Examining organizational behavior of Hispanic-Serving Institution computer science departments: Toward servingness and equity in the field

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Abstract

This study examines the organizational behavior of departments in Hispanic-Serving Institutions (HSIs) with sustained success in graduating Latinx computer science bachelor's degree recipients. I employ the conceptual framework of HSI *servingness*, built on a systematic review of literature on HSIs, to investigate the creation of opportunity structures to serve Latinx and minoritized students at the department level. The research for this piece is based on a multiple ethnographic case study of four computer science departments in the Computing Alliance of Hispanic-Serving Institutions (CAHSI). The data corpus included 103 interviews with multiple stakeholders and 69 observations, each of which was conducted on site at the departments. In the analysis, three findings emerged as especially distinctive organizational behaviors to advance minoritized students' outcomes in computer science. The first was how departmental personnel used disaggregated institutional data in race-conscious and intersectionality-oriented ways to inform more inclusive departmental practices and to meet demands for external disciplinary accreditation. The second was how departmental personnel took collective responsibility to build career support for students. The third involved how personnel applied a talent development perspective to pedagogical approaches and to creating validating environments for Latinx and other minoritized students. This research extends scholarship on servingness in HSIs to both departmental organizational contexts and to computer science fields. It also offers organizational strategies to create more inclusive environments and promote equitable outcomes for minoritized students in science.

Keywords:

Hispanic-Serving Institutions, computing, information systems, organizational analysis, student success, Latinx, broadening participation, equity, diversity, inclusion

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1. INTRODUCTION

Computer science remains among the least diverse science fields by race and gender (National Academies of Science, Engineering, and Medicine [NASEM], 2018). Its racial and gender diversity has, in fact, declined in recent years (Mack et al., 2019). To date, investments to diversify this discipline, and science disciplines more broadly, have primarily funded efforts in selective Historically White Institutions (HWIs; NASEM, 2019). HWIs have predominantly enrolled white students and privileged white racial values, practices, and symbols, while marginalizing perspectives of Black and other racially minoritized groups (Brunsma et al., 2013; García, 2019; McGee, 2020a). Although selective HWIs receive the majority of federal funds for science research and programs, they graduate very few students from racially minoritized groups in science fields (NASEM, 2019).

By contrast, *Minority-Serving Institutions* (MSIs), which are institutions federally designated on the basis of mission or enrollment composition of racially minoritized groups, graduate disproportionately high shares of racially minoritized STEM students (NASEM, 2019). *Hispanic-Serving Institutions* (HSIs), federally designated institutions with at least 25% full-time equivalent Latinx enrollment, constitute the majority (over 70%) of all MSIs and enroll high shares of racially minoritized students, including two-thirds of all Latinx college students, more Black students than HBCUs, and more Native American students than TCUs (*Excelencia* in Education, 2020; Núñez et al., 2015). Here, I use the term *Hispanic* when referring to the federally defined entity of Hispanic-Serving Institution, and *Latinx* interchangeably with Hispanic in other contexts. Latinx is a gender-inclusive term, both a noun that represents the population group and an adjective that directly references the pan-ethnic ancestry of this population (Mora et al., 2021).

Consistent with findings that HSIs produce high numbers and shares of Latinx science graduates in general (NASEM, 2019), HSIs also demonstrate high success in graduating Latinx computer science bachelor's degree recipients. In 2017, just 11% of bachelor's degree recipients in computer science were from Latinx backgrounds, but 37% of them graduated from HSIs, a more than three-fold discrepancy (National Center for Science and Engineering Statistics [NCSES], 2019). Yet, there is very limited research on how HSIs develop organizational cultures and behaviors that advance racially minoritized students' science attainment (NASEM, 2019).

Because they are defined on the basis of enrollment, HSIs encompass considerable institutional diversity, including public and private, 4-year institutions and community colleges, and institutions in Puerto Rico as well as on the U.S. mainland (Núñez et al., 2016). Therefore, HSIs have quite diverse missions, complicating the question of what the term *serving* means in the phrase Hispanic-Serving Institutions. To address this complexity, scholars have conducted a comprehensive synthesis of all educational research on HSIs to develop a conceptual framework of *servingness* that characterizes the qualities of HSIs that intentionally support Latinx and other racially minoritized students (García et al., 2019). This framework recognizes that HSIs operate within a long-standing historical context of white supremacy that has limited racially minoritized communities' postsecondary opportunities (Carales & Doran, 2020; García, 2019; Wilder, 2013).

According to the servingness framework, within the context of white supremacy, HSIs negotiate with *external influences* outside of the university, such as state legislatures and federal funding agencies, to advance opportunities for Latinx and minoritized students (e.g., Carales & Doran, 2020: García et al., 2019, p. 771). The framework also posits that when enacting servingness, HSI personnel develop organizational *structures for serving* students, through activities including, but not limited to, mission statements, culturally relevant curricula, and

programs for minoritized students. Through these initiatives, HSIs that enact servingness promote *validating experiences within the structures*, where students encounter supports that contribute to positive *academic* and *non-academic outcomes*, like academic performance, graduation, and civic engagement (García et al., 2019, p. 771).

Taken together, García et al.'s (2019) synthesis of research on HSIs' general student success strategies and NASEM's (2019) synthesis of research on HSIs' initiatives to raise minoritized students' success in science fields illustrate that the scholarship on these topics predominantly focuses on the roles of individuals or programs in advancing student success. However, far fewer studies have addressed the organization as the unit of analysis (e.g., García et al., 2019). This condition, coupled with MSIs' lack of representation in research about equity-oriented efforts to serve minoritized science students (NASEM, 2019), limits the understanding of how to advance equity in science.

