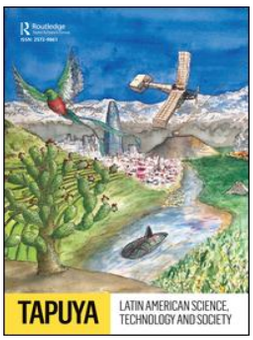

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Centering Hispanic-Serving Institutions' strategies to develop talent in computing fields

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ABSTRACT

Hispanics have become the largest ethnic minority in the US Better serving Hispanics to succeed in tertiary education and scientific fields like computing is critical to build equitable life opportunities and strengthen the US workforce. Typically, the most selective postsecondary institutions are emphasized as exemplary models for developing human capital in the US. Yet, due to the nation's tertiary education institutional stratification, relatively low numbers of Hispanics are enrolled in these institutions. We examine how Hispanic-Serving Institutions (HSIs), federally designated institutions in the US that enroll at least 25% Hispanics, develop strategies to raise Hispanic attainment in computing fields. Specifically, we explore the activities of HSIs in the Computing Alliance for Hispanic-Serving Institutions (CAHSI), a network of over 60 HSIs and other stakeholders that are committed to raising Hispanic attainment in postsecondary computing. We address the question: *How do HSIs in CAHSI employ strategies to develop talent in computing among Hispanics?* Specifically, we examine how CAHSI institutions apply values that are grounded in Hispanic communities, including emphases on *confianza, respeto,* and *familia*, to support Hispanic students in computer science. Our findings indicate the importance of centering Hispanic cultural assets to improve Hispanic success in computing.

KEYWORDS

Hispanic-Serving Institutions; science education; computer science; equity; Latinx

PALAVRAS-CHAVE

Instituições frequentadas por Hispânicos nos Estados Unidos; educação científica; ciências da computação; equidade; Latinx

PALABRAS CLAVE

Instituciones que sirven Hispanos en los Estados Unidos; educación científica; ciencias de la computación; equidad; Latinx

Desenvolvimento de talento em Latinx grupos nas Ciência da Computação no contexto de instituições frequentadas por Hispânicos nos Estados Unidos

RESUMO

Atualmente nos EUA os Hispânicos estão a tornar-se a maior minoria étnica do país. É fundamental criar oportunidades de vida equalitárias e fortalecer as qualificações de trabalho nos EUA para que os Hispânicos possam ter sucesso no ensino superior

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em campos científicos como as ciências da computação. Normalmente, as instituições de educação pós-secundária mais seletivas são usadas como modelos para o desenvolvimento de capital humano nos EUA. Contudo, devido à estratificação institucional da educação terciária no país, relativamente poucos Hispânicos frequentam estas instituições. Neste estudo as Instituições de Serviços Hispânicos (ISHs), instituições designadas pelo governo federal dos EUA que matriculam pelo menos 25% de hispânicos, são examinadas com o objetivo de identificar as estratégias que estas instituições desenvolvem para aumentar o sucesso dos Hispânicos nas ciências da computação. Estas estratégias estão alinhadas com os valores comuns das comunidades Hispânicas. O caso explorado neste estudo é a Aliança de Computação para Instituições que Servem os Hispânicos (ACISH), uma rede de mais de 60 ISHs e outras partes interessadas que trabalham para aumentar o sucesso de Hispânicos nas ciências de computação. A seguinte questão foi investigada: Como é que as ISHs na ACISH servem as comunidades Hispânicas para promover o seu sucesso nas ciências de computação? Especificamente, foram examinadas as formas como as instituições na ACISH aplicam os valores das comunidades Hispânicas, incluindo a ênfase na "confianza" (confiança), "respeto" (respeito), e família, para apoiar estudantes Hispânicos nas ciência da computação. As descobertas deste estudo enfatizam a importância de centralizar os valores culturais Hispânicos para melhorar o sucesso dos Hispânicos na ciências de computação.

Desarrollo de talento Latinx en Ciencias de la Computación en instituciones que sirven Hispanos en los Estados Unidos

RESUMEN

En los E.U.A. la comunidad Hispana se ha convertido en la más numerosa de entre todas las minorías étnicas. Por esta razón, es importante que los hispanos reciban apoyo para tener éxito en la educación terciaria y en programas de computación. Este éxito es fundamental para construir oportunidades más equitativas y fortalecer la fuerza laboral de los E.U.A. Típicamente, las instituciones postsecundarias más selectivas son recalcadas como modelos ejemplares para desarrollar el capital humano en los E.U.A. Sin embargo, debido a la estratificación institucional en la educación terciaria de la nación, pocos hispanos se matriculan en estas instituciones. Examinamos como las instituciones de servicio hispánicos (en inglés "Hispanic-serving institution" o HSI), universidades públicas o privadas donde el 25% o más de los estudiantes son hispanos, han desarrolado estrategias alineadas con los valores de la comunidad hispana para aumentar el número de hispanos en las ciencias de la computación. El estudio de caso se concentra en la Alianza de Computación para Instituciones de Servicio a Hispanos (en inglés "Computing Alliance for Hispanic-Serving Institutions" o CAHSI), una organización de más de 60 HSIs y grupos interesados que se comprometen a aumentar el éxito de los hispanos en programas de computación en las universidades. Abordamos la pregunta: ¿Cómo sirven las HSIs en CAHSI a las comunidades hispanas para avanzar el éxito de estudiantes en el área de computación?

Específicamente, examinamos cómo las instituciones de CAHSI aplican valores asociados a las comunidades hispanas, incluyendo un énfasis sobre la confianza, el respeto y la familia, para apoyar a los estudiantes hispanos en ciencias de computación. Nuestros resultados indican la importancia de centralizar valores culturales hispanos para mejorar el éxito de estudiantes hispanos en computación.

1. Introduction

People of Hispanic[1] background in the US are underrepresented in computing fields[2] and in tertiary education, while Hispanics have become the largest ethnic minority population in that nation. As the labor market demand for workers in science and computing fields continues to increase, raising Hispanic attainment in computing and in tertiary education is critical to build equitable life opportunities and sustain the economy. Typically, research about US tertiary education focuses on the most selective and internationally top-ranked institutions, which are also emphasized as exemplary models for developing human capital in science fields (Casselman 2016; Gonzales and Núñez 2014; National Academy of Sciences, Engineering, and Medicine 2019). Most students enrolled in such institutions are white, with very few Hispanics or Blacks among them (Carnevale et al. 2018). For example, although Hispanics constitute 21% of the population enrolled in US post-secondary education, only about one in eight (12%) Hispanics are enrolled in the most selective public 4-year institutions (Carnevale et al. 2018). Thus, the potential for highly selective and predominantly white institutions to expand the share of Hispanics in science fields is highly limited.

By contrast, Minority-Serving Institutions (MSIs), which typically are less or non-selective institutions, play a significant role in developing national talent in the science, technology, engineering, and math fields (STEM) in the US MSIs in the US were initially developed toward the end of the 1800s to serve populations that historically had no access to tertiary education. Specifically, Historically Black Colleges and Universities (HBCUs) and Tribal Colleges and Universities (TCUs) were designated by the US federal government to provide tertiary educational opportunities for African American and Native American indigenous populations. As the nation's populations of Hispanics and Asian Americans increased in the twentieth century, additional MSIs were federally designated for these populations (NASEM 2019). Notably, there are also MSIs outside the US that focus on serving historically underrepresented groups in tertiary education. These global MSIs exist on all continents except Antarctica and serve linguistic and religious minority groups, as well as racial minority groups, within their respective nations (see Hallmark and Gasman 2018).

