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EXTERNAL EVALUATION OF CAHSI INCLUDES

Annual Report, 2019

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EXECUTIVE SUMMARY

In the first year of the CAHSI INCLUDES Alliance funding, CAHSI has made great strides in restructuring its organization and influencing a shift towards collective strategic action. The structure, which developed from reflection upon the success of the INCLUDES pilot, developed regional shared leadership in the form of leads and co-leads as well as staffed positions of "connector" and "coordinator." These staffed positions create the "glue" for CAHSI regions to operate, and evaluative evidence suggests connectors are gaining prominence within the social network, and that regional connectivity is dense, meaning multiple connections exist across network partners for the most part, and regional communication and collaboration is frequent.

Observation and document analysis suggest that the CAHSI INCLUDES network is aligning work with the "Collective Impact Principles of Practice," in this first year in the areas of equity focus, building trusting relationships, and attuning to local contexts are particularly evident. Equity is evident in much that CAHSI backbone staff say and do—in the documentation of CAHSI's values such as in the visioning documents, in the data points of interest for developing common measures, and in the way in which meetings commence among CAHSI members. Statements about CAHSI values are stated verbally in all onboarding meetings and are visible on all visioning documents. Participants are beginning to look at how they can contribute to Hispanic and female parity in their departments, for example, indicating data about student enrollment is an important element of moving the needle. Also, all onboarding meetings are run with facilitation from the backbone and explicit use of cooperative learning strategies to ensure all members are heard by their colleagues.

CAHSI builds on over a decade of common efforts through National Science Foundation funding. These relationships may be responsible for the high level of trust perceived within the network. The CAHSI INCLUDES core network (defined as leads, co-leads, backbone, connectors, and coordinators) has developed high levels of trust—the Social network analysis indicates individual connections among members have trust scores averaging 3.58 on a 4-point scale, with 86% overall trust within the network.

Onboarding events held in each region served to introduce new and continuing partners to the CAHSI mission and vision and were carried out with intention towards sharing and co-developing the common agenda relevant to the local contexts of the regions and sub-regions. The need to come together in an onboarding to develop shared understanding of the problem and the possible solutions combined with the charge to carry forward rapidly was a tension felt in the first year, as multiple onboardings across the nation in a 7-month period were difficult to coordinate. However, to date all regions and sub-regions have held onboardings with the communities they intended to engage, and strategic action trackers, a method for documenting planned actions, are underway across all 4 regions.

Observation of onboardings as well as formal and informal interviews indicate that thinking strategically about equity is a skill that takes time to develop—for some it involves reimagining teaching and critiquing the so-called meritocracy and hierarchy in academic settings. Focusing on one's assets, when H.S.I.s are operating with reduced financial and human resources, is a shift for some. Learning to make change with few resources is an area for growth across regional participants, yet strides have been made in this area. To date, 100% of CAHSI participants who have participated in 5 or more CAHSI events indicate they are beginning to think strategically about how to improve the proportion of computing credentials earned by Hispanics by 2030.

The problem-solving course dissemination in the past 2 years builds a strong case for the ability of the CAHSI network to mobilize quickly to disseminate a new practice. The deep and visible participation of industry partner Google may have played a role in motivating and accelerating new adopters. Regular videoconference communication among instructors, availability of curricular materials from multiple sources (e.g., Google, instructors who piloted the courses), and related grant initiatives occurring locally may also have been factors in the speed of the "roll-out." While work remains to codify the courses and boost enrollment across adopting institutions, the approach utilized to share the problem solving course across CAHSI could be a model for disseminating new practices.

Onboardings provided an opportunity to reflect on the local conditions of computing and create an impetus for data collection and analysis to better drive decision making. Local contexts vary across CAHSI membership—for some with 80-100% enrollment by Hispanics in computing departments, enrollment and retention numbers are more important than parity (i.e., representation equal to the demographics of the institution). In this way, investigating the current state of affairs is becoming more important for tailoring strategies towards known problem areas. The rhetoric regarding data-driven decision making and common measures of success is beginning to permeate at the participant level—82% of collective impact survey participants stated they used data for decision-making at least "to a slight extent." The evaluators have had multiple requests this year to provide technical assistance for evaluation in smaller aspects of programming (e.g., outreach, PLTL, one-day events), which indicates an interest in data collection and measurement. As the data management team begins to analyze institution-level data, we anticipate greater opportunity for data use within CAHSI.

Recommendations
Encourage and solidify communities of practice and develop leadership around practices

The CAHSI Backbone has made substantial strides in the past year in guiding and connecting members within regions. Regional connections and visioning are strong, yet stakeholders commented in interviews that they would like stronger relationships across regions to share ideas, practices, and resources. Likewise, many CAHSI faculty and partners have been highly engaged in several strategic actions, including problem-solving courses and student chapters and clubs, yet the uptake of other signature practices, including Fellow-Net and, to a lesser extent, the ARG model, has not been as widespread. In addition, levels of engagement with CAHSI vary by members' length of involvement with the CAHSI community. Both veterans and newcomers are highly engaged, though in different ways. CAHSI veterans carry the torch of expertise in existing signature practices and communicate CAHSI's vision and strengths to national audiences, while newcomers have brought new energy, fresh ideas, and novel strategies and practices to the network. However, mid-level veterans (3-9 years) were less engaged in the network as measured by their attendance at events and participation in strategic actions. As CAHSI expands, it will be important to maintain focus on connectivity among members, establishing communities of practice around key practices, and codifying materials and resources related to all of its signature practices to facilitate training and implementation of core practices. One way to achieve the multi-faceted goal of increased cross-pollination of emerging practices and ideas, and enhanced uptake of existing signature practices is by **encouraging and solidifying communities of practice around core signature practices as well as emerging practices and areas of interest (e.g. policy)**. Identifying a team of leaders to champion and engage the network in specific, key practices (e.g., PLTL; emerging K-12 or workforce development/career readiness practices; policy work as conducted by Kean University) would contribute to stronger connections across regions and allow members to converge around a practice that transcends singular regions. The identification of a team of CAHSI Champions to lead communities of practice around certain initiative may also revitalize the "forgotten middle" of CAHSI members (3-9 years of involvement) who may be uncertain about their role and/or leadership in the transition to a collective impact framework. These leaders, or maestr@s, could codify and disseminate materials and trainings in core practices, increasing the uptake of strategic actions across regions, and reducing the burden on the CAHSI Backbone to provide training and support for every strategic action. The CAHSI Backbone has been careful and thorough in onboarding and guiding veterans and new members, and it will be important to continue that deliberate, thorough process with faculty leaders (or maestr@s), perhaps through an application and selection process or some other formal mechanism to signify dedication and commitment to the leadership role.

