

Broadening Participation of Latinx in Computing Graduate Studies

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Introduction

A national alliance of Hispanic-Serving Institutions (HSIs) is committed to supporting students in attaining credentials in computing, and this **Work in Progress (WIP) paper** will focus on its latest effort in advancing undergraduate computing majors into graduate school to address the low numbers of Hispanics, or Latinx, attaining graduate degrees in computing. The Computing Alliance of Hispanic-Serving Institutions (CAHSI) expands adoption of evidence-based, multi-institutional graduate support structures that lead to Latinx students' success. The strategic efforts address well-documented barriers among graduate students (across all areas of study), e.g., feeling of isolation, lack of support structures, deficit thinking, and negative departmental climate [1], [2], [3], [4], [5]. The CAHSI Alliance was established in the early 2000s to create a unified voice of HSIs in consolidating resources and strengths committed to increasing the number of Latinx students in computing. The CAHSI Alliance'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, CAHSI Alliance's graduation rates have consistently surpassed national trends, when comparing its departments against other long-standing computing departments, as shown in Figure 1. With recent funding from the National Science Foundation (NSF), the

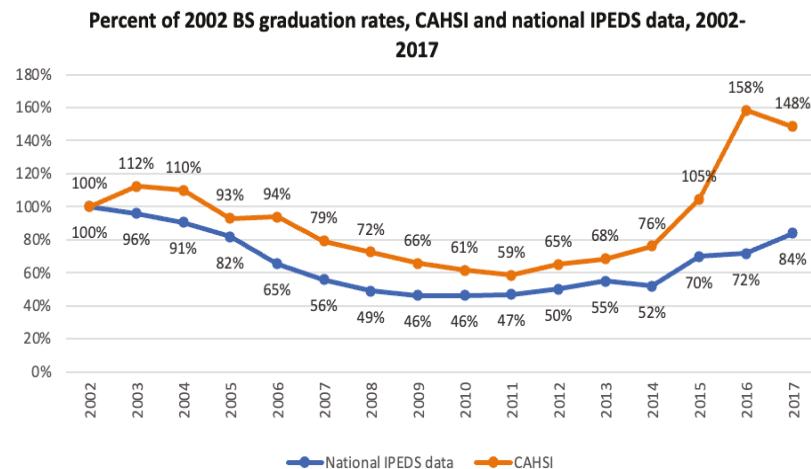


Figure 1. Comparison rates.

Alliance is now shifting its focus to address the low numbers of Latinxs in graduate studies, which remains low despite growth in numbers nationally at the undergraduate level [6]. The number of Latinx who complete graduate programs in computing fields comprises a mere 3 percent in master's and 2 percent in doctoral programs [7].

Project Overview

Addressing the low numbers of Latinx in graduate computing will be accomplished through a paradigm shift in how Latinx students are supported in advancing to and through graduate studies. Prior work by CAHSI has demonstrated the success of undergraduate research engagement, most recently in a virtual experience [8]. Recognizing the importance of identifying research careers in the first and second years of undergraduate study, participating universities will highlight research opportunities and expose students to research in their introductory courses through in-class and lab assignments. The intent is to convey the importance of research and excitement of innovation and discovery. This early acquisition of **research knowledge** will position research careers next to industry professional careers earlier in the undergraduate career of students, allowing both career pathways to be identified. To increase the number of 3rd and 4th year students participating in extensive **research**

preparation experiences, CAHSI institutions will work together to involve students in research projects at their respective institutions that align with research at Alliance doctoral-granting institutions, focusing on students with financial need and first-generation, college-going students. It is anticipated that participating students will develop their domain knowledge in areas aligned with Alliance research institutions. Students will also be encouraged to participate in external research experiences for undergraduates (REUs) and/or research internships at national labs. Finally, the Alliance will create a pathway for doctoral students with upper division students at non-PhD granting institutions paired with a mentor in a doctoral-granting institution. **Graduate student support structures** include establishment of a doctoral scholars' network that is envisioned as a community connecting across Alliance institutions (see project summary in Figure 2).