[1]A variety of terms have been applied to this population in the US (Núñez et al. 2013). For the purposes of this piece, we use the term Hispanic to be consistent with the term that the US government uses to define this population, and accordingly, to align with our focus on US federally designated HSIs.

[2]We use the terms "computing" and "computing fields" to encompass academic disciplines in the US that are called several names. These names typically include: *computer science*, *computer engineering*, *information science*, and *computer information systems*. These terms are often implicitly interchanged (or used to encompass one another) in academic and policy discourse about these fields, as in the source: National Academic of Sciences, Engineering, and Medicine (2018).

In 1992, as Hispanics were becoming the largest ethnic minority population in the US, the federal government designated Hispanic-Serving Institutions (HSIs) as not-for-profit 2- or 4-year postsecondary institutions that enroll at least 25% full-time Hispanic undergraduates. HSIs now number 523, by far the largest share among the over 700 MSIs (NASEM 2018). HSIs currently enroll two-thirds (67%) of all Hispanic undergraduates in US postsecondary education (Excelencia in Education 2020). In contrast to their severe underrepresentation in enrollments at selective 4-year HSIs (Carnevale et al. 2018), Hispanics constitute 23% of enrollment in 4-year public HSIs and 44% of enrollment in 4-year private HSIs (NASEM 2019, 61). Nearly half (46%) of Hispanic STEM bachelor's degree holders graduated from HSIs in 2016, despite the fact that HSIs currently constitute only about 15% of all US postsecondary institutions (National Science Foundation 2019) and receive, on average, just two-thirds the financial resources of all US postsecondary institutions (HACU, n.d.).

In the US, 2-year public institutions, also known as community colleges, also provide an important avenue into STEM fields for Hispanics. Fifty-five percent of MSIs are community colleges (NASEM 2019, 59) and half of HSIs are community colleges (Núñez, Crisp, and Elizondo 2016). Compared with their share of the US population, which is about 18% as of 2019, Hispanics are actually overrepresented in 2-year institutions, constituting 26% of total enrollment in these institutions (American Association of Community Colleges 2020). About half of Hispanics in higher education (52%) are enrolled in community colleges, compared with just 41% of undergraduates from all racial/ethnic backgrounds (American Association of Community Colleges 2020).

To address the underrepresentation of Hispanics in computing, the Computing Alliance of Hispanic-Serving Institutions (CAHSI) is a multi-institutional network of HSIs that advances effective strategies to support Hispanic student success, with the overall goal of raising Hispanic attainment in these fields (Gates, Thiry, and Hug 2016). Since 2000, CAHSI institutions have, on average, graduated a higher share of Hispanic bachelor's degree recipients in computing than other higher education institutions (Villa et al. 2019). Since its formal inception in 2006, the network, based at The University of Texas El Paso (UTEP), has expanded from a small group of fewer than ten 4-year institutions to over 60 4-year and 2-year mainland and Puerto Rican HSIs and other industry and non-profit partners (Villa et al. 2019). Using CAHSI as a case, we address the question: *How do HSIs in CAHSI employ strategies to develop talent among Hispanics in computing?* In our analysis, we identify strategies that reflect the key values emphasized identifying the roles of *confianza*, *respeto*, and *familismo* in supporting Hispanic student success in computing; we challenge "epistemic injustice" (Frank 2013) that emphasizes the sole use of English norms and publishing in dominant English outlets (Rodríguez Medina 2019). Focusing our study on HSIs, rather than the selective Predominantly White Institutions that have typically been the sites of research about these strategies (NASEM 2019), suggests that to develop talent among Hispanic communities in computing fields, it is critical to center on Hispanic cultural values.

2. Literature review

Hispanics historically have lagged behind other US racial/ethnic groups in tertiary and STEM degree attainment (NASEM 2019). Hispanics tend to enroll in less selective and

less well-resourced institutions that receive far fewer funds for operation than more selective institutions (Carnevale et al. 2018). Hispanics' concentration in less selective institutions results in part from their comparatively limited academic preparation, which stems from historical educational segregation in less well-resourced primary and secondary schools (e.g. Gandara and Contreras 2010; Fuller et al. 2019). This condition also results from Hispanics' preferences in choosing tertiary institutions. Hispanics prefer to attend institutions closer to their families of origin and are more averse to attending higher-cost institutions than members of other racial/ethnic groups (Núñez and Bowers 2011). These preferences also influence Hispanics' tendencies to be enrolled in less selective and less costly institutions, including community colleges and HSIs specifically (Bowen, Chingos, and McPherson 2009; Núñez and Bowers 2011). These tendencies reflect Hispanic cultural values that stress the importance of prioritizing family care taking (*familismo*), minimizing the need to pay for college, and working for pay to establish financial well-being (Núñez et al. 2013; Núñez and Sansone 2016).

Hispanic enrollments in tertiary education have increased in recent years, and the percentage of Hispanics earning bachelor's degrees in STEM among all US degree recipients nearly doubled between 2006 (8.1%) and 2016 (14.1%) (NSF 2019). Hispanics now constitute an estimated 18.5% of the total US population (US Census 2019). Yet in more lucrative fields like computing, Hispanics constitute a disproportionately low percentage (10.8%) of bachelor's degree recipients (NSF 2019).

Computing has been identified as a field with an especially sexist and racist culture (Dunbar-Hester 2019; Webb 2019). The norms, shared beliefs, and behaviors that constitute computer science culture have been documented as denigrating women through practices of misogyny (Chang 2018) and perpetuating racism through algorithms that misrecognize or exclude Black and non-white images and perspectives (Benjamin 2019; Buolamwini and Gebru 2018; Noble 2018). Furthermore, digital technologies have reinforced the privilege of the English language and accents, and the marginalization of linguistic expression and accents from the Global South (Poster 2019). Collectively, these conditions contribute to why women and people of color continue to be represented in computer science postsecondary education programs and related technology industries at such low rates (Chang 2018; Webb 2019).

Several factors pose barriers to computing attainment for Hispanic students in particular (NASEM 2018). Lower levels of academic preparation, unsupportive educational settings, and the competitive nature of STEM culture have all been documented as key concerns hindering the attainment of Hispanics, other students of color, and women in STEM fields (Engberg and Wolniak 2013; Hurtado et al. 2007; Hurtado et al. 2010; Ong et al. 2011; Ovink and Veazey 2011). Latinx STEM students at four-year institutions that are not HSIs and consist of a predominantly white student body have reported a lack of institutional support for their academic success (Hurtado et al. 2007; Ovink and Veazey 2011). In computer science, students generally report a lack of social support from their peers and instructors (Waite et al. 2004). Moreover, consistent with broader analyses of computing culture as misogynistic and racist (Chang 2018; Dunbar-Hester 2019; Webb 2019), women and underrepresented minority students are more likely to perceive educational climates in computing fields to be sexist or racist (Barker, McDowell, and Kalahar 2009).