Expand coaching efforts for regional leadership and connectors

The CAHSI Backbone provided tremendous support at the regional and individual level to incoming coordinators, connectors and other members. The onboarding process has been thoughtful and ongoing. In interviews, stakeholders, especially coordinators, connectors, leads,

and co-leads, expressed an interest in continued and expanded coaching in key areas. For instance, the onboarding process has spurred the development of regional strategic plans and stakeholders have begun to think strategically about their activities, goals, and strengths. Still, the quality and depth of strategic plans varies by region, suggesting *a need for ongoing and regular coaching in the strategic planning process, among other areas.* Such coaching could be facilitated in an ongoing and scheduled manner with accountability steps along the way. *In surveys and interviews, stakeholders also expressed some uncertainty about establishing industry partnerships, securing funding, managing regional dynamics, cultivating equitable and inclusive climates, and managing growth within the region.* These are all potential areas in which the Backbone could provide specific individual or regional coaching for leadership and other key stakeholders.

Systematize data collection and dissemination strategies

The staffing of the data management team and presentation of data at regional onboarding meetings has begun to shift members' thinking about data possibilities and uses. Individual members and regions at large have begun to make some inroads in data use but are not yet systematically using data to identify areas of need or to track their progress towards CAHSI's vision. It will be important in the coming year to *finalize common measures and systematize a process of data collection and communication with stakeholders* so that CAHSI members are aware of the expectations around data and can begin to embed data into their strategic planning processes. With staff in place, the data management team made progress in this area at the Southwest onboarding with the presentation of institutional and regional data and the resulting discussion around the representation of Latinas in computing departments. The Backbone should consider how to systematize common data processes and dissemination for the regions and individual institutions.

Coach faculty working in isolation

Establishing regions and onboarding processes has helped to strengthen ties within regions, yet the greatest barrier cited by members was the isolation of some faculty members within their own departments. Local institutions vary in their buy-in to CAHSI's vision and some participants do not have local power to make systematic changes. The Backbone can consider how to *coach isolated faculty to help them to be more effective when they have less local peer faculty and/or administrative support and provide multiple ways for them to connect with the network (e.g, Communities of practice).* It will also be important to consider how to more directly involve chairs and leadership at all institutions as local leadership in a few institutions has shown varied commitment to CAHSI's vision, all the way from strong support from college presidents at some institutions to a lack of involvement from local chairs at other institutions.

Draw on the expertise of UTEP CS faculty in the Southwest region

CAHSI leadership has always been situated at UTEP yet as CAHSI has moved to the collective impact framework, UTEP has transitioned from a CAHSI member to the Backbone organization.

UTEP is a vital resource and example of promising practices, both curricular, co-curricular, and systemic. CAHSI may consider whether it is worthwhile to engage more faculty members within the CS department at UTEP in CAHSI to serve as mentors, role models, and peers of faculty within the Southwest region. With new institutions and faculty joining CAHSI in the region, newcomers could benefit from peer faculty who are not a part of the Backbone that can share expertise and engage more actively and directly with the Southwest region faculty.

Varied forms of communication and dissemination of information

The Backbone has facilitated communication processes and promoted regional dialogue in many ways. In interviews, stakeholders expressed interest in *expanding the repertoire of communication mechanisms across the network overall*. For instance, there was strong interest in a CAHSI-wide newsletter that would highlight opportunities, deadlines, and share regional highlights or successes. Stakeholders also requested a shared calendar that would include deadlines as well as events (e.g. deadline for student applications, etc.) and would be shared across the network. Finally, some stakeholders had difficulty in accessing and sharing documents in the IBM Cloud, suggesting that more training may be needed or consideration of another tool that will generate greater engagement.

INTRODUCTION

The Inclusion Across the Nation of Communities of Learners (INCLUDES) initiative is one of the National Science Foundation's Ten Big Ideas with the goal of dramatically broadening participation in STEM fields by creating networked relationships among organizations and across sectors. The Computing Alliance of Hispanic-Serving Institution (CAHSI) INCLUDES community builds upon the success of CAHSI in the past decade in developing the organizational capacity and partnerships to promote the recruitment, retention, and advancement of Hispanics in computing. CAHSI INCLUDES uses the collective impact framework to bring together stakeholders across sectors to tackle the problem of the underrepresentation of Hispanics in computing.

This mixed-methods evaluation study contains formative, summative, and needs assessment elements. The evaluation goals are to provide information and feedback to help CAHSI INCLUDES in understanding the reach, capacity, connections, and strategic actions in its collective impact efforts. The evaluation data collected for this report includes participant observation at CAHSI INCLUDES events and meetings, stakeholder interviews, website and document analysis, social network and collective impact surveys of CAHSI members and affiliates, and case study data of particular initiatives. The evaluation questions addressed in this report are:

1) How has the CAHSI INCLUDES community developed the capacity, connections, and expertise to be able to work collectively across regions to achieve a common vision?

2) How has CAHSI utilized the collective impact model and it's principles of effective practice to facilitate change?

3) In what ways does capacity and strategic planning differ by region and by the length of involvement of members in the CAHSI community?

4) To what extent has communication and trust developed across the network to facilitate strategic planning and action?

5) In what ways has the Backbone functioned to support the growth and development of the CAHSI INCLUDES network in relation to the five elements of collective impact?

Rather than focusing on individual institutional results within regions, this report focuses on the work of the national CAHSI INCLUDES community in solidifying its vision and partnerships and advancing common goals. To this end, the evaluation focuses on the connections within the CAHSI network; the commitment, values, and organizational capacity of network members and

affiliates; and the strategic actions undertaken within the network. The evaluation focuses exclusively on capacity and activities of the regional and national network overall to implement strategic action and does not address individual or institutional outcomes related to achieving CAHSI's vision. The CAHSI data management team will be responsible for tracking each institution's progress towards reaching CAHSI's vision and monitoring national benchmarks related to enrollment, graduation, and other metrics of Hispanic representation in computing. In turn, the external evaluation will focus on the health, growth, and capacity of the network overall. This report is framed within the five elements of collective impact to provide insight into the development of the CAHSI community as related to the five critical areas of collective impact work.