The purpose of this piece is to examine how organizational behavior in HSI computer science departments can create opportunity structures for Latinx and other minoritized students' success in this discipline. First, I briefly review the research on equity in computer science and how the department is a critical site to advance this objective. Then, I introduce the site of this inquiry, the Computing Alliance of Hispanic-Serving Institutions (CAHSI), a network of HSIs that has implemented an array of student success practices geared toward minoritized students (CAHSI, n.d.). Compared with other postsecondary institutions and even other HSIs, CAHSI departments have graduated disproportionately high numbers of Latinx computer science bachelor's degree recipients in the past two decades (Villa et al., 2019) and offer compelling sites to study organizational behavior to advance equity in this discipline. To guide this inquiry, I follow with a more detailed explanation of the servingness framework about organizational behavior in HSIs

(García et al., 2019). Subsequently, I present the methods and results from a multiple ethnographic case study (Eisenhardt & Graebner, 2007) of four computer science departments in the CAHSI network. I conclude with implications for research, policy, and practice.

2. EQUITY IN COMPUTER SCIENCE: THE IMPORTANCE OF THE DEPARTMENT

In addition to being among the least diverse science disciplines by both race and gender, computer science has been identified as a discipline with engrained racist and misogynistic practices that hinder full participation of minoritized groups (Chang, 2018; Dunbar-Hester, 2019; McGee, 2020a, 2020b; NCSES, 2019; Webb, 2019). Women and racially minoritized computer science students are more likely than others to perceive their disciplinary educational climates as sexist or racist (Barker et al., 2009; McGee 2020a, 2020b; Rodríguez & Blaney, 2020; Sax et al., 2018; Seymour & Hunter, 2019). Furthermore, students with more communal academic orientations express a lower sense of belonging in computer science (Sax et al., 2018).

These conditions particularly disadvantage women and Latinx students, who are more likely to have communal dispositions, in terms of finding a disciplinary sense of community (Hug, 2018; Hug & Jurow, 2013; López et al., 2019; Sax et al., 2018). Latinx computer science students also tend to have limited access to course curricula or pedagogical techniques that reflect their culture and language (Casillas-Martínez & González-Espada, 2019; Nahapetian et al., 2019; Villa et al., 2019). Furthermore, Latinas constitute just 2% of all computer science undergraduate bachelor's degree recipients (and just 19% of *all Latinx* bachelor's degree recipients), and even lower shares of master's and doctoral degree recipients in the discipline (NCSES, 2019). Therefore, among various demographic groups, Latinas can encounter among the lowest number of role models from their gender and race backgrounds in computer science (Casillas-Martínez & González-Espada, 2019). At the same time, Latinas in the discipline may

experience conflicts between fulfilling Latinx familial expectations to be dutiful daughters in responsibilities such as family caretaking, while also forging science identities in a particularly male-dominated and individualistic STEM field (Rodríguez & Lehman, 2018; Rodríguez & Blaney, 2020).

Given the lack of representation and chilly climates for Latinx, particularly Latinas, in computer science (Chang, 2018; Dunbar-Hester, 2019; Ong et al., 2011; McGee, 2020a, 2020b; Ong et al., 2011; Rodríguez & Blaney, 2020; Rodríguez & Lehman, 2018; Seymour & Hunter, 2019), developing culturally relevant and supportive organizational practices in computer science departments is essential to advance these students' success (Mack et al., 2019). Because the department represents the nexus where students engage with their institutions and major discipline (Chapman, 2020), it is a central site to implement equity-centered reforms in science fields more generally (American Association for the Advancement of Science, 2019; Hrabowski, 2019) and in computer science specifically (Mack et al., 2019). Faculty, who hold the most daily responsibilities in working with students and central contributors to student success (Mayhew et al., 2016), most directly identify with the department as their primary work environment (Kezar et al., 2015). Taken together, these factors underscore the importance of the department in equity efforts.

Results from a multi-institutional initiative suggest a positive association between the implementation of culturally relevant curricular and pedagogical practices in computer science departments and positive academic outcomes for minoritized students (Mack et al., 2019). This initiative, called the American Association of Colleges and Universities (AAC&U) Teaching to Increase Diversity and Equity in STEM (TIDES), supported small faculty and administrator teams in nearly 20 computer science departments to learn about and establish culturally relevant

practices in their own units (Mack et al., 2019). Although these practices showed promise in diversifying computer science, they also had limited scope, in that they were primarily implemented in a subset of courses or co-curricular activities, rather than across the whole department. Furthermore, broader organizational factors also influenced the ease and success of the implementation of these practices, leading Mack and colleagues to assert that a department's "institutional context" is critical in assessing its capacity to enact equity-centered efforts (Mack et al., 2019, p. 6). These factors included support from administrators and faculty within the institutions, and access to additional human or financial resources that could sustain such practices in the departments. Results from this research suggest the importance of extending inquiry to the organizational behavior of departments, when examining efforts to advance minoritized students' outcomes in science.

3. THE COMPUTING ALLIANCE OF HISPANIC-SERVING INSTITUTIONS (CAHSI): DEPARTMENTAL EFFORTS TO ADVANCE EQUITY IN COMPUTER SCIENCE

The sites for this empirical investigation were computer science departments in HSIs that are part of a network of HSIs committed to raising Latinx computer science attainment in the U.S. As the second largest ethnic group in the U.S., Latinx can play a significant role in contributing to computer science fields (NASEM, 2018, 2019). Given that 67% of Latinx in U.S. postsecondary education are enrolled in HSIs (*Excelencia* in Education, 2020) and that HSIs graduate disproportionately high shares of Latinx computer science bachelor's degree recipients (NCSES, 2019), HSIs are prime sites to study equity-oriented efforts for Latinx in the discipline (NASEM, 2019).