Hispanic students' experiences in computing may be more positive and supportive at HSIs than other institutions, as evidenced by the fact that HSIs produce better student

outcomes than other institutions in terms of computing credentials and other STEM fields (Gómez, Cobian, and Hurtado 2018). These patterns appear to be consistent in both 4-year and 2-year HSIs. A disproportionately high percentage (37%) of Hispanic bachelor's degree graduates in computing graduate from HSIs, compared to 10.8% among all US tertiary institutions (NSF 2019). Given their high enrollments of Hispanics, two-year HSIs also play an important role in improving the pathways to STEM-related education, training, and careers (NASEM 2019; Zamani-Gallaher et al. 2019).

One US study on women and underrepresented postsecondary students in computing found that students who have a more communal orientation to their studies also report a weaker sense of belonging in computer science (Sax et al. 2018). A communal orientation to education is especially important to Hispanics in general (Núñez et al. 2013). When Hispanics in engineering and computing lack a sense of communal or family orientation in their studies, they report less positive academic experiences, which could adversely affect their success in these fields (López et al. 2019). Furthermore, too often Hispanics do not see dimensions of their culture (e.g. representations of Hispanic scientists, societal problems relevant to Hispanics, Spanish language, Hispanic music) reflected in computing curricula, pedagogy, or more broadly, in the postsecondary contexts they navigate (Casillas-Martínez and González-Espada 2019; Nahapetian et al. 2019; Villa, Hampton, and Hsu 2018). Computer science education that does not promote a sense of belonging or affirm Hispanic students' racial/ethnic identities can inhibit their engagement in computing. However, some innovative programs that have engaged computer science faculty in developing culturally responsive curricula and pedagogy in at 4-year HSIs (e.g. Casillas-Martínez and González-Espada 2019; Nahapetian et al. 2019) and 2-year HSIs (Webb, Gonzales, and Trent 2019) have shown success in recruiting and retaining Hispanic students to computer science. The success of these programs illustrates the potential for culturally responsive education that affirms Hispanic values and identities to increase their participation in computing (Mack, Winter, and Soto 2019).

Collectively, this evidence indicates that Hispanics at HSIs have more positive experiences and support in STEM fields than their counterparts at non-HSIs (Sánchez 2019). One study found that, even at an HSI with a high proportion of Hispanic students, students from STEM disciplines were more likely than those in non-STEM disciplines to report witnessing or experiencing incidents of overt and covert discrimination and isolation (Sánchez 2019). This finding indicates that even at HSIs the exclusionary cultures of science and computing (Benjamin 2019; Chapman 2020) create climates that are not welcoming for Hispanics (Casillas-Martínez and González-Espada 2019; Faye-Carter, Dueñas, and Mendoza 2019).

3. Conceptual context

While scientists may assume that their approaches to inquiry and practice are "value-free" (Harding 2015), in fact the scientific disciplines, including computer science, are intertwined with social, cultural, and historical contexts that have excluded people of color from full participation and in some cases reified societal forms of stratification (e.g. Benjamin 2019; Faye-Carter, Dueñas, and Mendoza 2019). Given the importance of interactions between faculty and students in influencing a range of student outcomes (Mayhew et al. 2016), the values that faculty and other personnel enact can have critical

effects on student success, including within computing fields (Mack, Winter, and Soto 2019). For tertiary institutions to correct historical inequities in outcomes such as Hispanic computing attainment, they must change their " … underlying values, assumptions, structures, processes, and culture" (Kezar 2018, 71). Such change includes transforming the mindsets of faculty and administrators so that they are equity-oriented to develop the talent of all students, regardless of their backgrounds (Dowd and Bensimon 2015).

Based on a comprehensive review of all research to-date about HSIs, García, Núñez, and Sansone (2019) have found that, to enhance Hispanic student outcomes, personnel at HSIs must enact "servingness," or a multidimensional framework of strategies that intentionally center Hispanic success at multiple levels. For the remainder of this manuscript, we will use the term "servingness" to represent this multidimensional framework. Key dimensions of Hispanic servingness include: (1) *external influences*, which include national legislation and the role of public funding agencies like NSF and NIH; (2) *structures for serving*, which include mission statements, strategic plans, culturally relevant curricula, and specialized programs; and (3) *student experiences and outcomes*, ranging from the quality of interactions with faculty to whether and how quickly students complete degrees (García, Núñez, and Sansone 2019).

Faculty and administrative leadership is required to enact Hispanic servingness to raise science degree attainment in HSIs, particularly to develop organizational infrastructures to support Hispanic students' talent development (García, Núñez, and Sansone 2019; NASEM 2019). Such leadership include what García and colleagues (2019) call *external boundary management*, which involves how personnel at tertiary education institutions interact with *external influences,* such as legislatures or funding agencies, to strengthen their capacities to serve and support students (27). In the US, these external stakeholders include: (1) federal, state, and local legislatures; (2) industry; (3) foundations; (4) non-profit agencies and (5) federal funding agencies such as NSF and NIH. Among other factors, how HSIs navigate, address, and respond to relationships with these external stakeholders, influences their capacity to build *structures for serving* Hispanic students. Such capacity includes the potential to garner external funding, including that from federal agencies like NSF, to serve students.

HSIs build *structures for serving* through an array of approaches. These approaches include developing mission statements, strategic plans, curricula, co-curricular opportunities, programs, grant-funded initiatives, and pedagogical strategies with the intention of supporting Hispanic student success (García, Núñez, and Sansone 2019). Among the strategies to develop structures for serving listed above, implementing programs that target Hispanic students is a common strategy. Programs are often an appealing and accessible strategy because they can be funded by external sources, are small in scale, and lend themselves to experimentation and refinement before being implemented at a larger scale. For example, the NSF has funded many programs administered within tertiary institutions to offer science students scholarships, guidance in applying to graduate school, and opportunities to conduct research with faculty and internships in science industries. These programs are intended to fulfill a key component of NSF's mission: to broaden participation in science by diverse groups.

Research has recently emerged about how faculty and staff serve Hispanic students in terms of curricula, pedagogy, leadership, and explicit commitments to success within the social sciences and humanities (e.g. García 2019; Núñez, Murakami-Ramalho, and Cuero

2010). However, much less of this research addresses effective strategies that HSIs employ in science disciplines to raise Hispanic attainment and success (NASEM 2019). To augment understanding of Hispanic servingness in HSIs, and how it is enacted in science disciplines and computer science in particular, we turn to our analysis of CAHSI, a network of HSIs across the US that was formed in 2004 and then formally funded in 2006 to raise Hispanic educational attainment in computing and has since expanded its activities through extensive financial support from the US National Science Foundation (NSF) and computing industry partners.

CAHSI is a network of institutions in the US that has developed several strategies to serve and support Hispanic students in computing fields. It has enacted strategies at the three levels of Hispanic servingness: (1) external influences, (2) building structures for serving, and (3) student academic and non-academic outcomes (García, Núñez, and Sansone 2019). At the level of student outcomes, CAHSI institutions have positively influenced student outcomes. Between the years 2003 and 2017, Hispanic computing bachelor's degree completion rates at CAHSI institutions have increased and consistently been higher than the US national average rate at all institutions, among all Hispanic students (Villa et al. 2019).

