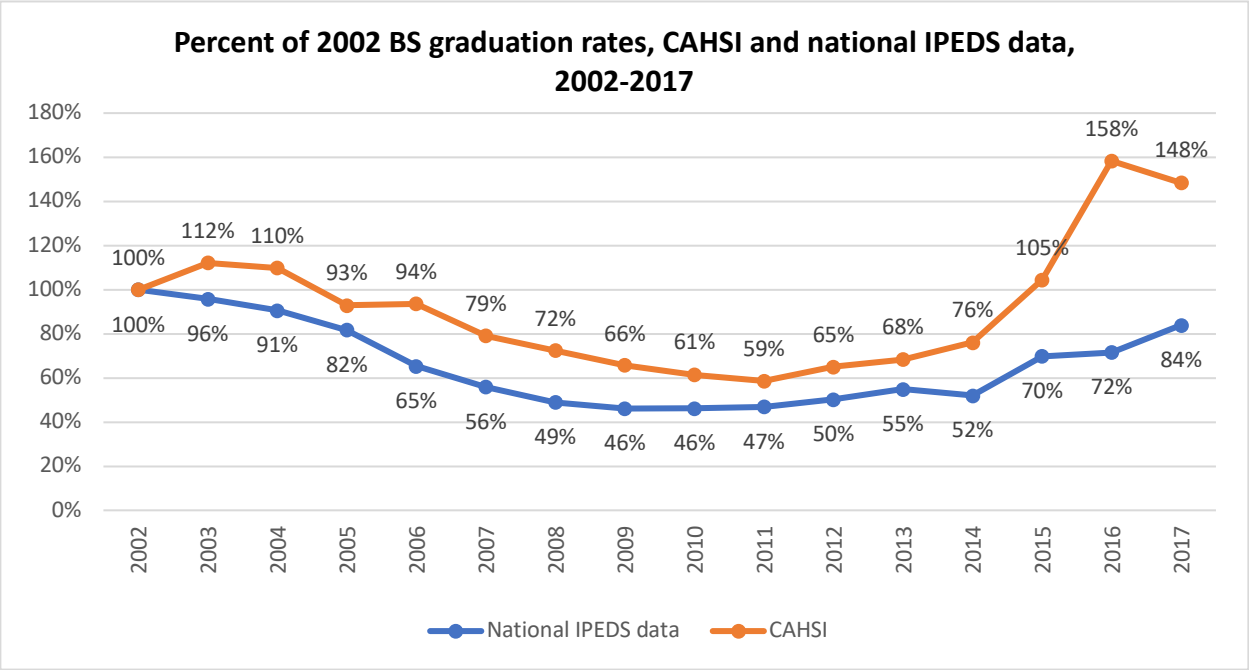

Figure 1. Percent of 2002 BS Graduate Rates, CAHSI and National IPEDS Data, 2002-2017

Figure 1 shows the comparison between CAHSI graduates and graduates of computing departments beginning in 2002, as reported to the U.S. Department of Education through the

Integrated Postsecondary Education Data System (IPEDS). That is, in 2017, this comparison set (IPEDS data) of departments graduated 72% of the number that they graduated in 2002 while CAHSI institutions graduated 148% of its 2002 total. Most CAHSI departments increased their BS graduation rates in 2016-17. A cautionary note: This comparison is constrained by programs that existed in 2002 — however, many institutions, including CAHSI schools, are innovating by developing new programs to address student and workforce needs.

Piloting Collective Impact

In 2016, NSF awarded CAHSI a Design and Development Launch Pilot (DDLP) grant, during which time CAHSI adopted the collective impact model with a subset of its institutions to effectively and strategically expand its network to increase its impact through social change [20, 21]. As such, CAHSI created on-ramps for new CAHSI members, such as institutions that connect to their specified regional network (e.g., Northern California and Southwestern U.S.); community college feeders into selected CAHSI institutions (e.g., UTEP, CSUDH, NMSU); and other partner organizations, e.g., *Excelencia* in Education (EiE). This on-ramping effort resulted in the expansion of CAHSI from 15 HSIs to over 30 (both 2- and 4-year institutions), and with industry partners and other non-profits, the Alliance grew to over 60 organizations.

In order to better support collaborative change, CAHSI's adopted the five key conditions of collective impact: **1)** Common Agenda; **2)** Backbone Support; **3):** Continuous Communication; **4)**: Mutually Reinforcing Activities; and **5)**: Shared Measurement [20, 21]. Together, and particularly with the insight of our newly on-boarded community college partners, CAHSI member institutions set a new shared vision for the Alliance: By 2030, Hispanics will represent 20% or more of those who earn credentials in computing. Credentials are defined as degrees and certifications that lead to gainful employment and advancement in the field. This "20-30" vision will be achieved through the growth of a networked community committed to recruiting, retaining, and accelerating the progress of Hispanics in computing.

The National CAHSI INCLUDES Alliance

Over the last few years, CAHSI's growth and successful collaborations demonstrate its potential for the CAHSI INCLUDES Alliance to realize its 20-30 vision. In 2018, NSF selected CAHSI as a national INCLUDES alliance to collectively continue to move the needle for Hispanics in computing and reach its vision.