As a network of HSI computer science departments that was first funded by NSF in 2006 and grew to over 40 institutions by 2020, the Computing Alliance of Hispanic-Serving

Institutions (CAHSI) has implemented an array of student support strategies to advance Latinx computer science attainment (for more information, see CAHSI, n.d.;Villa et al., 2019). Since 2000, CAHSI departments have consistently graduated a larger share of Latinx computer science bachelor's degree recipients than similar departments in other HSIs and in other postsecondary institutions more generally (Gates et al., 2016; Hug, 2018; Villa et al., 2019). CAHSI's guiding purpose is to "create a unified voice to consolidate the strengths and resources of HSIs and other groups committed to increasing the number of Hispanics in all computer science areas" (Gates et al., 2016, p. 70). The CAHSI network has also committed to the goal of increasing the share of all U.S. computer science credential earners who are Latinx to 20%, by the year 2030 (Villa et al., 2019). As the recipients of a large-scale NSF grant to scale and spread their strategies to a wider array of HSIs, CAHSI members work with other higher education institutions, industry partners, non-profits, and funding agencies like NSF to build capacity for Latinx and other minoritized student opportunities to succeed in the discipline (Núñez et al., 2021; Villa et al., 2019).

Though more research on HSIs' organizational identities and cultures has emerged in recent years (e.g., García, 2019; García et al., 2019), little of this research has focused on HSIs' organizational practices to promote minoritized student success in the context of science disciplines (NASEM, 2019). As evidenced through a long-held commitment to increase Latinx attainment in the discipline, CAHSI computer science departments offer compelling sites to examine organizational behavior to serve Latinx and minoritized students in science.

4. HSI SERVINGNESS CONCEPTUAL FRAMEWORK

To characterize the organizational behavior of HSIs in relation to supporting Latinx and other minoritized students, García and colleagues (2019) synthesized the comprehensive body of

research on HSIs to date to advance a framework of servingness. The framework emphasizes that HSIs operate within the racialized U.S. higher education system, where institutions that enroll higher shares of racially minoritized students (which tend to be community colleges and less selective 4-year institutions) also receive less public funding (García, 2019). García et al.'s (2019) multidimensional framework emphasizes that to enact servingness in countering the white supremacist history of U.S. higher education (Carales & Doran, 2020; García, 2019; Wilder, 2013), HSIs should support Latinx students in three dimensions.

The first dimension involves managing external influences, or those entities outside of the HSIs that can nonetheless influence these institutions' capacities to fulfill their missions. These external influences include state legislators (e.g., Carales & Doran, 2020), federal agencies such as the NSF or the U.S. Department of Education (both of which administer specific HSI programs), alumni, boards of trustees, and community leaders (García et al., 2019, p. 771). In one example of managing such external influences, CAHSI members across the country came together to generate recommendations for the NSF to improve support for HSIs' research efforts (American Society for Engineering Education [ASEE], 2020; Núñez et al., 2021). Subsequently, CAHSI leaders organized efforts for HSI computer science scholars to develop their grant writing capabilities, in an effort to strengthen the departments' capacities to garner external funding from the agency.

The second dimension of servingness centers on building structures for serving within the institution that symbolically and practically promote student success. These structures include developing mission statements, strategic plans (including diversity plans), leadership and decision-making practices. Such structures also include promoting compositional diversity of faculty, staff, administration, and students. Institutional advancement activities, HSI grants, incentive structures and programs designed to support minoritized students also constitute structures for serving.

Culturally relevant curricula and pedagogy and community engagement are also examples of these structures (García et al., 2019).

The third dimension of servingness centers advancing positive and mitigating negative student experiences. A key component of this third dimension is promoting validating experiences for students (Rendón, 1994; Rendón Linares & Muñoz, 2011). Validating experiences include same-race peer interactions, cultural affirmation (e.g., Spanish communication), and mentoring and support groups for minoritized students. Here, the servingness framework also emphasizes that mitigating *negative racialized experiences within the structures*, like discrimination, harassment, and microaggressions, is critical in advancing effective servingness and validating experiences (García et al., 2019). A servingness framework also accounts for both commonly used and culturally relevant indicators of student success, which include both academic and non-academic outcomes (García et al., 2019). Academic outcomes include GPA, course completion, timely graduation and completion, and science degree attainment. Non-academic outcomes include several culturally relevant indicators like academic self-concept, social agency, and civic engagement, as well as development of racial and leadership identities, critical consciousness, and social justice orientation (García et al., 2019, p. 771).

García and colleagues (2019) noted that studies on HSIs about validating experiences and academic and non-academic outcomes, including those related to science student success, typically employed individuals (e.g., faculty, staff, students) or programs as units of analysis. This pattern has also been identified in studies concerning HSIs with regard to promoting minoritized students' success in science (NASEM, 2019). In this piece, I extend this research by focusing on the department as the unit of analysis for understanding organizational behavior in HSIs to create

structures for serving (García et al., 2019) with regard to Latinx and other minoritized students' science opportunities.