CAHSI has also been successful at advancing effective "signature practices" to support Hispanic student success, and expanding its reach to involve more HSIs, industry partners, and non-profit and other stakeholders in meaningful ways to build capacity of the consortium and the HSIs within it (Villa et al. 2019). Over the next five years and beyond, CAHSI plans to extend its reach through: (1) strengthening data collection and analysis to understand student success strategies and outcomes (at the individual and institutional levels), (2) advancing networks of regional and national HSIs to lift Hispanic success and attainment in computing (at the alliance and regional levels), and (3) making an impact at the national level, by both raising the national share of Hispanics in computing and by "serving as a voice for Hispanics in computing" to shape policy and social science discourse and legislation about these issues (Villa et al. 2019, 4).

Given the network's success and array of activities to raise Hispanic student computing outcomes, it serves as an appropriate case for studying how tertiary faculty and administrators can enact Hispanic servingness to support students in computing fields. In this study, we focus on the first two levels of servingness—managing external influences and building structures to serve students—to indicate values and strategies in tertiary institutions that can positively influence Hispanic computing attainment. Next, in our methods section, we explain in further depth the network's history, goals, and recent efforts to inform the US National Science Foundation about how to build capacity to expand attainment in Hispanic computing credentials.

4. Methods

We employed a constructivist grounded theory approach to incorporate perspectives from the literature on STEM and computer science education, HSIs, and higher education more generally, to examine the activities of CAHSI in an inductive manner (Charmaz 2014, 2017). We combined this approach with a single case study method (Eisenhardt and Graebner 2007), with CAHSI and its activities serving as the case through which we explored strategies to support Hispanics in computing. Our objective was to generate

theoretical perspectives about a topic that has been underexplored in higher education (Jones, Torres, and Arminio 2014), in this case, the values and associated mindsets that underlie efforts to build capacity to raise Hispanic computing attainment in US tertiary education.

4.1. Site

The Computing Alliance of Hispanic-Serving Institutions, also known as CAHSI, is a consortium of over 30 HSIs and over 30 industry, non-profit, and other stakeholders working together to raise Hispanic attainment in computing (Gates, Thiry, and Hug 2016). CAHSI's formation resulted from a discussion among HSIs at the 2004 National Science Foundation's (NSF) biennial Minority Institutions Infrastructure (MII) meeting; and seven HSIs, led by The University of Texas El Paso, helped to found the initial network (Gates, Thiry, and Hug 2016). The core purpose of CAHSI 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 computing areas" (Gates, Thiry, and Hug 2016, 70). Building on its past success in raising Hispanic attainment in computing, CAHSI's current goal is to raise the share of credentials in computing earned by Hispanics (about 11% in 2017, according to NSF) to 20% of the total by 2030, a figure that would reach parity with the share of Hispanics in the overall US population (NSF 2019; Villa et al. 2019).

Since 2006, CAHSI has received several NSF grants and funding from other sources to expand its programmatic efforts and engage new partners, including other HSIs, non-profit science organizations, and technology companies such as Google. Recognizing that HSIs and other MSIs receive far less funding than other institutions to support students (NASEM 2019), the National Science Foundation (NSF) Computing and Information Sciences and Engineering (CISE) Directorate funded a convening led by CAHSI to develop recommendations on how the agency can better support HSIs to contribute to talent development for Hispanics and other historically underrepresented groups in STEM fields. In seeking insights about how to better support HSIs and MSIs in serving students, the NSF aimed to enhance its own mission of broadening participation from different demographic groups in sciences.

4.2. Data collection

Research team members examined programmatic documents and key published articles about CAHSI's programs. In addition, we conducted analyses of data we collected as participant observers at the convening referenced above, called the CAHSI INCLUDES Community Workshop on Building CISE Research Capacity at HSIs. At this July 2019 convening, 24 faculty and administrators from HSIs and members of a non-profit organization met to examine ways to build capacity in HSIs for research and teaching support for faculty, administrators, and students. Most attendees came from departments or colleges of computer science and engineering, and the group included personnel from 16 distinct HSIs and additional stakeholders invested in Hispanic computing student success, including members of non-profit organizations and program officers from NSF.

As part of the two-day meeting, attendees were divided into six groups and asked a series of questions about how to build capacity in HSIs and what efforts to prioritize. Over the course of the first day, with the guidance of a group facilitator, each group addressed topics including: (1) building partnerships between HSIs and better-resourced research institutions that are "mutually beneficial" (NASEM 2019), (2) evaluating the most successful NSF funding programs in supporting HSIs' efforts, (3) interdisciplinary collaborations, and (4) mentoring post-baccalaureate scholars in computing fields (from graduate students to early career faculty). Each participant-observer observed a group meeting, and the group meetings were also tape recorded and transcribed. The first three authors served as participant-observers in the workshop and fully observed the convening, generating 18 hours of observation notes.

4.3. Data analysis

The meeting transcriptions, participant-observers' notes, and key documents and articles about CAHSI's mission, programs, and outcomes constituted the data set for this study. The three participant-observers independently coded transcripts and observation notes. They began by using the constant comparative method (Strauss and Corbin 1990) to conduct line-by-line analyses of these written materials to find common patterns in the data and to generate initial codes to characterize these patterns (Charmaz 2014). From the beginning of the analysis process, they applied sensitizing concepts (Bowen 2006), based on prior literature about Hispanics in computing and HSI educational environments, to inform the development of codes and memos. Throughout the analysis process, they also wrote separate theoretical memos about emergent themes in the data (Strauss and Corbin 1990; Miles, Huberman, and Saldaña 2020). Subsequently, they compared their initial codes and memos to examine patterns of convergence and divergence (Emerson, Fretz, and Shaw 2011). On the basis of these patterns, they developed focused codes (Charmaz 2014) to advance and refine theoretical concepts that would come to constitute key themes in the data (Charmaz 2014; Emerson, Fretz, and Shaw 2011; Miles, Huberman, and Saldaña 2020).

4.4. Trustworthiness

To enhance trustworthiness (Lincoln and Guba 1985) of the analysis and the processes of triangulating the findings, the research team took several steps. First, they conducted the initial analysis of the data separately before comparing their initial codes. This procedure maximized the potential for the team to compare areas of divergence in the data and to identify alternative cases (Gall, Gall, and Borg 2007; Miles, Huberman, and Saldaña 2020) that would push them to refine their initial interpretations. Second, the research team employed other data sources, including CAHSI program descriptions and final reports about the meeting, to enhance and refine the analysis. Third, the research team conducted "member checking" (Lincoln and Guba 1985) by having other leaders of CAHSI who organized the meeting review the specific findings in this manuscript. These leaders agreed with the substantive content and did not make any significant corrections to the interpretations. Fourth, the positionality of the researchers as Hispanics and their prior immersion in HSI environments enhanced their capacity to make sense of the data.

Specifically, the research team for this analysis included four Hispanic women from the US with significant experience in and expertise about HSIs. Three had attended or worked in an HSI before beginning this project, in roles including faculty, staff, and students. The team also included scholars fluent in Spanish who could understand bilingual communication in the meeting. These skills and experiences enhanced the participant-observers' capacity to communicate with and understand participants' perspectives in the meeting.