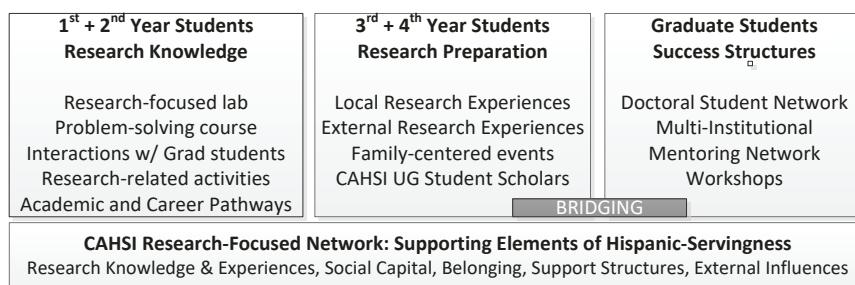


Figure 2. Strategic efforts.

Theoretical Framework

Observers note that advancing equity in science, and in computer science in particular, requires involvement of the discipline, department, and institution [9]. Yet, implementations of innovations in science education have been stymied by the lack of integration of scholarship on higher education organizational change and science education [10]. Social science research for the CAHSI INCLUDES Alliance will integrate these typically siloed areas of inquiry to understand how to strengthen inclusion of Latinx and other minoritized students in computer science department settings.

If the institutional setting of a department is a key component of understanding the nature and extent of its equity-centered initiatives, then studying computer science departments in HSIs can provide unique insights about how MSIs create postsecondary and career opportunities for minoritized computer science students. Yet, despite the fact that MSIs, including HSIs, enroll and graduate large shares of minoritized STEM and computer science degree earners, little research to date has examined the organizational strategies to create science opportunities for minoritized populations in MSIs specifically [11]. In its network of over 50 computer science departments at a range of doctoral and non-doctoral granting HSI institutional types, from community colleges to R1 research institutions [12], [13], [14], CAHSI serves as a compelling setting to examine the challenges and opportunities computer science departments face in advancing Latinx and minoritized graduate students' success in the discipline.

Notably, HSIs are defined by having a minimum 25% undergraduate enrollment full-time student body [15]. In alignment with this definition, the focus of the Alliance to date has been undergraduate education, particularly in terms of the network's institutional practices [16]. Little research, however, has addressed the experiences and outcomes of Latinx graduate students at

HSIs, especially the need for HSIs to expand their focus to better serve and support graduate Latinx students [17].

What the “serving” means in “Hispanic-Serving Institution” is an issue that HSI researchers, policymakers, and practitioners grapple most with, as HSIs are defined only by Latinx undergraduate enrollment shares rather than a specific mission to support Latinx students [18]. To operationalize what “serving” Latinx and other minoritized groups means, a recent comprehensive synthesis of all educational research literature to date generated a framework to understand the concept of *servingness* [19]. Servingness encapsulates the various dimensions and components within and beyond educational environments that support Latinx and other minoritized students. It begins with the premise that HSIs operate within a hierarchical and stratified system of higher education in which institutions with higher shares of Latinx and other minoritized students receive far fewer resources, on average, than other institutions to support their students [20].

Servingness, as enacted by HSIs, operates on three levels: (1) negotiating with external influences outside of the university, such as state legislatures and federal funding agencies [21]; (2) creating opportunity structures for serving through specific programs and services for Latinx and other minoritized students; and (3) affirming cultural experiences that incorporate students’ full racial identities, leading to positive intermediate student outcomes (e.g., sense of belonging and academic self-concept) and more conventionally addressed measures of success like graduation rates, degree completion rates, and progression into the work force [16]. If scant research exists about strategies to expand equity for Latinx and minoritized undergraduate students in MSI and HSI settings, even less addresses the experiences of graduate students in these settings [11].