5. METHODS

The purpose of this research was to examine how organizational behavior in HSIs creates opportunity structures for Latinx and other minoritized students in computer science fields, employing the department as the unit of analysis. For this inquiry, I drew on a multiple ethnographic case study (Eisenhardt & Graebner, 2007) of four CAHSI computer science departments. Rather than generalizability of findings, my aim was to generate and refine "theoretical propositions" (Yin, 2018, p. 20) to guide conceptual understanding of how HSIs construct educational opportunities in this discipline.

5.1 Author Positionality

My scholarly identity (Neumann, 2009) engaging in research and policy to advance Latinx student success, the contributions of HSIs, and build inclusive STEM environments informed this inquiry. Inspired by the transformative paradigm (Hurtado, 2015; Mertens, 2009), I followed an *HSI positionality* (Núñez, 2017) – an institutional positionality based on my prior personal and professional experience as faculty in an HSI – to work in a reciprocal way with the CAHSI network and researchers. As a Latina scholar, I approached the project as an opportunity to serve as a partner with CAHSI to advance understanding and practice to support and raise the attainment of Latinx students in computer science (e.g., ASEE, 2020).

5.2 Data collection

For the multiple ethnographic case study, the research team visited four CAHSI departments, each in large public 4-year HSIs and large state university systems. Although HSIs are institutionally diverse (Núñez et al., 2016), four large public 4-year HSIs were chosen as sites

for departments to participate in this study. This selection approach was intended to minimize variation in organizational behavior in departments that might be attributed to sector (i.e., public or private) or degree type offered (i.e., bachelor's or associate's degree). To compare organizational practices between departments, and to enhance transferability of the results, the selection criteria for these campuses involved maximum variation for (a) region of the country, (b) state location, (c) percentage of enrollment of Latinx students, (d) length of time as an HSI, and (e) length of time as a member of CAHSI. The research team conducted one four-day site visit to the departments at North, South, Southwest, and West Universities (pseudonyms). Table 1 shows each department's institutional characteristics at the time of the visit.

[INSERT TABLE 1 HERE]

Congruent with case study methods (Yin, 2018), the research team collected multiple kinds of data, including participant-observations of multiple CAHSI network meetings. During these visits, they conducted a total of 103 interviews and 69 observations, and additional documents with information about the network and departmental activities. The semistructured interviews (Merriam, 2009) were tailored to each participant's role and responsibility. They focused on participants' perceptions of opportunities and challenges for departmental support of Latinx student success in computer science. In total, 40 faculty, 17 staff, 22 administrators, and 22 students (18 undergraduate and 4 graduate) were interviewed. Observations included class meetings, faculty meetings, professional club meetings, tutoring sessions, programmatic initiatives (including CAHSI- or NSF-based programs), and university-wide meetings of science or student success initiative committees. Observation protocols were designed based on extant research literature, while also allowing researchers flexibility in recording activities. We followed Emerson et al.'s (2011) guidelines for writing fieldnotes using these protocols, and

wrote in-process memos about interviews and observations while collecting data (Miles et al., 2020).

5.3 Data analysis

Site visit interviews were transcribed verbatim, observation meeting notes were typed, and these were assembled with key documents and CAHSI network meeting notes. For this analysis, I applied the constant comparative method (Strauss & Corbin, 1998) to identify common patterns in the corpus of the interview transcripts, observation notes, meeting notes, and documents. Through this process, I generated initial codes (Charmaz, 2014) to characterize these patterns and wrote separate memos, matrices, and visual displays about the emergent themes in the data (Miles et al., 2020). I refined the initial codes to develop focused codes (Charmaz, 2014) that would come to constitute some of the key themes discussed in this piece (Charmaz, 2014; Emerson et al., 2011; Miles et al., 2020). In addition to these procedures, I generated summaries of characteristics and findings for each campus, to conduct the cross-case analysis (Yin, 2018) of the four campuses.

Because few studies of servingness to date have been conducted in the organizational unit of the department or in the context of a specific discipline like computer science (García et al., 2019), I first coded the data inductively (Charmaz, 2014), rather than use categories of servingness or findings from other research as *a priori* (Miles et al., 2020) codes. Once I had created initial codes (Charmaz, 2014), I employed a pattern-matching technique (Yin, 2018) in which I compared emerging themes in the data to themes in the extant research literature on HSIs and equity-oriented science efforts.

Employing multiple data sources enhanced trustworthiness (Lincoln & Guba, 1985) of the analysis. In addition, I also conducted member checking (Lincoln & Guba, 1985) by

presenting preliminary findings to approximately 42 individuals in regular CAHSI network meetings or research conferences with HSI leaders. In these sessions, participants expressed an alignment with their own experiences and observations, without suggesting changes to the interpretations. Furthermore, I examined alternative interpretations of the data to challenge and refine the analysis (Gall et al., 2007). For example, in analyzing the use of data to guide decision making (the third theme discussed in the findings), I first concluded that the use of student data was limited to accreditation purposes. Only after further review of the data did I come to conclude that departmental personnel employed data for multiple purposes beyond accreditation.

5.4. Limitations

The HSIs in the study were not representative of all HSIs, as they did not include community colleges, smaller private HSIs, or Puerto Rican institutions, each of which are important HSI types (Núñez et al., 2016). Second, it is possible that the stakeholders interviewed and events observed in the departments were not indicative of all perspectives or activities in these units. Third, the site visits reflect departmental perspectives and activities concentrated at one point in time, though further data collection and analysis were conducted both before and after the site visits to enhance triangulation of findings (e.g., through document analysis and participation in CAHSI meetings).