4.5. Limitations

This study was based on data from one meeting, at one point in time, with a group of HSIs that is not representative of HSIs as a whole, because only 4-year HSIs were represented (Núñez, Crisp, and Elizondo 2016). The data are only based on the HSIs that are a part of the CAHSI network and participated in the workshop. None of the 2-year institutions in CAHSI participated, because they were relatively new additions to the CAHSI network, and their partnerships with the network were not yet well-established. Further, this particular meeting focused on building capacity for institutions to conduct research, and community colleges in the US do not incorporate research as a central part of their mission. As a case study, our research aimed not for generalizability to other contexts, but rather, to generate and refine "theoretical propositions" (Yin 2018, 20) that could advance understanding of our research questions concerning how HSIs build organizational capacity to serve and support Hispanic students in computing.

At the end of this article, we briefly discuss our plans to address some of these limitations in future research.

5. Results

In our participant-observation in the workshop and review of key documents examining CAHSI's activities and student outcomes, we found that institutions in CAHSI recognize and incorporate key values of Hispanic communities as assets in raising Hispanic attainment in computing: (1) *confianza*, or mutual trust and support, *respeto*, or a respect for members of the community (3) and *familismo*, or an emphasis placed on the community ties fostered by familial structures and affiliations (e.g. Núñez et al. 2013). Our findings indicate that CAHSI faculty and administrators enact these values in three levels of "servingness" (García, Núñez, and Sansone 2019), by: (1) addressing external boundary management with other tertiary institutions and agencies, (2) building structures for servingness in its colleges and universities to support Hispanic student success, and (3) promoting positive experiences and outcomes for Hispanic students in their computing programmatic efforts. Below, we discuss the application of each value in more detail.

5.1. Confianza

Hispanics have a particularly strong social and relational orientation (Martínez and Hernández 2004); therefore, building mutually beneficial and trusting interpersonal and community connections, or *confianza*, is critical for them to succeed in postsecondary education (e.g. Núñez et al. 2013; Stanton-Salazar 2001). Before discussing how CAHSI employs *confianza* to strengthen efforts to serve Hispanic students, it is instructive to

discuss how a lack of *confianza* in initiatives like partnerships can inhibit the capacity to support Hispanic students. While partnerships between HSIs and more well-resourced research institutions are one critical strategy to build capacity to serve Hispanic students (NASEM 2019), HSIs do not always have positive experiences in such partnerships. Quite commonly, the more well-resourced research institutions often take most of the money from such partnerships, do not spend extensive time in collaboration with or support of HSI personnel, or see the HSIs as suppliers of students of color rather than as co-creators of knowledge (NASEM 2019; Núñez 2017). Such negative experiences challenge HSIs' *confianza* in external boundary management with other tertiary institutions.

The HSIs that initially formed CAHSI first met at an NSF biennial MII meeting, which emphasized "a grassroots effort to unify and strengthen computing research and education among Hispanic-Serving Institutions" (Gates, Thiry, and Hug 2016, 1). Several participants in the workshop discussed how the time spent together in such gatherings allowed members of CAHSI to build trust with one another and to identify committed stakeholders to the project. Building the trust and capacity to form the network took a couple of years, from when the institutions first met in 2004 to receiving NSF funding to formally establish the network in 2006 (Villa et al. 2019, 2).

In addition, CAHSI emphasizes open and continuous communication within its network of members. The partnerships between HSIs are divided into different regions, forming smaller communities to facilitate ongoing interactions, with the intention of nurturing a culture of "mutual trust and respect" (Computing Alliance of Hispanic Serving Institutions, n.d.). In fact, to become a formal institutional member of CAHSI, personnel from the institution have to commit in writing to help pursue the goals of CAHSI as a collective and at their own institutions through signing a "Consortium Agreement" or Memorandum of Understanding (MOU). These conditions of CAHSI illustrate the importance of *confianza* between personnel at the network's institutions to achieve the organization's goals.

In addition to this external boundary management between its members, CAHSI has implemented several programs as part of its structures of Hispanic servingness. Some of these programs, like Peer-Led Team Learning (PLTL) models, emphasize *confianza* and connections between peers in computing classes, to support building academic and leadership skills among undergraduates majoring in computing. In PLTL, peer leaders are selected based on high academic performance in computing classes with low student success rates. These leaders are then trained to support students taking these courses in building the necessary skills to complete coursework successfully. One study found that students who participated in PLTL had significantly higher completion rates of these courses than those who did not (Gates, Thiry, and Hug 2016). One peer leader explained the value of connecting with peers:

> … 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 learned can help other people. I was like, I'm going to hang out in the (computer science tutoring) lab … 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 [degree]. (As cited in Gates, Thiry, and Hug 2016, 3)

Seeing other students succeed in a more supportive (rather than competitive) environment, helped this student have the *confianza* that they too, could succeed in computer science classes that had initially intimidated them.

5.2. Respeto

Holding *respeto*, or moral integrity in relating to members of a community, is evident in how CAHSI creates its partnerships with other institutions. A meeting attendee who discussed collaborating with well-known researchers as part of these partnerships stated that mutual respect is essential when developing relationships because "If you want to succeed, you have to make sacrifices in the beginning and show them that you can contribute to a project without expecting anything in return." Meeting participants noted that when more selective and well-resourced institutions invited HSIs early on to formulate grants or programs, devoted time to build relationships with HSIs, allocated equivalent resources to the HSIs and their own institutions, and provided opportunities for HSIs to offer feedback and co-construct partnerships, such partnerships were more likely to be successful. These kinds of activities illustrate *respeto* and reciprocity to HSIs for their unique assets and capacity to contribute to research endeavors as well as opportunities to broaden participation among historically underrepresented populations in science.

Besides partnerships with more well-resourced institutions that were not HSIs, an additional dimension of external boundary spanning that meeting participants raised was how proposals to agencies like NSF from HSIs are often evaluated using narrow criteria that do not take into account HSIs' unique circumstances and contributions. Participants also discussed how more selective, well-resourced, and predominantly white institutions are often perceived as more prestigious by reviewers. This bias about institutional quality and its negative impact on the proposals of applicants from less selective institutions has been documented in sociological studies of the evaluation of grant and fellowship proposals (e.g. Lamont 2009).

For example, participants discussed how their proposals would often be critiqued for a lack of research publications or limited participation in conferences, assessed as potential limitations in their research experience. However, HSIs operate with only two-thirds of resources, on average, as other institutions (HACU, n.d.). These faculty often have far higher teaching loads, while lacking institutional funding for attending conferences and traveling to build relationships with potential collaborators or program officers at funding agencies. In the meeting we observed CAHSI participants discussing at length how NSF and other funding agencies should take into account the unique circumstances under which many HSI faculty and administrators work. They characterized proposal evaluation processes at federal agencies and other funders as reflecting "institutional bias." One meeting participant expressed this sentiment in Spanish, arguing that, when evaluating proposals from less well-resourced HSIs, funding agencies should correct their typical approaches and be "sin gríngolas," or, roughly translated into English, "without blinders." The "gríngolas" or "blinders" represent the predominant narrow viewpoint that more selective, well-resourced, and predominantly white institutions are better at conducting science research, as illustrated in studies of evaluation review processes (Lamont 2009).

To address such "gríngolas" at the student level, several CAHSI institutions implemented a program called Fellow-Net for graduate students that submit fellowships to the agency for scholarships. In this program, faculty mentor these students to prepare applications to fund graduate studies that will be more competitive in comparison to those of applicants from more selective institutions that receive the bulk of these grants (Villa et al. 2019). Students are advised to participate in an array of activities that

expose them to multiple areas of the discipline, including research opportunities, extracurricular activities, professional associations, and presenting and publishing research. In addition, faculty offer advice and feedback to students on how to assemble their packet, including how to write an essay that vividly illustrates a student's talents and why they deserve these resources to pursue further studies in the discipline. This program engages faculty and students in recognizing and affirming *respeto* for their work and presenting applications in a way that will challenge funding agencies' "gríngolas" and institutional bias.