COMMON AGENDA: CAHSI'S VISION AND MISSION

In the INCLUDES pilot project, CAHSI made great progress in democratically and deliberatively developing vision and mission statements. In the past year, the focus has centered on introducing new institutions and members to the vision, mission, and goals of the community. CAHSI INCLUDES held onboarding meetings for each region to introduce new members to the vision and work of the CAHSI community and to engage regions in strategic planning about how they can best utilize their strengths, resources, and time to make progress towards achieving CAHSI's vision. One of the goals of the evaluation this year was to better understand how members view the common agenda and the progress they have made in thinking strategically about working toward the common goals.

Common Agenda: One of the principles of collective impact. It is a vision for change shared by all participants that includes a common understanding of the problem and a joint approach to solving the problem through agreed-upon actions.

The development of a common agenda occurred during the pilot INCLUDES and continues as regions develop their strategic actions that relate to CAHSI's vision- ***By 2030, Hispanics will represent 20% or more of those who earn credentials in computing.*** Data for the evaluation of CAHSI INCLUDES' development of a common agenda is reported from a variety of sources, specifically the social network analysis, participant observation of onboarding meetings, interviews with CAHSI stakeholders, and the CAHSI-wide collective impact survey.

Social Network Analysis: A Common Agenda

As CAHSI moved from a collaborative, programmatic model to a collective impact model, it was important to understand how staff and other stakeholders view the shift in approach. Understanding of collective impact and how the approach could improve CAHSI's outcomes is necessary before setting a common agenda, as the approach is related to the means. SNA survey

respondents were most likely to see potential benefits of the collective impact approach in improved resource sharing (17 of 20), improved sense of belonging and community (17 of 20), improved recruitment of new partners (16 of 20), and increased awareness of computing careers (16 of 20). The top four mirror participants' responses regarding the **most important** benefit.

Table 1. SNA Survey Results: Benefits of Collective Impact

Benefits of shifting to the collective impact approach for CAHSI INCLUDES could be (or could potentially include): (choose all that apply).	# of responses
Improved resource sharing across CAHSI INCLUDES members and partners	17
Increased sense of belonging/community among those who influence Hispanics in computing	17
Improved recruitment of new partners at the LOCAL/REGIONAL level	16
Increased local/regional awareness of computing as a viable career option	16
Improved community support ACROSS sectors (education, non-profit, industry)	14
Improved decision making at the local/regional level	14
Improved communication among computer science stakeholders	13
Increased ability to measure change in the computing workforce	13
Increased sense of urgency to make change	13
Improved sense of LOCAL/REGIONAL ownership for CAHSI initiatives	12
Increased opportunities to lead CAHSI INCLUDES efforts	10

As CAHSI INCLUDES participants build their networks and develop strategic plans for moving the needle in computing, it is vital to gather resources (network, human, and financial). SNA respondents listed the contributions they bring to CAHSI. The average number of listed contributions was 10.3 out of a possible 16, indicating great diversity in participants' abilities to contribute as well as multiple stakeholders attacking each needed task. The least-selected contributions are connections to national industry and time for training others, as well as "outsider perspective-taking." See table below.

Table 2. SNA Survey Results: Individuals' Contributions to CAHSI

Contributions to CAHSI	# of responses
My administration/coordination of CAHSI events and activities	19
My advocacy for Hispanics in Computing	18
My LOCAL/REGIONAL connections to academic institution	17
My facilitation/leadership skills	16
My time for recruiting underrepresented students to participate in CAHSI events (e.g., HENAAC)	16
My advocacy for CAHSI students to earn research opportunities	15
My LOCAL/REGIONAL connections to industry	14
My time for mentoring students	13
My time for implementing initiatives (e.g., ARG, PLTL, problem solving, one day events)	13
My specific knowledge/expertise regarding educational practice in an HSI setting	12

My time to organize student activities/opportunities	12
My scientific/technical knowledge or expertise	11
My time to review student work	10
My feedback regarding CAHSI INCLUDES practices from an outsider perspective	8
My time for training others in initiatives (e.g., ARG, PLTL, problem solving, one day events)	7
My NATIONAL connections to industry	5

Working strategically to "move the needle"- operationalizing the common agenda through regional work

As CAHSI becomes more adept at Collective Impact as a method of operating in each region, the teams are beginning to develop the principle practices used to describe effective collective impact initiatives, specifically working towards *systemic efforts.* The table below indicates at least one action that each region is taking up to solve a specific problem they face in reaching CAHSI's vision.

Table 3. Participant Observation and Document Analysis: Strategic Actions

Regionally defined problem	Action	Stakeholders involved	Focus areas selected from list generated by CAHSI backbone	Sample tasks documented by evaluation
Depending on their school and major at the CC, transfer students are differentially prepared for 4 year CS.	Developing sustainable, successful 2+2 pathways for local community college students to earn 4 year degrees at CAHSI lead institutions	Connector, Coordinator, Lead, co-lead	Capacity building, continuous improvement	Connector and coordinator examine demographic data related to community college enrollment; look at success rates for students and target outreach to highly Hispanic CCs
CS department faculty lack the data they need to make decisions about where to increase student support	Understanding system-wide data tools that provide fine-grained data about student recruitment, retention, and course success.	Co-lead, coordinator, and connector	Capacity building, continuous improvement	Three regional members meet regularly outside of monthly regional meetings "workshopping" the data they can access through the system. As they understand the data in more depth, they will share what they learn with the larger group.

Student conference opportunities are costly, yet valuable for students.	Development of a discretionary fund for supporting student conference attendance housed in the CS department	Lead, coordinator, connector	Mobilized funding, capacity building	Institutional lead is communicating with other offices on campus to understand relevant funding mechanisms
For many in the sub-region, recruitment into the department is needed, as numbers are declining.	Coordination of outreach materials and best practices for recruiting student participants	Lead, connector, coordinator, faculty, student success staff	Awareness building, capacity building, identity building	Evaluator shared materials, survey instruments, and delivered a short webinar on best practices in outreach
Courses are serving as gate-keepers for students in lower-level computer science	Improvement of student experiences in gate keeper courses in computer science through CAHSI signature practice (PLTL)	Coordinator, lead, co-leads, connectors	Capacity building, continuous improvement,	Coordination of sub-regional PLTL trainings (two held 10 hours' drive apart to support the majority of the region).