6. FINDINGS

These findings focus on patterns in departments' organizational behavior that have seen limited attention in other research about efforts to create opportunities for minoritized students' science attainment at HSIs (García et al., 2019; NASEM, 2019). Key themes included: (a) using data in *race-conscious* and *intersectional* ways to improve structures for serving, (b) creating

structures to support students' career development, and (c) cultivating a talent development mindset among faculty, administrators, and staff.

6. 1. Using data in race-conscious and intersectional ways to improve structures for serving

The typical use of data to guide continuous improvement in higher education departments and institutions, including HSIs, all too often ignores the potential to identify and address racial gaps in equity (Dowd & Bensimon, 2015; Malcom-Piqueux, 2020). In contrast, CAHSI departmental personnel used data disaggregated by race to identify and reduce racial gaps in computer science enrollments. As part of this effort, each department collected disaggregated data about how their own department's racial composition of computer science majors was aligned with the overall racial composition of Latinx students at their institutions (see Table 1). When they identified negative disparities, department strategized about how to raise the representation of Latinx in their disciplines.

This approach of examining parity in Latinx representation resembles the Equity Scorecard approach (Bensimon et al., 2006) that has been used in other departmental, institutional, and state contexts to identify and address postsecondary racial equity gaps (Dowd & Bensimon, 2015). Although in other cases external consultants outside of the institution have guided stakeholders through the Equity Scorecard approach (e.g., Dowd & Bensimon, 2015), CAHSI departmental administrators, faculty, and students voluntarily carried out this approach. Tracking compositional diversity of Latinx students in their discipline indicated that these departments strove to enact their institutions' organizational identities as HSIs (García, 2019), to ensure, in the words of one leader, that both their departments *and* institutions were Hispanic-Serving.

Given limited representation of women and Latinas in computer science, departmental personnel also disaggregated data by gender, and, in turn, by gender within race. As such, they attended to the saliency of intersectionality in Latinas' experiences in the major (Rodríguez & Lehman, 2018), using disaggregated data to develop and refine strategies to promote Latinas' (and other women's) success in computer science. When departmental personnel noted disparities in computer science enrollments of undergraduate women and Latinas, compared with those of men and Latinos (and similarly, with university-wide enrollments of these groups in their institutions), they strengthened or implemented strategies to support women and Latinas in the major. For example, three of the four departments housed active professional clubs aligned with a national association dedicated to increasing women's participation in the discipline. To further address intersectional gender and race disparities, the network also coordinated with a non-profit to create scholarships to support Latinas in their studies. In addition, CAHSI network members designed special professional development events for Latinas at an annual Latinx-focused professional conference in computer science. To illustrate the value of these activities, in one department, a Latina who had encountered discouragement from a faculty member to major in computer science, described her participation in a professional club as like being in a "family." She expressed that being a club leader had been a key factor keeping her in the major, when her courses enrolled so few women and she encountered such discouragement. Feeling an increased sense of community in the club and seeing other Latinx role models in the CAHSI network made her feel like, "If they can succeed, I can succeed."

The departments also employed these data to guide periodic disciplinary accreditation processes through the Accreditation Board for Engineering and Technology (ABET), which, in coordination with 35 scientific disciplinary associations, conducts voluntary accreditation of

programs in five areas, including computer science (ABET, n.d.). All four departments were ABET-accredited. Department leaders often referenced ABET standards in efforts to align their programs' curricula with national standards in computer science bachelor's degree programs, and how they could use disaggregated data for accreditation purposes. For example, during a regular faculty meeting, one administrator spoke with their faculty about the importance of collecting accreditation data on an ongoing basis for program improvement, rather than waiting until the last minute. Together, these findings suggest that CAHSI departmental personnel tracked compositional diversity data for both external boundary management with accrediting agencies and to guide internal organizational practices to advance structures for serving Latinx students in general and dually minoritized groups of Latinas in particular (García et al., 2019).

6.2 Creating structures for serving students' career development

Academic, social, cultural, and financial supports are often emphasized in advancing success for Latinx and other underrepresented students in science (e.g., Núñez et al., 2013; McGee, 2020a, 2020b; NASEM, 2019). This study's results indicate that departmental personnel created structures for serving students in terms of career support, which has been less covered in the literature. Career support is especially important for Latinx because Latinx are most likely to value working hard as a vehicle for economic mobility, Latinx college students are more likely to work for pay, and employment prospects can shape Latinx students' postsecondary trajectories to a greater degree than for other groups (Carnevale & Smith, 2018; Dowd & Malcom, 2012; Núñez & Sansone, 2016; Santiago, 2020). Interpreted through the framework of servingness (García et al., 2019), career support was embedded in culturally relevant approaches to curriculum and pedagogy, as well as programs and services geared toward the socialization of Latinx and minoritized students to computer science.

Career support took several forms within the departments. Two departments directly integrated career support into their curricula, offering credit-bearing classes focused on preparing for professional opportunities in the discipline. As noted above, Latinx students are more likely than others to work for pay during college and may spend less time on campus. Therefore, embedding career content into these courses courses enabled students to obtain professional development during formal class time, rather than requiring students to seek these opportunities outside of class and outside of the department (such as having to go to the campus career center). The career-oriented classes incorporated assignments like practicing interviewing, developing resumes, writing cover letters, and applying to graduate opportunities. Examples included requiring students to develop a 30-second elevator pitch introducing themselves and to conduct different kinds of mock interviews aligning with the common formats of employers, such as Google.