5.3. Familismo

The activities of CAHSI also indicate an application of the value of *familismo*, reflecting an emphasis on family ties and caretaking of the family in Hispanic culture. One of the alliance's central goals is to establish a community of different institutions to advance a shared identity " … to create a unified voice in an effort to consolidate the strengths, resources, and concerns of CAHSI institutions" (CAHSI, n.d.). Several CAHSI institutions have increased their research activities enough between 2004 and 2019 that they are now considered research institutions in common US higher education classification schemes. In the meeting conversation, personnel from CAHSI institutions discussed how they employed an intergenerational approach to involve university personnel at all levels, including faculty, students, and staff, to engage in more research activities. In a different context, a faculty member said, "If the students succeed, then we succeed." These assumptions of interdependency among stakeholders in the universities and shared responsibility for student success reflect an approach of *familismo*.

CAHSI also enacts *familismo* in its programmatic activities with students, through its Affinity Research Groups, which operate at several of the institutions. These groups are organized to apply cooperative learning approaches toward the development of basic and research skills in computing fields. Participation in these groups is associated with increased student achievement and self-esteem (Villa et al. 2019). These groups emphasize a sense of community and collaboration for students and thus reflect a sense of *familismo* that has been found to be familiar, comforting, and supportive to many Hispanic students in engineering fields (López et al. 2019).

In the convening we observed, faculty and administrators also emphasized a factor that they take into account in implementing the array of CAHSI programs to advance Hispanic talent development in computing. These faculty and administrators referenced the importance of addressing Hispanic students' caretaking responsibilities to their families that are emphasized in *familismo*, through allowing more flexible scheduling and time commitments in these various programs. In aiming to accommodate Hispanic students' needs to balance family considerations in relation to implementing various opportunities, the CAHSI network also demonstrates understanding of the importance *familismo* that its students often hold.

6. Discussion and conclusion

Our analysis indicates that CAHSI activities and leaders enact underlying values of *confianza*, *respeto*, and *familismo* that have been found to be critical in supporting Hispanic students in primary, secondary, and tertiary settings (e.g. López et al. 2019; Núñez et al.

2013; Stanton-Salazar 2001). To challenge the historical exclusion of Hispanics from computing, CAHSI members infuse values, ways of knowing, and experiences grounded in the contexts of Hispanic communities that help Hispanic students to feel validation (Rendón 1994) and a sense of belonging (Hurtado and Carter 1997) to have more positive experiences and success in science fields (López et al. 2019). Computing may appear to be a value-free, objective discipline that equally and universally affirms all cultures (Harding 2015), but in fact it has a significant history and practice of marginalizing ethnic minorities' perspectives and peoples (Benjamin 2019; Noble 2018; Webb 2019). The success of these programs at HSIs for Hispanics (Villa et al. 2019) indicates the importance of taking into account important values in Hispanic communities when developing strategies to advance their attainment in computing.

Our study suggests that CAHSI members enact Hispanic servingness (García, Núñez, and Sansone 2019) through exercising external boundary management and developing targeted programs in computing that are aligned with Hispanic values. The NASEM (2019) emphasizes that "intentionality" to serve students of color in the sciences is critical to ensure their success. Our research indicates that the application of values that are grounded in Hispanic communities can inform the actualization of intentionality in leadership, including the development of strategic and programmatic initiatives to serve and support Hispanic students in computing fields.

Now, Hispanics are too-often the target of resurgent nativism in the US, and are a racial/ethnic group experiencing among the most negative economic, health, and social consequences due to the global coronavirus pandemic (Krogstad and López 2020; US Bureau of Labor Statistics 2020). Hispanic college students face challenges with food and housing insecurity that will only intensify under these conditions (Duran and Núñez, 2020). One national survey of college students indicates that Hispanics are experiencing the most difficulty among all racial/ethnic groups in adjusting to new forms of online instruction during the pandemic, as they are the most likely to indicate that finding a quiet place to study is difficult and that they are very concerned about balancing family and work responsibilities while sustaining their studies (Means and Neisler 2020, 13).

It is more critical than ever that initiatives like CAHSI broaden opportunity structures for Hispanics. Examining HSIs' strategies to apply *confianza*, *respeto*, and *familismo* to increase Hispanic student success in computing can provide significant insights on how to align Hispanic communities' ways of knowing and experiencing the world with support to pursue computing fields. More research is needed about other aspects of Hispanic servingness (García, Núñez, and Sansone 2019) and "intentionality" (NASEM 2019) to raise Hispanic attainment in computing. In the coming years, our research about the CAHSI network will continue with site visits to conduct case studies of four member campuses in the northern, southern, and western regions of the US At these campuses, we will be able to examine more about how these values and other dimensions of Hispanic servingness are enacted in everyday activities at HSIs. This research will offer more insights about how to develop institutional mindsets and practices to develop Hispanic talent in computing.

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References

American Association of Community Colleges. 2020. *American Association of Community Colleges 2020 Fast Facts*. Washington, DC: American Association of Community Colleges. https://www.aacc.nche.edu/research-trends/fast-facts/

Barker, L. J., C. McDowell, and K. Kalahar. 2009. "Exploring Factors that Influence Computer Science Introductory Course Students to Persist in the Major." *ACM SIGCSE Bulletin* 41 (2): 282–286.

Benjamin, R. 2019. *Race After Technology: Abolitionist Tools for the New Jim Code*. New York, NY: Polity.