Embodying Collective Impact- How CAHSI Operationalizes the Principles of Practice

The onboarding meetings that occurred across the country during the first year of the Alliance grant were designed to set the tone for CAHSI's work using Collective Impact. The evaluators attended each of the onboarding meetings. In this section, we describe how the onboardings incorporated the principles of practice that Collective Impact intends.

Principle 1: Design and Implement the initiative with a priority placed on equity

Given CAHSI's mission, it is clear that equity is at the forefront of the initiative. The onboardings supported equity in multiple ways:

a) A deliberate values statement was voiced at the beginning of onboarding meetings by the director or deputy director of CAHSI. It states: "We believe inclusiveness must accompany diversity."

b) Onboardings place individuals in leadership roles and use cooperative learning strategies to manage turn taking and talk. Roles are assigned to group members, who are monitored by backbone facilitators to ensure all participants have a chance to speak.

c) Language is challenged when negative assumptions are made about students: for example, "our undergraduates aren't capable of good research," would be met with the statement "It takes a lot of work, but we have found that undergraduates can do well in research if they have support and training."

d) As in past years with CAHSI, data are gathered related to parity of computing departments to see if the demographics of the department match the demographics of the institution. While in past iterations of CAHSI, this was reported annually in the aggregate, the focus on data driven decision making creates an opportunity for departmental stakeholders to look at their own data and make decisions on strategies to combat inequity in enrollment and advancement.

Principle 2: Include Community Members in the Collaborative

CAHSI is branching out to involve new types of members. CAHSI began as a collective of department chairs—it has since engaged faculty, staff, instructors, and community college staff and faculty. In this iteration, there is an understanding that staff is needed to further the aims of the collective. Connectors and Coordinators attend onboardings as well. The settings of meetings have shifted to intentionally include differing partners more fully (e.g., the advisory board meeting was held at new partner SFSU's campus). While at present CAHSI is involving students locally and through recognition events, there has not yet been full integration of students themselves into the collective impact work. HENAAC would be a prime opportunity to engage students in the work of collective impact.

Principle 3: Recruit and co-create with cross-sector partners

Some of the deepest collaborations thus far with cross-sector partnerships has been with Google. In 2017, Google staff described a need for general problem solving skills, as well as interviewing skills in computer science, which is carried out in a "think aloud" where interviewees draw their thoughts out on white boards as they approach a problem provided by an interviewer. The director of CAHSI brought together a small team of instructors and CAHSI leads to develop coursework that would take an active learning approach to the subject of problem solving and would introduce students to standard processes for solving problems systematically. Google hosted the training for the course and provided feedback, shared problems for practice, and committed to visiting each course virtually or in person to provide feedback on problem solving, describe how they solve problems at Google, or present a problem to the group for discussion. This collaborative effort has been a sustained, deep collaboration across partners.

Principle 4: Use data to continuously learn, adapt, and improve

As onboardings were for some regions the first opportunities for stakeholders to develop collective strategic actions, participants were asked to consider how they would measure their success. The forms that each region update regularly have the columns entitled "expected results" and "success indicators" listed next to each strategic action. During onboarding meetings, participants would ask evaluators on site about data sources, data instruments, and analysis techniques they could use to examine their continuing or new practices to make sure they were making a difference regarding Hispanic advancement in the field of computing. As the data management team utilizes climate data from students and departmental graduation rates by demographic variables such as gender and ethnicity, stakeholders will have multiple data sources to help them make meaning of the relative success or value of their efforts.

Principle 5: Cultivate leaders with unique systems leadership skills

Backbone staff engaged the regional leadership in the planning of onboarding meetings, and encouraged regional leadership to make opportunities to lead discussions about priorities, local contexts, and local partners of interest. While the backbone staff, evaluators, and/or data management team staff led much of the content of the onboarding meetings, regional leadership were offered opportunities to coach and guide the discussion alongside the backbone staff. The structure of CAHSI creates a position for the "connector" which encourages staff to spend time getting to know the regional players, including partner institutions, non-profits, and industry— this support staff position is designed to take on some of the systemic leadership tasks and abilities needed to develop a well-functioning regional network. Connectors were coached and supported through the backbone, before during and following the onboarding meetings.

Principle 6: Focus on Program and System Strategies

At a recent onboarding, the problem of mathematics under-preparedness was raised as an issue for action. During the dialog, multiple strategies were suggested that ranged from programmatic in nature to policy-oriented: a) creating a summer math intensive course that students could take that would cover 2 semesters of prerequisite math prior to their freshmen year, b) reconsidering the mathematics needed in the major as it related to the needs of the computer science discipline and thinking about how far into calculus students needed to go to be proficient in CS, and c) discover if alternative pathways such as BA degrees which had less stringent math requirements were viable departmental options. Sharing perspectives from multiple community college and four-year faculty shifted participants thinking about how to combat the problem of math under-preparedness.

Principle 7: Build a culture that builds relationships, trust, and respect across participants

CAHSI spent intentional time in each on-boarding getting to know the participants who attend the meetings. Small group work that is facilitated by CAHSI backbone staff occurs throughout the onboarding, and participants are encouraged to eat dinner together when possible to build relationships. As groups work together to define common problems, they share their strengths and weaknesses in "asset mapping" activities. Members are asked to participate for a full year before officially joining CAHSI—in this way institutions have time to build relationships and show commitment to the effort, building mutual trust.

Principle 8: Customize for local context

Onboarding meetings created an opportunity for members to define for themselves the methods by which they will address underrepresentation in computing in their area, within their means based on their roles and responsibilities. For example, for highly Hispanic regions with low overall enrollment, increasing numbers of students through recruitment and career awareness has become a focus area. For another region, "time to degree" has become a system-wide initiative that influences most departments engaged in CAHSI, and so cohort models that build student community and support are programmatic interventions some institutions are working on.

CAHSI has developed a practice of describing the organization's values explicitly in documentation and in all in-person meetings. This becomes part of the messaging related to CAHSI in internal and external communication, and is the foundation of the vision. Shared values are difficult to manage across growing collaborations. Staff discussed some of the issues in ensuring partners share the values of CAHSI.