The career classes not only focused on the content of job applications, but on how students could highlight their work experience in ways that emphasized their strengths to potential employers. Many students worked in entry-level positions, and might have perceived their own employment experience as irrelevant to the technology industry. To emphasize that these students' work experiences were also salient in preparing for technology jobs, one instructor explained during class how students could highlight their past or current work experience in non-computer science jobs. To a student cashier at Dunkin Donuts, she pointed out that, "You can explain in applications or interviews that you are responsible for finances, train people, and assist customers." To the student who worked at Best Buy, she recommended, "Rather than just say, 'I'm a stock boy at Best Buy,' state that 'I manage inventory and customer requests'." She also reminded students to list their science-related awards and opportunities,

including participating in undergraduate research and attending professional computer science conferences. Thus, the instructor encouraged students to perceive their work experiences as strengths and imparted how to translate these experiences as salient to their future computer science careers. Outside of formal coursework, all of the departments held shorter-term workshops, such as meetings with Google employees to learn about the company's interview process, that could accommodate the schedules of working students.

Student attendance at professional conferences focusing on Latinx communities and/or women in computer science also constituted a critical dimension of career support, accounting for the role of intersectionality in students' experiences as well. The CAHSI network's funding, and in some cases, other supplemental departmental funding, supported students' attendance. Staff and faculty encouraged students to apply, reminded them of deadlines, helped them prepare the applications, and wrote recommendation letters. Consequently, each year, several Latinx and women students from each department attended key national conferences focused on promoting racial or gender diversity in the discipline. At these conferences, students often were invited to meet with the employers who were recruiting job candidates. Many students obtained internships or job offers as a result of making these connections. These opportunities afforded students the chance to go to conferences that, as one student put it, "typically only kids at the rich schools get to go to." These conferences also enabled minoritized students to meet other Latinx, women, and Latina computer science faculty and industry leaders at these conferences, who served as important role models.

Staff and faculty in these departments committed to ensuring that students who were accepted to such conferences could financially attend, and demonstrated attunement to familial issues that Latinx students might negotiate in traveling to attend such conferences. They

described advising students on how to communicate with their families about the benefits of attending such conferences. Because it is not unusual for Latina students to be expected to remain at home, to take care of family members (Rodríguez et al., 2021; Sy & Romero, 2008), personnel recognized that Latina students, in particular, might encounter resistance from their families to attend conferences. In some cases, these personnel assured parents that, when attending specific conference events, their students would not be traveling alone, but alongside departmental faculty and staff. These practices provide additional evidence of a culturally relevant orientation of intersectionality (Núñez, 2014a, 2014b; Núñez et al., 2020; Rodríguez & Lehman, 2018) toward supporting Latinas in navigating the computer science major.

6.3 Cultivating a *talent development* mindset

Faculty attitudes and mindsets are quite consequential for student success in science. The quality and quantity of in- and out-of-class faculty-student interactions are among the most critical predictors of student success in college (Mayhew et al., 2016). Furthermore, the extent to which science faculty believe students' abilities are malleable and have the potential to grow is positively associated with increases in students' academic performance (Canning et al., 2019). Across CAHSI departments, administrators, faculty, and staff commonly expressed a view that both they and the students had the potential for growth and to learn from one another. It was not unusual for the departmental personnel to ask at some point in their interviews, "What can I (or my unit) do better?" This expression indicates that faculty, staff, and administrators cultivated a talent development mindset, or an institutional focus on advancing student development through an emphasis on practices like effectively teaching students of diverse backgrounds (Astin & antonio, 2012). Findings from this study indicated that many departmental personnel applied an assumption and expectation that administrators, faculty, and students alike carried significant

potential for growth in their habits of mind, skills, and interactions with one another to develop Latinx students' computer science talent.

Reflecting a talent development perspective, some faculty emphasized teaching and encouraging student development as their most important professional responsibilities. An especially clear articulation came from a faculty member who was also a successful researcher, who explained, "I know the importance of research, but I think teaching has the most impact among all my faculty responsibilities, through being able to support students' growth." Another, who had likewise received significant external research funding, said, "I would not be doing this job if not for teaching, because what is the point? That is the most meaningful thing, to help students develop and grow." Speaking to both the faculty and student perspectives, another professor explained, "I learn more from the students than they do from me." An administrator framed promoting student success as, in essence, an "oath" that college personnel commit to in their roles.

Flexibility in assessing talent to pursue the major also constituted a talent development ethos. Faculty and administrators in some departments discussed being flexible with admission into the major as a way to enroll students who showed potential in computer science but might otherwise have been excluded based on other metrics (e.g., reading, writing, or language competency tests). One campus offered introductory courses in math and science in Spanish as a bridge for English Learner Latinx students to pursue these fields. Their faculty and administrators sometimes found that English Learner students who had not yet completed the reading or language requirements nonetheless performed well in math and introductory computer science courses, and therefore showed potential to succeed in the major. A faculty member at that campus observed, "If the student knows the math but is still learning English, what does it

matter? They can still handle the computer science coursework." In that department, an immigrant and English Learner Latina student who had been required to take language bridge courses later became a student leader in the major. On another campus, a senior-level administrator questioned, "Do they *really* need that math class for the major?" as he discussed a proposed curricular reform to enable more students to pursue math and science in a way that could reduce time to degree or allow more flexibility in course sequences.

Flexibility in pedagogical approaches also reflected a talent development mindset. Specifically, several instructors described how they applied growth-oriented approaches in their classroom pedagogy. They emphasized to students that there were different pathways to getting the right answer, giving students partial credit when students demonstrated how they got an answer (even if that answer was not the correct one). In some cases, they encouraged students to talk through their logic. For example, one instructor explained that, in his experience, Latinx students had strong oral communication skills. So, when Latinx students found it difficult to express their logic in written form, he encouraged them to talk out their process of arriving at answers. Several instructors stressed the importance of imparting to students the message that studying computer science involves lots of trying and making mistakes. In the words of one, "I really try to show students that it is ok to fail, and to try and try again."