Bowen, G. A. 2006. "Grounded Theory and Sensitizing Concepts." *International Journal of Qualitative Methods* 5 (3): 12–23.
Bowen, W., M. Chingos, and M. McPherson. 2009. *Crossing the Finish Line: Completing College at America's Public Universities*. Princeton, NJ: Princeton University Press.
Buolamwini, J., and T. Gebru. 2018. "Gender Shades: Intersectional Accuracy Disparities in Commercial Gender Classification." *Proceedings of Machine Learning Research* 81: 1–15.
Carnevale, A., M. Van Der Werf, M. C. Quinn, J. Strohl, and D. Repnikov. 2018. *Our Separate and Unequal Public Colleges: How Public Colleges Reinforce White Racial Privilege and Marginalize Black and Latino students*. https://1gyhoq479ufd3yna29x7ubjn-wpengine.netdna-ssl.com/wp-content/uploads/SAUStates_FR.pdf.
Casillas-Martínez, L., and W. González-Espada. 2019. "Cybernetic Girls Can Be Pinky." In *Culturally Responsive Strategies for Reforming STEM Higher Education*, edited by K. M. Mack, K. Winter, and M. Soto, 33–51. Bingley: Emerald Publishing.
Casselman, B. 2016. "Shut Up About Harvard: A Focus on Elite Schools Ignores the Issues Most College Students Face." *FiveThirtyEight*, March 30. https://fivethirtyeight.com/features/shut-up-about-harvard/
Chang, E. 2018. *Brotopia: Breaking Up the Boys' Club of Silicon Valley*. New York, NY: Penguin Press.
Chapman, R. 2020. "Rendering the Invisible Visible." In *Diversifying STEM: Multidisciplinary Perspectives on Race and Gender*, edited by E. O. McGee, and W. H. Robinson, 36–52. New Brunswick, NJ: Rutgers University Press.
Charmaz, K. 2014. *Constructing Grounded Theory*. 2nd ed. Thousand Oaks, CA: Sage.
Charmaz, K. 2017. "Special Invited Paper: Continuities, Contradictions, and Critical Inquiry in Grounded Theory." *International Journal of Qualitative Methods* 16: 1–8.
Computing Alliance of Hispanic Serving Institutions. n.d. *About CAHSI*. https://cahsi.utep.edu/about/
Dowd, A., and E. Bensimon. 2015. *Engaging the "Race Question": Accountability and Equity in American Higher Education*. New York, NY: Teachers College Press.
Dunbar-Hester, C. 2019. "If 'Diversity' is the Answer, what is the Question? Understanding Diversity Advocacy in Voluntaristic Technology Projects." *DigitalSTS: A Field Guide for Science and Technology Studies*, edited by J. Vertesi and D. Ribes, 81–98. Princeton, NJ: Princeton University Press.
Duran, A., and A.-M. Núñez. 2020. "Food and Housing Insecurity for Latinx/a/o Students: Advancing an Intersectional Research Agenda." *Journal of Hispanic Higher Education*. https://journals.sagepub.com/doi/abs/10.1177/1538192720963579
Eisenhardt, K. M., and M. Graebner. 2007. "Theory Building from Cases: Opportunities and Challenges." *Academy of Management Journal* 50 (1): 25–32.
Emerson, R. M., R. I. Fretz, and L. L. Shaw. 2011. *Writing Ethnographic Fieldnotes*. Chicago, IL: University of Chicago Press.
Engberg, M., and G. C. Wolniak. 2013. "College Student Pathways to the STEM Disciplines." *Teachers College Record* 115 (1): 1–27.
Excelencia in Education. 2020. *Hispanic-serving Institutions (HSIs): 2018–19*. Washington, DC: Excelencia in Education. https://www.edexcelencia.org/Hispanic-Serving-Institutions-HSIs-2018-2019
Faye-Carter, D. F., J. E. R. Dueñas, and R. Mendoza. 2019. "Critical Examination of the Role of STEM in Propagating and Maintaining Race and Gender Disparities." *Higher Education: Handbook of Theory and Research* 34: 39–97.
Frank, J. 2013. "Mitigating Against Epistemic Injustice in Educational Research." *Educational Researcher* 42 (7): 363–370. doi:10.3102/0013189X12457812.
Fuller, B., Y. Kim, C. Galindo, S. Bathia, M. Bridges, G. J. Duncan, and I. García Valdivia. 2019. "Worsening School Segregation for Latino Children?" *Educational Researcher* 48 (7): 407–420. doi:10.3102/0013189X19860814.
Gall, M. D., J. P. Gall, and W. R. Borg. 2007. *Educational Research: An Introduction*. 8th ed. New York, NY: Pearson.
Gandara, P., and F. Contreras. 2010. *The Latino Education Crisis*. Cambridge, MA: Harvard University Press.

García, G. A. 2019. *Becoming Hispanic-Serving Institutions: Opportunities for Colleges and Universities*. Baltimore, MD: Johns Hopkins University Press.

García, G. A., A.-M. Núñez, and V. A. Sansone. 2019. "Toward a Multidimensional Conceptual Framework for Understanding 'Servingness' in Hispanic-Serving Institutions: A Synthesis of the Research." *Review of Educational Research* 89 (5): 745–784. doi:10.3102/0034654319864591.

Gates, A. Q., H. Thiry, and S. Hug. 2016. "Reflections: The Computing Alliance of Hispanic-Serving Institutions." *ACM Inroads* 7 (4): 69–73. doi:10.1145/3010823

Gómez, A., K. P. Cobian, and S. Hurtado. 2018. "Improving STEM Degree Attainment Rates: Lessons from Hispanic Serving Institutions." Annual Meeting of the American Educational Research Association (AERA), New York, NY.

Gonzales, L. D., and A.-M. Núñez. 2014. "Ranking Regimes and the Production of Knowledge in Academia: (Re)shaping Faculty Work?" *Education Policy Analysis Archives* 22 (31). doi:10.14507/epaa.v22n31.2014.

Hallmark, T., and M. Gasman. 2018. "MSIS Across the Globe: Laying the Foundation for Future Research." *Higher Education* 75 (2): 287–298. doi:10.1007/s10734-017-0139-8.

Harding, S. G. 2015. *Objectivity and Diversity: Another Logic of Scientific Research*. Chicago, IL: The University of Chicago Press.

Hispanic Association of Colleges and Universities. n.d. *About Hispanic-Serving Institutions (HSIs)*. https://www.hacuadvocates.net/abouthsis?0

Hurtado, S., and D. F. Carter. 1997. "Effects of College Transition and Perceptions of the Campus Racial Climate on Latino College Students' Sense of Belonging." *Sociology of Education* 70 (4): 324–345.

Hurtado, S., J. C. Han, V. B. Sáenz, L. L. Espinosa, N. L. Cabrera, and O. S. Cerna. 2007. "Predicting Transition and Adjustment to College: Biomedical and Behavioral Science Aspirants' and Minority Students' First Year of College." *Research in Higher Education* 48 (7): 841–887.

Hurtado, S., C. B. Newman, M. C. Tran, and M. J. Chang. 2010. "Improving the Rate of Success for Underrepresented Racial Minorities in STEM Fields: Insights from a National Project." *New Directions for Institutional Research* 2010 (148): 5–15.

Jones, S. R., V. Torres, and J. Arminio. 2014. *Negotiating the Complexities of Qualitative Research in Higher Education*. 2nd ed. New York, NY: Routledge.

Kezar, A. 2018. *How Colleges Change*. 2nd ed. New York, NY: Routledge.

Krogstad, J. M., and M. H. López. 2020. *Coronavirus Economic Downturn has hit Latinos Particularly Hard*. Washington, DC: Pew Research Center Hispanic Trends. https://www.pewresearch.org/hispanic/2020/08/04/coronavirus-economic-downturn-has-hit-latinos-especially-hard/

Lamont, M. 2009. *How Professors Think: Inside the Curious World of Academic Judgment*. Cambridge, MA: Harvard University Press.

Lincoln, Y., and E. Guba. 1985. *Naturalistic Inquiry*. Newbury Park, CA: Sage.

López, E. J., V. Basile, M. Landa-Posas, K. Ortega, and A. Ramírez. 2019. "Latinx Students' Sense of Familismo in Undergraduate Science and Engineering." *The Review of Higher Education* 43 (1): 85–111.

Mack, K. M., K. Winter, and M. Soto, eds. 2019. *Culturally Responsive Strategies for Reforming STEM Higher Education*. Bingley: Emerald Publishing.

Martínez, M., and E. Hernández. 2004. "Latinos at Community Colleges." *New Directions for Student Services* 105: 51–62.

Mayhew, M. J., A. N. Rockenbach, N. A. Bowman, T. A. Seifert, G. T. Wolniak, E. T. Pascarella, and P. T. Terenzini. 2016. *How College Affects Students Volume 3: 21st Century Evidence That Higher Education Works*. San Francisco, CA: Wiley.