To this point, CAHSI's core leadership had functioned in part as a backbone, maintaining successful one-to-one relationships with its member institutions. However, the NSF INCLUDES Alliance grant has allowed CAHSI to expand its infrastructure, extending Backbone personnel to better support the growing Alliance, and clearly establishing and codifying Backbone functions and roles. As shown in Figure 2, with its new role as a national NSF INCLUDES Alliance, the Alliance Backbone includes the establishment of a leadership team and five key strategic teams consisting of experts in policy and advocacy; data management and analytics; and communication, network, and resource management.

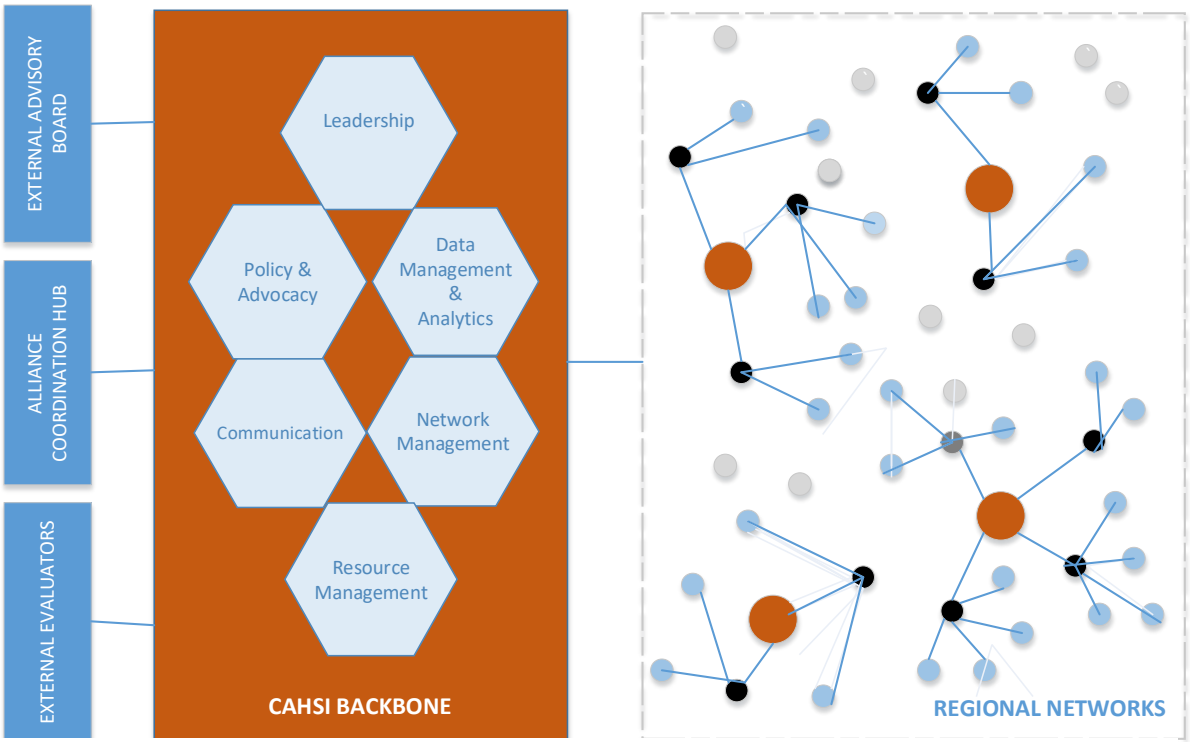

Figure 2. The Alliance infrastructure that includes the Backbone, external interactions, and the network of Alliance members. The orange circles denote the leads of Regional Networks, the black circles the co-Leads, the blue circles CAHSI institutions, and the grey circles other partners.

Advancing Hispanic student success in higher education through data-driven analyses, EiE and the research team contributes to CAHSI **policy and advocacy** efforts through developing, designing, and releasing national policy briefs on Alliance efforts to increase Hispanic representation and attainment in computing. The **data management** team collects, analyzes, and disseminates data on program enrollment, progress, and completions. This team combines information from the U.S. Department of Education's Integrated Postsecondary Educational Data System (IPEDS) with student-level data, acquired through established data sharing agreements, to provide Alliance institutions with up-to-date data to inform program improvement efforts. Figure 3 shows the levels of data expected to be collected, which informs the regions and other entities within the Alliance of decisions for improvement. The **resource, communication, and network team** supports the regional network through adoption of the online digital