> *"I learned at (onboarding meeting) that a lot of faculty see underrepresentation as a student problem. Deficit thinking. It is the students who are underprepared. That became apparent to me …. I think the biggest challenge is guiding conversations about climate in a more thoughtful way."*

> *"I think all our (active) contacts themselves are minorities. I don't think any of them are white, and so I think they just get it. They lived it, they understand it. And they are all at colleges or universities that are HSI. So they may see their students, they see the need. …those are the people we want onboard. So the other ones that we've had, (other institutional contacts), I think to an extent they kind of understand it, but I don't know how willing they are to really step up and say, 'Okay, what can I do? Here I am.' … To me the biggest thing has just been finding the right people who are totally on board."*

> *"With our close partners in the Central Valley, I think they really grasp the problem because from what I gather, they've been working with (stakeholders) for quite some years on different CAHSI projects. I think you really understand that and especially because in the central valley area, we have a lot of Hispanic, Latino individuals. So they engage with these people on a regular basis. A lot of them are there for some students 'one on one.' I think I'm fairly confident that they have the vision."*

Creating industry partnerships in which there are shared values and motivations for recruiting and retaining Hispanic technical workers is important to CAHSI INCLUDES stakeholders, as is ensuring the industry partners share CAHSI's value of promoting diversity alongside inclusive technical workforce climates. A staff member described how the lack of shared values may lead to negative outcomes for Hispanic professionals in computing as well as for industry, and described how CAHSI can connect to industry more deeply to ensure success.

> *"So from what I see overall, from like an industry perspective, they need diversity in their workplace. That's just overall a big issue that they have. … We can prepare students to get into industry, so does the support continue afterwards? Because I feel this population is very special, and the approach is very different from how you may approach another population. So if, let's say, Hispanic students enter a company and it's not as diverse, do they have the tools that they need to move forward and stay, or are they gonna leave because of that? So industry, they have, obviously, their HR team, who is recruiting, but CAHSI also needs to work with the diversity group."*

Collective Impact Survey: Advancing the Common Agenda

The results of the collective impact survey demonstrate that the CAHSI INCLUDES community made progress in putting CAHSI's mission and vision into action. Most CAHSI survey respondents reported that they had developed and designed strategic plans and actions during the past year. This relatively high response may have been because of the strategic planning that CAHSI members engaged in during the regional onboarding meetings. For instance, 100% of attendees of the regional onboardings had developed strategic plans "to some extent" or "to a great extent," while members who did not attend onboardings were less likely to have engaged in strategic planning and actions. This may also indicate, though, that onboarding meetings were productive forums for beginning the process of strategic planning, but strategic planning may not have been carried forward at full capacity within the region after the onboarding meetings. Participants' responses also indicate that they spent more time on developing, rather than implementing, strategic actions which is to be expected at this point in the collective impact effort with many new members and institutions joining the community. CAHSI participants made some progress in identifying and managing regional partners but only a small minority of members did so to a "great extent." About half of CAHSI members actively worked on grant proposals to further their regional efforts, although fewer sought out prospective organizations that could fund regional or local efforts.

Figure 1. CAHSI Members' Advancement of Common Agenda
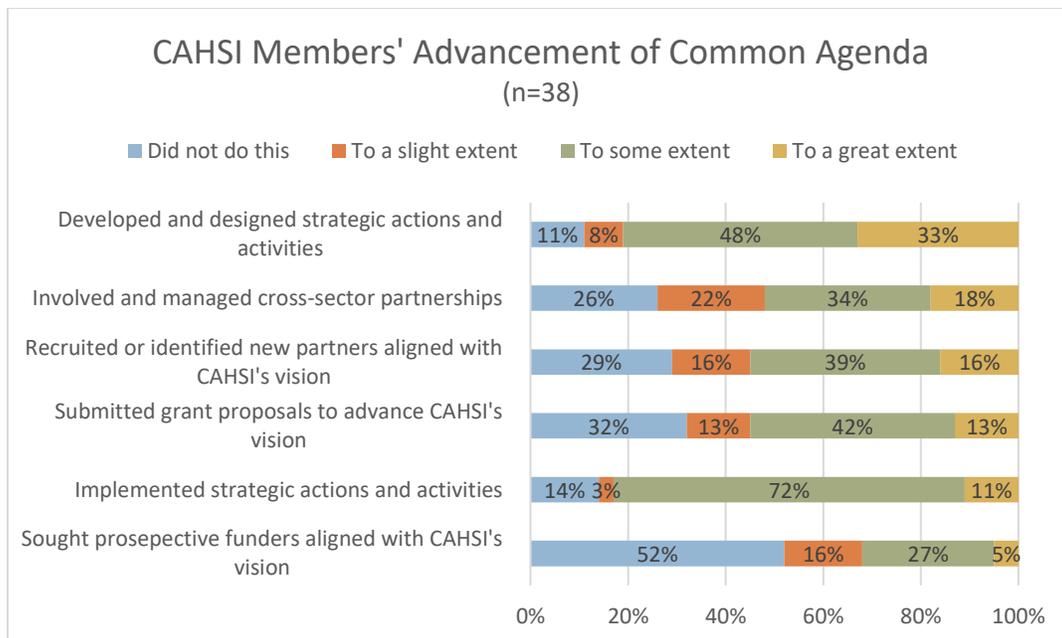
There was some variation in regional implementation of the CAHSI common agenda, although regional variation can be hard to discern because of lower numbers of participants generally and/or response rates in some regions. Still, about half of respondents from each of

the four regions were newcomers to CAHSI so each region was represented by a mix of newcomers and veteran members. Nevertheless, the Southeast and North had taken more steps to seek partners and to develop strategic actions than other regions. There was little variability by region in the development or implementation of strategic actions. On the other hand, there was greater variation in initiating partnerships or funding streams where some regions seem to have made a stronger collective effort in these areas while others are beginning to make progress in these areas.