Means, B., J. Neisler, and Langer Research Associates. 2020. *Suddenly Online: A National Survey of Undergraduates During the COVID-19 Pandemic*. Digital Promise. https://digitalpromise.org/wp-content/uploads/2020/07/ELE_CoBrand_DP_FINAL_3.pdf

Miles, M. B., A. M. Huberman, and J. Saldaña. 2020. *Qualitative Data Analysis: A Methods Sourcebook*. Thousand Oaks, CA: Sage.

Nahapetian, A., V. Huynh, O. Ruvalcaba, R. Alviso, and G. Melara. 2019. "Music as the Icebreaker for Learning to Code." In *Culturally Responsive Strategies for Reforming STEM Higher Education*, edited by K. M. Mack, K. Winter, and M. Soto, 217–228. Bingley: Emerald Publishing.

NASEM (National Academies of Sciences, Engineering, and Medicine). 2018. *Assessing and Responding to the Growth of Computer Science Enrollments*. Washington, DC: The National Academies Press. https://www.nap.edu/catalog/24926/assessing-and-responding-to-the-growth-of-computer-science-undergraduate-enrollments

NASEM (National Academies of Sciences, Engineering, and Medicine). 2019. *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce*. The National Academies Press. https://www.nap.edu/catalog/25257/minority-serving-institutions-americas-underutilized-resource-for-strengthening-the-stem

National Science Foundation. 2019. *Higher Education in Science and Engineering: Science and Engineering Indicators 2020* (National Science Board Report 2019-7). Alexandria, VA: National Science Foundation. https://ncses.nsf.gov/pubs/nsb20197/

Noble, S. U. 2018. *Algorithms of Oppression: How Search Engines Reinforce Racism*. New York, NY: New York University Press.

Núñez, A.-M. 2017. "Flipping the HSI Narrative: An HSI Positionality." *Association of Mexican American Educators Journal* 11: 276–295.

Núñez, A.-M., and A. J. Bowers. 2011. "Exploring What Leads High School Students to Enroll in Hispanic-Serving Institutions: A Multilevel Analysis." *American Educational Research Journal* 48 (6): 1286–1313.

Núñez, A.-M., G. Crisp, and D. Elizondo. 2016. "Mapping Hispanic-Serving Institutions: A Typology of Institutional Diversity." *Journal of Higher Education* 87: 55–83.

Núñez, A.-M., R. Hoover, K. Pickett, C. Stuart-Carruthers, and M. Vázquez. 2013. "Latinos in Higher Education and Hispanic-Serving Institutions: Creating Conditions for Success." *ASHE Higher Education Report* 39 (1): 1–132.

Núñez, A.-M., E. Murakami-Ramalho, and K. Cuero. 2010. "Pedagogy for Equity: Teaching in a Hispanic-Serving Institution." *Innovative Higher Education* 35 (3): 177–190.

Núñez, A., and V. A. Sansone. 2016. "Earning and Learning: Exploring the Meaning of Work in the Experiences of First-Generation Latino College Students." *The Review of Higher Education* 40 (1): 91–116. doi:10.1353/rhe.2016.0039.

Ong, M., C. Wright, L. Espinosa, and G. Orfield. 2011. "Inside the Double Bind: A Synthesis of Empirical Research on Undergraduate and Graduate Women of Color in Science, Technology, Engineering, and Mathematics." *Harvard Educational Review* 81 (2): 172–209.

Ovink, S. M., and B. D. Veazey. 2011. "More Than 'Getting us Through': A Case Study in Cultural Capital Enrichment of Underrepresented Minority Undergraduates." *Research in Higher Education* 52 (4): 370–394.

Poster, W. F. 2019. "Sound Bites, Sentiments, and Access: Digitizing Communicative Labor in the Ear of Global Outsourcing." In *DigitalSTS: A Field Guide for Science and Technology Studies*, edited by J. Vertesi and D. Ribes, 240–262. Princeton, NJ: Princeton University Press.

Rendón, L. I. 1994. "Validating Culturally Diverse Students: Toward a New Model of Learning and Student Development." *Innovative High Education* 19: 33–51.

Rodríguez Medina, L. R. 2019. "A Geopolitics of Bad English." *Tapuya: Latin American Science, Technology and Society* 2 (1): 1–7.

Sánchez, M. E. 2019. "Perceptions of Campus Climate and Experiences of Racial Microaggressions for Latinos at Hispanic-Serving Institutions." *Journal of Hispanic Higher Education* 18 (3): 240–253.

Sax, L. J., J. M. Blaney, K. J. Lehman, S. L. Rodríguez, K. L. George, and C. Zavala. 2018. "Sense of Belonging in Computing: The Role of Introductory Courses for Women and Underrepresented Minority Students." *Social Sciences* 7 (122): 1–23.

Stanton-Salazar, R. 2001. *Manufacturing Hope and Despair: The School and Kin Support Networks of U.S.-Mexican Youth*. New York: Teachers College Press.

Strauss, A., and J. Corbin. 1990. *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*. Thousand Oaks, CA: Sage.

US Bureau of Labor Statistics. 2020. "Commissioner's Statement on the Employment Situation." https://www.bls.gov/news.release/jec.nr0.html

US Census. 2019. *Quick Facts*. Washington, DC: U.S. Census. https://www.census.gov/quickfacts/fact/table/US#

Villa, E. Q., E. Hampton, and P.-L. Hsu. 2018. "Navigating Hurdles Into and Through Undergraduate Engineering and Computer Science Studies." In *(Under)Represented Latin@s in STEM: Increasing Participation Throughout the Education and the Workplace*, edited by T. T. Yuen, E. P. Bonner, and M. G. Arreguín-Anderson, 33–46. New York, NY: Peter Lang.

Villa, E. Q., S. Hug, H. Thiry, D. S. Knight, E. F. Hall, and A. Tirres. 2019. "Broadening Participation of Hispanics in Computing: The CAHSI INCLUDES Alliance." Paper presented at the Annual Collaborative Network for Engineering and Computing (CoNECD) at the American Society for Engineering Education, Washington, DC. https://www.asee.org/public/conferences/148/papers/24674/view

Waite, W. M., M. H. Jackson, A. Diwan, and P. M. Leonardi. 2004. "Student Culture vs. Group Work in Computer Science." SIGCSE '04: Proceedings of the 35th SIGCSE Technical Symposium on Computer Science Education, New York, NY, 12–16.

Webb, A. 2019. *The Big Nine: How the Tech Titans and Their Thinking Machines Could Warp Humanity*. New York, NY: PublicAffairs, Hachette Book Group.

Webb, A., R. Gonzales, and M. P. Trent. 2019. "A Journey of Discovery." In *Culturally Responsive Strategies for Reforming STEM Higher Education*, edited by K. M. Mack, K. Winter, and M. Soto, 153–167. Bingley: Emerald Publishing.

Yin, R. K. 2018. *Case Study Research and Applications: Designs and Methods*. 6th ed. Thousand Oaks, CA: Sage.

Zamani-Gallaher, E., H. T. Yeo, A. L. Vélez, H. L. Fox, and M. Samet. 2019. *STEM Completion at Hispanic-Serving Community Colleges*. Champaign, IL: University of Illinois at Urbana Champaign Office of Community College Research and Leadership.