The framework of servingness that has been used to guide prior research on CAHSI’s network for undergraduate education [12] will extend to guide future research on graduate education in computer science. Conducting inquiry about the BPC-AE alliance will yield additional understanding in at least three areas: (1) effective departmental strategies to expand equity for Latinx and other minoritized graduate students in computer science, (2) effective programmatic strategies in service of this goal and (3) the nature of servingness as it applies to graduate science education settings. Furthermore, with the new inclusion of R1 HSIs in the BPC-AE network, the research will yield insights on how research institutions can intentionally enact servingness [14]. This is an important research direction, as more and more institutions are becoming and are looking (or should be looking) for guidance on how to better support their large Latinx and other minoritized groups.

Research Design for Social Science Research

With the dearth of research in exploring the experiences of Latinx graduate students in HSI graduate programs, the social science research integrated into this project aims to define a model of “servingness” in graduate computing education grounded in organizational contexts of HSIs that is transferable and adaptable to *all* institutions invested in broadening participation in computing. Drawing on the conceptual framework of “servingness” in HSIs [19], the research investigation will (1) analyze how Alliance computing departments’ organizational values and mindsets contribute to academic, financial, and social support of Latinx computing graduate students; (2) examine how and to what extent the departments’ organizational leadership fosters such support; and (3) identify conditions that shape the capacity to build “mutually beneficial”

partnerships among Alliance institutions. The research questions guiding the investigation are: What is the organizational behavior of Alliance departments to advance graduate student success in computing for Latinx students? How do inter-institutional partnerships advance success?

The qualitative multiple case study aims to generate and refine “theoretical propositions” [22, p. 20] to guide conceptual understanding of how HSIs construct educational opportunities in undergraduate and graduate computer science education. In alignment with a focus on organizational culture and leadership, the departments in the partnership will serve as units of analysis. With an eye toward examining partnerships between institutions, departments new to the Alliance will be selected as cases. Four departments will be selected as sited for maximum variation along the following criteria: region, state location, length of time as an HSI, size (total enrollment), and enrollment of Latinx and other minoritized students in the overall HSI and in its computer science department. Congruent with case study methods [22], the research team will collect multiple forms of qualitative data at each site to include key departmental documents (e.g., strategic plans, mission statements, curricular sequences), semistructured interviews [23] with key stakeholders (e.g., administrators, staff, faculty, and students), and observations of regular CAHSI Alliance network meetings. Based on past experience conducting research on organizational culture in CAHSI departments [24], the research team anticipates ~90 interviews with diverse stakeholders across all four departments will be conducted and supplemented with meeting observation notes and document analyses. The research team will analyze the text generated through these forms of data collection through the constant comparative method [25] to identify patterns of similarities and differences in the corpus of interview transcripts, meeting notes, and documents. In this process, the research team will generate open and axial codes [25] to identify emergent themes in the data [26].

Significance

Observers note that advancing equity in science, and in computer science in particular, requires involvement of the discipline, department, and institution [9]. Yet, implementations of innovations in science education have been stymied by the lack of integration of scholarship on higher education organizational change [10]. Social science research for the Alliance will integrate these typically siloed areas of inquiry to understand how to strengthen inclusion of Latinx and other minoritized students in computer science department settings. The inquiry will yield additional understanding in at least three areas: (1) effective departmental strategies to expand equity for minoritized graduate students in computer science, (2) effective programmatic strategies in service of this goal, and (3) the nature of servingness in this context. Furthermore, the research will yield insights on how research institutions can intentionally enact servingness [13], as more and more institutions are becoming and are looking (or should be looking) for guidance on how to better support their minoritized groups. If successful, this project will serve as a model for other STEM disciplines in advancing minoritized students to and through graduate studies while at the same time contributing scholarly manuscripts to the extant knowledge base.

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