Understanding how students' backgrounds shaped their pursuit of these degrees also shaped a talent development mindset. Faculty expressed recognition that work and family commitments can pose additional responsibilities for Latinx students and knew that many of their students worked part-time or full-time to finance their educations. Indeed, Latinx students are the most likely racial/ethnic group to work for pay during college (Carnevale & Smith, 2018; Dowd & Malcom, 2012; Núñez et al., 2016; Santiago, 2020). Furthermore, students at HSIs,

regardless of their race or ethnicity, are more likely than others to have chosen to attend their particular institution out of a preference to remain near their families of origin (Núñez & Bowers, 2011).

In light of these conditions, several faculty described making special accommodations in courses. For example, they recognized challenges for students in completing assignments or obtaining tutoring within particular time periods. As a consequence, they offered students alternative times or modes of completing assignments or tests, letting them turn in assignments on electronic or virtual platforms with flexibility about deadlines. One faculty member described how she let some of her students bring their children to class, adding, "I know they don't bring their children to class because they want to, but because they need to." An administrator included training to educate faculty about the multiple responsibilities that many students face, including employment and family caretaking, and how faculty can work with students with these commitments to promote their success. At one campus, supplemental tutoring sessions were offered at all times of the day to enable students to be able to gain additional academic support for the most challenging courses. Several faculty also discussed being willing to administer tests or hold office hours on Saturdays.

As part of a talent development mindset, faculty also identified Latinx students' cultural qualities and framed these in positive, asset-based ways. Recognizing how Latinx students may be engaged in multiple kinds of labor (i.e., paid employment, supporting family), several described Latinx students as "hard working." Many admired the capacity for bilingualism among Latinx students, and some were even trying to learn Spanish so to better communicate with their students. One instructor developed an assignment where students were required to design a program to generate syntax in Spanish. A different instructor discussed how he sometimes paired

Latinx English Learner students who were hesitant to speak up in class with other bilingual students to talk through their answer, encouraging them to speak in whatever language they felt comfortable.

Notably, not all faculty shared talent development-oriented views of students, nor did they all describe enacting these student support strategies. Some did not perceive the needs of Latinx students to be different from any others, reflecting a *color neutral* attitude which, in HSIs, is higher among science faculty than their counterparts in other disciplines (García et al., 2020). Others characterized Latinx students as "underprepared," without articulating the social and economic contexts (e.g., under resourced K-12 schools) that might account for a lack of preparation. A few faculty did not clearly articulate their own teaching or student support responsibilities, but, rather, focused on the importance of research (Astin & antonio, 2012), reflecting the emphasis in American higher education of incentives tied to research, and a tendency of faculty to affiliate primarily with their discipline, rather than to engage more deeply in their institution (Clark, 1989). Collectively, these findings nonetheless indicate possibilities for computer science faculty, administrators, and staff to cultivate culturally attuned talent development mindsets, a component of HSI servingness that can positively shape pedagogical approaches and contribute to validating experiences for students (García et al., 2019).

7. DISCUSSION OF HSI DEPARTMENTAL SERVINGNESS IN COMPUTER SCIENCE

The conceptual framework of servingness in HSIs emphasizes the importance of examining the organization as the unit of analysis and, correspondingly, creating structures for serving minoritized students (García et al., 2019). This research suggests that focusing on the organizational behavior of departments expands understanding of how HSI personnel create structures for serving minoritized students in science. Findings indicate that race-conscious data-

driven decision making (Dowd & Bensimon, 2015; Malcom-Piqueux, 2020) that includes an intersectional sensibility (Núñez, 2014a, 2014b; Núñez et al., 2020; Rodríguez & Lehman, 2018) can enhance the development of organizational behavior that supports Latinx student success in science. This approach to using data not only tracks racial and gender compositional diversity of students, it can influence leadership and decision-making practices to inform diversity plans, programs, and services for minoritized students, and external boundary management to strengthen support for faculty, staff, and students (García et al., 2019).

This research extends scholarship on academic, financial, social, and cultural approaches to advance equity in science in MSIs (e.g., NASEM, 2019) by illustrating how HSI departments also build career support through tailoring curricula, pedagogy, programs, and services to validate the cultural assets that minoritized students bring to the classroom. Structuring curricular and co-curricular opportunities that expose students to job application skills, potential employers, and Latinx role models offers students critical cultural and social capital (Bourdieu, 1986; Ovink & Veazey, 2011) to plan for their post-college lives as professionals (Santiago, 2020). Department stakeholders can also encourage students to take an assets-based approach in presenting their capabilities to potential employers. These activities encourage students to identify and leverage their non-dominant forms of capital (Carter, 2005) and community cultural wealth (Yosso, 2005) that might otherwise go unseen or unvalued, when evaluated by white or upper socioeconomic normative standards (e.g., when students hold service jobs that could be perceived as menial work that is irrelevant to computer science professions). In terms of servingness, these approaches illustrate how departments can create structures for serving that value and engage minoritized students' assets like aspirational capital (e.g., being "hard working") and linguistic capital (e.g., bilingualism) while challenging white supremacist

conceptions of what can and should be valued in the workplace (García, 2019; García et al., 2019; Yosso, 2005).