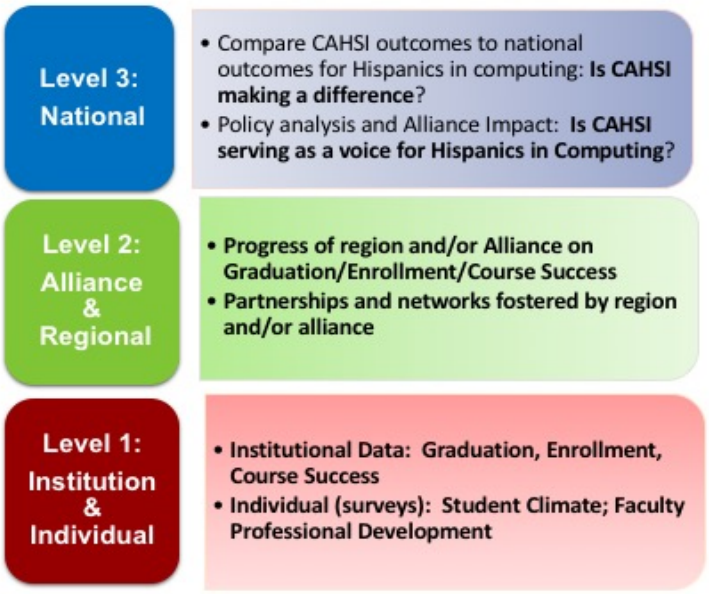

Figure 3. Goals and metrics provide feedback to Alliance entities to foster a culture of results-based accountability.

communication and collaboration platforms that connect individuals and organizations to the rest of the scientific community, allowing them to communicate and collaborate more effectively. In addition, the team oversees the resources that support CAHSI members and their networks, e.g., materials supporting adoption of signature practices, student development opportunities, and faculty expertise. The aim is to accelerate change in affecting collective impact.

As part of its infrastructure expansion and also recognizing the importance of developing the agency of member institutions, CAHSI has established regional and sub-regional networks with "on-the-ground" personnel intimately familiar with the needs and opportunities in their areas. Currently, the regional networks are North (Illinois and New Jersey), Southeast (Puerto Rico and Florida), West (Northern and Southern California), and Southwest (Arizona, Texas, and New Mexico). Each region has Regional Leads who establish regional connections, guide the agenda for the region, link people with resources and opportunities, and leverage resources and solutions. As part of the Alliance Leadership Team, these Leads set the direction for their respective geographic area, supported by a Regional Connector who provides on-the-ground support and takes on responsibility for the well-being of their community [22]. The Leads and Connectors know their community's educational and innovation landscape; and social, economic and cultural nuances. The Regional Leadership along with regional stakeholders are best equipped to identify issues and opportunities that are relevant to the community they serve [23]. Within each region, there are also co-Leads who are responsive to a smaller geographic boundary and Coordinators who are facilitate communications via administrative tasks. Working together, Leads, Connectors, co-Leads, and Coordinators round out the Regional Leadership Team for each geographic region.

Eventually, the CAHSI INCLUDES framework will include the Alliance Maestr@s program, Student Advocates, and CAHSI Student Scholars within each region. The **Maestr@s program** will sustain growth and propagate expertise in computing fields and collective impact approaches. This would be accomplished through a network of experts, who will lead workshops to disseminate CAHSI's signature practices. Informed by organizational change literature, specifically a transformative change framework [24] and an infrastructure capacity framework [25]. CAHSI does more than simply inform faculty and staff of research-based pedagogical approaches — CAHSI has a proven record for its ability to *change mindsets* in challenging norms that serve as barriers to student achievement [24, 25, 26]. This emphasis on changing mindsets can be seen particularly in the Alliance's signature practices to date. **Student Advocates** will disseminate important information to peers about the support structures available to ensure their success. **Scholars** are those who have demonstrated excellence in four core areas: professional development, scholarly achievements, community outreach, and co-curricular or extracurricular activities.

Finally, the Alliance is currently focused on determining what other practices are proving effective and adding more signature practices to our portfolio, such as: (1) providing workshops on computational thinking and computer science principles to effectively prepare K-12 teachers to integrate these into its existing curriculum; and (2) the development of one- and two-credit hour courses on problem solving, which are now in its pilot stage at six CAHSI institutions. These problem solving courses are intended to shift student thinking about how best to systematically approach a problem, reflect on that process, and articulate possible solutions. Google underwrites this effort.

Successes to Date/Action Items

In December 2018, CAHSI INCLUDES held its first "All Hands Meeting" with regional leads and co-leads from each of its four regions with an aim of introducing all of the partners to the collective impact model. Keeping in mind the 20-30 vision and the mission of CAHSI, as a whole, each region has identified action plans to mobilize their region, addressing challenges and seizing opportunities that are unique to their geographic locations. Additionally, a new website is under construction to appeal primarily to students who are in the computing pipeline.

Conclusion

The national CAHSI INCLUDES Alliance is a network of committed institutions and organizations from public and private sectors with an established record of advancing Hispanics in higher education. This is a holistic approach to broadening participation of Hispanics in computing that is based on prior successes and a willingness to work collectively to enact sustained change through establishment of a common agenda. The agenda guides the vision and strategy for collective impact, conducts data collection to longitudinally track student movement across campuses, and launches regional pilots to test feasibility of the full-scale plan and process for change.

CAHSI believes that, in order to move the needle for Hispanics in higher education, efforts must go beyond simply telling faculty and staff about research-based approaches; CAHSI strives to change mindsets in challenging norms that act as barriers to student achievement. It is when working collectively and transparently with partners committed to the shared vision that CAHSI believes that it can truly accelerate change in the landscape for Hispanics in computing.

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