Figure 2. Advancement of CAHSI's Vision, by Region
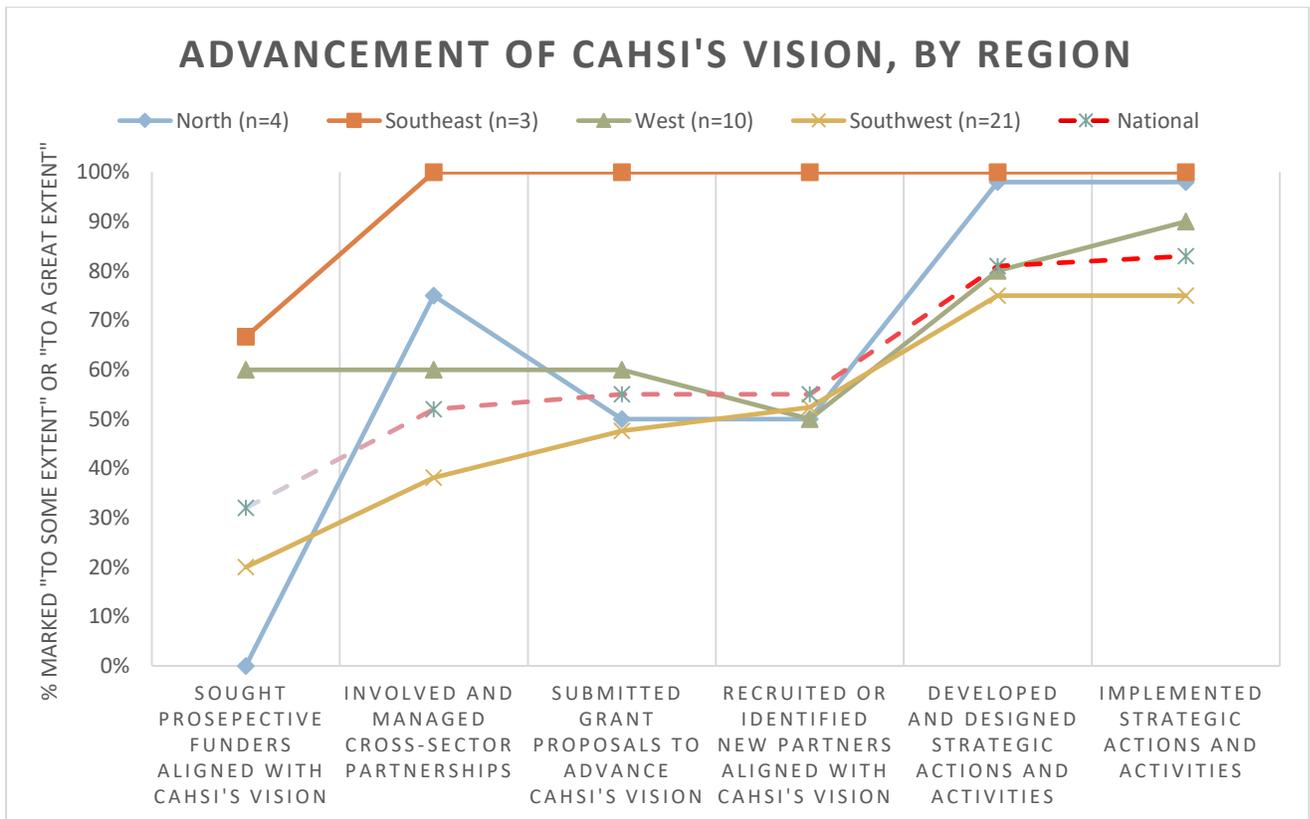
Because there was almost an even mix of newcomer and veteran survey respondents from each region, it is important to look at differences in carrying out CAHSI's vision by members' length of affiliation with CAHSI. Not surprisingly, those with more than 10 years of involvement in CAHSI had consistently taken the most steps to advance CAHSI's vision, including seeking funders and partners. All 10-year veterans had also actively engaged in developing and implementing strategic actions. Somewhat unexpectedly, CAHSI participants who had been involved with CAHSI for 3-9 years were least likely to take active steps to advance the common agenda through partnerships or other means. Newcomers were moderately engaged in advancing CAHSI's vision with those with a slightly longer involvement (1-2 years) demonstrating more active engagement than those who have been involved with CAHSI for less than a year.

Figure 3. Advancement of CAHSI's Vision, by Length of Affiliation

ADVANCEMENT OF CAHSI'S VISION,
BY LENGTH OF AFFILIATION
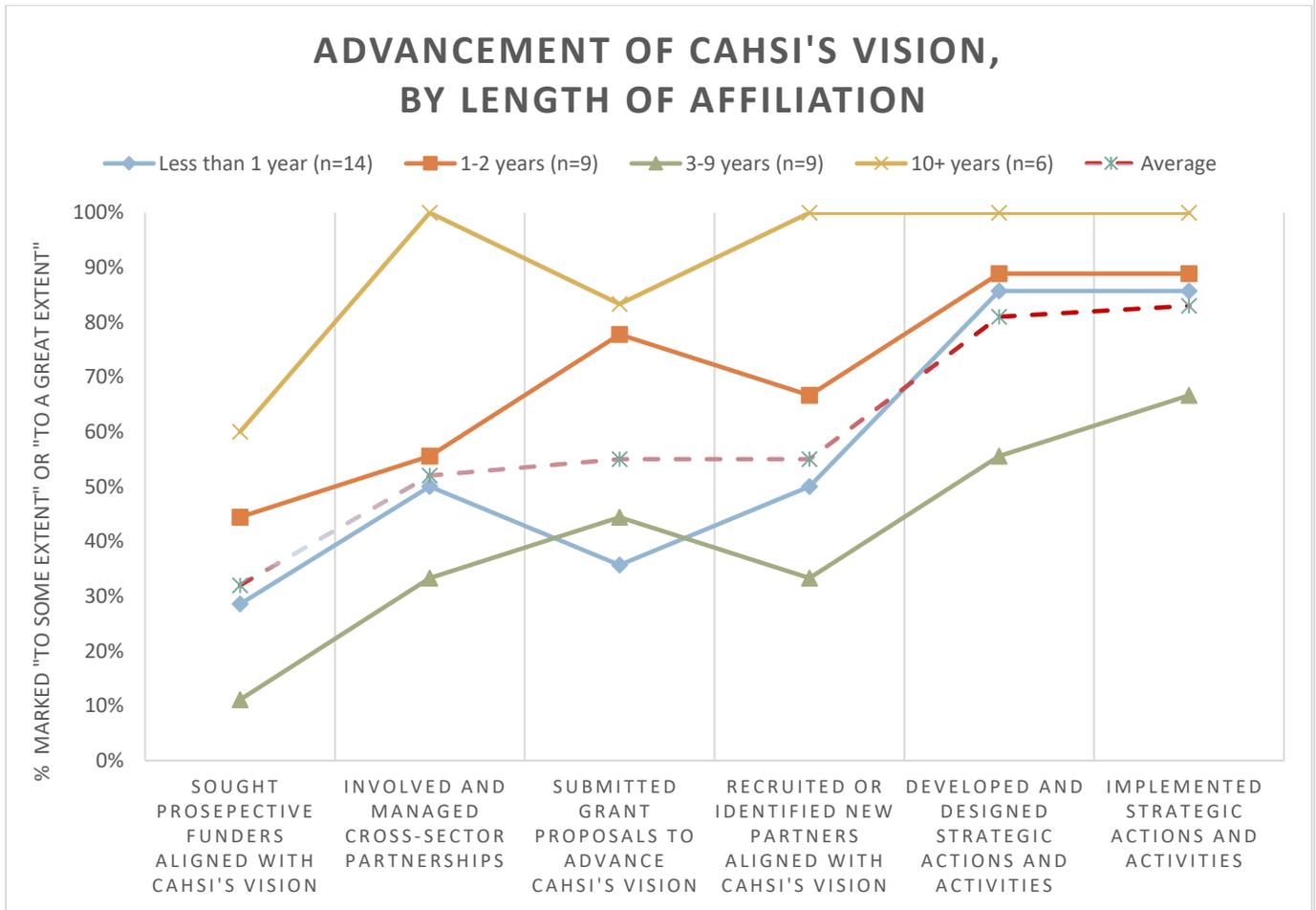
CAHSI has held a number of meetings, workshop, and events in the past year and it is also important to consider what influence CAHSI members' level of engagement with the network through these events may have on their advancement of CAHSI's vision. As described previously, participants who attended onboarding trainings were more likely to have engaged in strategic planning. While it might be expected that veterans had had higher levels of engagement than newcomers, there was a connection yet there were certainly some members who did not fit the pattern (e.g., highly engaged newcomers and veterans who only attended one or two events). There were no veterans of 5+ years who did not attend a single event in the past year so levels of engagement remain high with longstanding members. Still, for the most part, the more CAHSI events that members attended, the more likely they were to seek funding and partners and to engage in strategic actions to promote CAHSI's vision.