This research also reveals dimensions of a talent development (Astin & antonio, 2012) mindset in a discipline where such a mindset appears to be relatively unusual (e.g., Mack et al., 2019; McGee, 2020a, 2020b; Rodríguez & Blaney, 2020; Seymour & Hunter, 2019). One dimension of a talent development mindset involves expanding ways to assess potential to pursue the computer science major (e.g., beyond test scores or developmental education placement). Another includes the employment of pedagogical growth-oriented approaches, providing students multiple opportunities to solve problems and demonstrate their abilities in different ways. A third dimension includes understanding and applying Latinx culture, language, and values to create environments that incorporate academic and social validation (Rendón, 1994; Rendón Linares & Muñoz, 2011). As one example, this dimension can involve engaging families to understand and support how Latinx students pursue career pathways, cultivating familial capital (Yosso, 2005) that can apply in distinctive ways to Latinas' experiences in computer science (Rodríguez & Lehman, 2018; Rodríguez et al., 2021). Enacting a talent development mindset can inform leadership and decision making (e.g., expanding flexibility of criteria for admission into the major) and the creation of validating experiences (García et al, 2019), each of which are critical in creating structures for serving Latinx students in computer science.

8. CONCLUSION (IMPLICATIONS FOR RESEARCH, POLICY, AND PRACTICE)

Most research to promote equitable science outcomes to date has been conducted in HWIs, meaning that MSIs, HSIs, and minoritized students are underrepresented in institutional and student samples in this line of inquiry (NASEM, 2019). This state of research has limited

knowledge about culturally relevant and responsive models to promote equity in science for minoritized groups. The research in this piece focused on organizational behavior in HSI computer science departments, to expand the institutions and students accounted for in studies about student success in computer science, and to address organization level factors that affect minoritized students' science opportunities.

This study employed servingness, a conceptual framework focused on multiple contexts and outcomes to promote student success in HSIs (García et al., 2019), to understand the organizational behavior of computer science departments in HSIs that have demonstrated effectiveness to promote Latinx and minoritized student success in the discipline (Gates et al., 2016; Villa et al., 2019). Servingness recognizes that HSIs are racialized institutions situated in a system of white supremacy that has limited their resources (García, 2019). Findings from this study indicate that these departments demonstrate servingness by creating structures for serving and validating experiences to broaden opportunities for Latinx and other minoritized students in computer science (García et al., 2019).

More research focusing on the organization (e.g., the department) as the unit of analysis could enhance the understanding of how servingness is enacted (García et al., 2019) and of what organizational behavior is most conducive to minoritized student success in science disciplines (NASEM, 2019). Such research could shed light on how stakeholders can work together to enhance student success. Given that community colleges constitute about one-half and Puerto Rican institutions about one-fifth of HSIs (Núñez et al., 2016), future research should examine the creation of structures for serving minoritized students in other institutional settings like these.

Faculty and administrator mindsets and assumptions can pose a barrier to organizational change to promote student success, even in equity-oriented science reform efforts (Kezar, 2018;

Kezar & Bernstein-Serra, 2020; Kezar et al., 2015). Future research should explore further the quality of faculty mindsets and how they guide organizational behavior at the department level. Future scholarship could also examine the employment of data to shift faculty mindsets in directions such as increased racial and intersectionality consciousness (Malcom-Piqueux, 2020; Núñez et al., 2020; Rodríguez & Lehman, 2018). The CAHSI multi-institutional network provided opportunities for departmental leaders in different HSIs to review disaggregated data by race and gender, and to learn from other departments' successful approaches. Other institutions could similarly partner to support one another in implementing equity-oriented approaches to promote equity in computer science and science disciplines more generally.

As demands to enroll in computer science degree programs increase (NASEM, 2018), there might be a temptation to exclude Latinx and other minoritized students from becoming majors in the discipline, due to narrower assessments of academic potential. To counteract such trends, applying a more expansive talent development mindset in curricular policies and pedagogy can expand possibilities for Latinx and minoritized students to pursue the field. Flexibility in assessing minoritized students' potential is critical, considering that there have been national concerns about a shortage of computer science faculty, which can limit the availability of openings in departments' classes and majors (e.g., NASEM, 2018).

Public and private funders should allocate more resources to strengthen HSIs' capacities to create structures for serving Latinx and minoritized students in science fields. Such investments could further advance conceptual and practical understandings of servingness, while increasing positive academic and non-academic outcomes for Latinx and minoritized students (García et al., 2019). Such research could advance more culturally relevant models to promote equity in science that could be adapted to other institutional settings, including those in HWIs

(NASEM, 2019). As illustrated in these findings, race conscious and intersectional use of data, career support, and talent development mindsets could be applied to a broader array of disciplines and institutions.

Finally, as the Latinx population continues to increase, 352 institutions have become *emerging HSIs*, with between 15 and 24.99% Hispanic enrollment (*Excelencia* in Education, 2020). Adding these to the current number of 539 HSIs would represent a 65% increase in HSIs. To be responsive to student needs, these institutions will have to adjust their educational models in more culturally relevant directions to promote student success (Marin, 2019). It is critical that these institutions and others employ culturally relevant conceptual frameworks and practical strategies grounded in research about the very institutional contexts that have been especially successful in serving large numbers of Latinx and other racially minoritized students – MSIs and HSIs (Malcom-Piqueux, 2020; McGee, 2020a, 2020b; NASEM, 2019; Núñez et al., 2021). Examining how HSIs enact organizational behavior to promote Latinx and minoritized student success has significant potential to advance new ways of thinking about and practicing equity in science.

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