ADVANCEMENT OF CAHSI'S VISION,
BY ENGAGEMENT WITH NETWORK

CAHSI participants showed a relatively sophisticated understanding of the vision, or common agenda, of the CAHSI INCLUDES network. In an open-ended question, many respondents described the focus on advancing Hispanics in computing fields and/or the focus on supporting student success. There was a strong emphasis on the goal of national change in the representation of Hispanics in computing. A quarter of members commented on the necessity of a network, partnerships, and collective action to achieve such an ambitious goal. Fewer responses focused on the fact that CAHSI is comprised of Hispanic-serving institutions, rather than simply Hispanic students. HSIs play a unique role in the national higher education ecosystem and there are certain strengths and challenges related to the HSI context. It will be important for CAHSI to maintain a focus on the institutional aspect of HSIs as the network continues to grow and expand to new institutions and cross-sector partners. Finally, a few respondents noted CAHSI's focus on equity for underserved students and its emphasis on inclusive cultural change.

Figure 5. CAHSI's Vision and Mission: Response to Open-Ended Question

CAHSI's Vision and Mission:
Responses to open-ended question (n=33)

Category	Percentage
Diversity/Hispanics in computing	38%
Support students	31%
National change in numbers	28%
Create network	25%
Focus on HSIs	16%
Equity/cultural change	9%
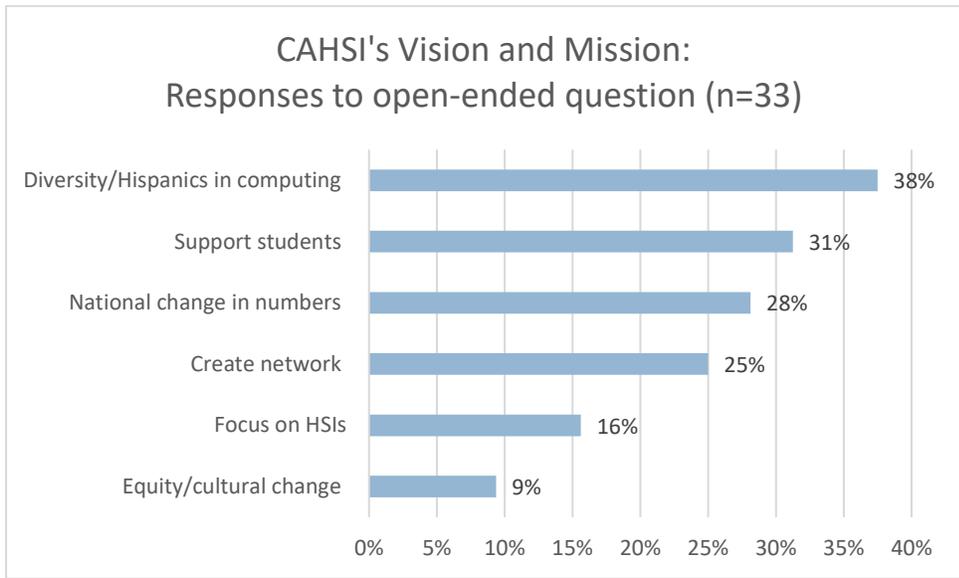
The following are some examples of participants' responses about CAHSI's vision.

Diversity/Hispanics in computing

Help Hispanic/Latino students to succeed in computing and STEM related disciplines. Create a pipeline to streamline their academic success transitioning from high school, to community college, to 4-year university, and to graduate school, and for a few of them, to succeeding in getting a Ph.D in computer science.

Support students

Strengthening the future Hispanic student in their knowledge of computing and to prepare them to achieve opportunities they never thought they could reach.

National change in numbers

To increase the number of Hispanics through effective education and preparation to enter professional careers in computer science at both the undergraduate and graduate degree levels.

Create network

I define it as a collective approach to improve and increase the quality and opportunities for the Hispanic community for professional development in the

computer sciences field where there should be a common agenda and a constant sharing of resources and information to empower and fortify each region.

Focus on HSIs

Connect the HSIs and help Hispanic students to achieve their goals.

Equity/cultural change

Increase the representation and success of Latinx students and professionals in computer science nationwide -- and this means changing how faculty think about first gen, URM students, creating pathways and research opportunities, providing resources and awareness of options.

Below is a word cloud comprised of CAHSI members' responses to the open-ended question that asked them articulate CAHSI's vision/common agenda in their own words.

Barriers to Achieving CAHSI's Vision

Lack of support from faculty peers was cited as the most common barrier to achieving CAHSI's vision in participants' responses to an open-ended survey question. As past evaluation evidence has shown, it is challenging for isolated faculty members to fully implement CAHSI's vision, especially in terms of equity, climate, or systemic change. Moreover, isolated faculty members are more likely to experience burnout or lack of motivation emanating from a lack of local support in their efforts to implement strategic actions. Other barriers were a lack of time and a lack of resources and funding, especially to support CAHSI signature practices. A few survey respondents cited a lack of administrative support for CAHSI's vision, but this was much less common than a lack of support from faculty peers. A few respondents also mentioned that it has been difficult to find other institutional partners for meaningful engagement around CAHSI's common agenda. A few respondents also noted that they don't attract high numbers of Hispanic

students in their department so recruiting and marketing are the biggest barriers. Sample responses about organizational barriers include:

> *Obtaining more meaningful partnerships with other 4-year institutions and community colleges*

> *My administration either not applying for grants, and not valuing what I am doing.*

> *Shortage of faculty who believe in CAHSI vision*

> *Faculty buy-in and departmental buy-in for CAHSI isn't as great as we had wanted. It seems that a lot of our faculty are stretched so thin that they don't have a lot of time to take on an additional role in CAHSI.*

> *Faculty overload due to very high undergrad student-faculty ratio in addition to high research and grad mentoring expectations.*

> *We have several barriers. The hardest to overcome is funding for signature practices such as PLTL.*

In conclusion, multiple measures indicate that the CAHSI backbone has made great strides in articulating its vision and mission and that these values have begun to be internalized among CAHSI members and participants. Participant observation and document analysis indicated the specific ways that members have internalized the vision and values of CAHSI and have enacted them in their local environments. Survey data also demonstrates that the onboardings were effective in communicating CAHSI's vision and that each region has begun to enact the vision.

MUTUALLY REINFORCING ACTIVITIES

Strategic actions, in the form of mutually reinforcing activities, are at the core of the work undertaken at the local and regional level. Mutually reinforcing activities must be guided by the common agenda with a clear link to how the strategic action will help to reach the vision and goals of the collective impact effort. CAHSI has undertaken mutually reinforcing activities for over a decade in the case of CAHSI signature practices. However, the expansion of the network and the shift in focus beyond undergraduate education provide opportunities to expand the repertoire of practices and activities that support progress toward the vision.

Mutually Reinforcing Activities: Engagement of a diverse set of stakeholders, typically across sectors, coordinating a set of differentiated activities through a mutually reinforcing plan of action.

Mutually Reinforcing Activities: Case Studies

This section profiles case studies of specific CAHSI activities, including problem-solving, PLTL training, and Google Tech Exchange. The section also includes findings from the graduate climate survey. Findings from a social network analysis are then presented. Following are results from the collective impact survey profiling the strategic actions undertaken by CAHSI regions along with regional priorities.

Problem solving course implementation

The problem-solving courses were developed in collaboration with Google and have been implemented as 1 and 2 credit courses across CAHSI institutions. Faculty indicate their experiences in teaching the courses highlight for them the holes in the current computer science curriculum, as well as the applicability of the course for all students across major types.

In measuring the impact of this course, the evaluator included student data from all problem solving course adopters who participated at least 3 times in problem solving meetings via Zoom, as a measure of "full adoption." The videoconference meetings were held as workshop sessions where faculty could discuss any issues they had with implementation, occasionally study a practice in more depth, and practice problem solving problems to consider features of the problem that might slow down problem solvers. Data were gathered in the fall and spring semesters of the 2018-19 school year. In all, 150 surveys were collected and are analyzed below. Survey respondents represent 7 schools. Nearly 60% of the students surveyed were Hispanic, and approximately 18% were underrepresented by ethnicity/race other than Hispanic/LatinX (16% African American, 1.5%Native American, <1% Pacific Islander). Twenty two percent of respondents indicated they were female.

In this self-report survey, students were asked to describe how the course influenced their problem solving capabilities. In an effort to make the survey results relevant for departmental use, the evaluator categorized the items by ABET criterion. The abilities covered in the survey corresponded best to Accreditation Board for Engineering and Technology (ABET) criterion E, "an ability to identify, formulate, and solve engineering problems."(http://ecee.colorado.edu/~mathys/ecen2250/abet/criterion3.html) Mean scores hover around 4 on a 5 point scale, which matches with "more after the course." The greatest reported gain was with "asking questions about the problem to be solved"—from open ended items as well, students mention in particular a need to clarify assumptions and investigate problems before attempting to solve them as a great change from their typical strategies.

Table 4. Problem Solving Courses—Solving Problems

[ABET 3E; E] Since taking the problem solving course, I	Much less after the course	less after the course	about the same as before the course	more after the course	much more after the course	N	Mean (scale = 1-5)
approach problems using a step-by-step process (e.g., IDEAL)	2	0	21	85	41	149	4.09
ask questions about the problem to be solved	1	1	16	71	60	149	4.26
consider multiple variables	1	2	21	74	51	149	4.15
consider multiple solutions	1	1	20	76	49	147	4.16
reflect on my thinking before designing a solution	1	2	23	77	46	149	4.11
think about the problem context (whose problem, the setting of the problem)	1	1	27	79	41	149	4.06
ask for feedback about my solution while or before I develop it	1	4	36	62	47	150	4.00
consider real-world applications	2	2	39	56	50	149	4.01
value solving for cost effectiveness	2	5	52	64	26	149	3.72
communicate a problem and a solution multiple ways	1	2	26	84	37	150	4.03
gather data from additional resources when solving a problem	1	8	34	64	42	149	3.93
value solving for simplicity	1	4	29	71	42	147	4.01

A goal of the problem solving courses has been to help students develop metacognitive strategies for approaching their discipline-specific problems. For the purposes of this report, metacognition can be thought of as thinking about one's own thinking and becoming reflective about learning processes. In the evaluation of the problem solving course, students were asked to describe the environment as it relates to the statements listed—in other words, the extent to which students had opportunities to consider metacognition. Classrooms were described as, on average, "often" providing opportunities to develop metacognition. Specifically, students were most likely to state that they "are asked to explain how they solve problems" (4.47 on a 5-point scale), "pose questions to better understand problems" (4.42 on a 5-point scale) and "try creative ways to solve problems" (4.36 on a 5-point scale).

Table 5. Problem-Solving Courses—Metacognitive Demands

METACOGNITIVE DEMANDS In this problem solving course:	almost never	seldom	sometimes	often	almost always	n	Mean (scale = 1-5)
Students are asked to think about how they learn.	2	7	28	64	48	149	4.00
Students are asked to explain how they solve problems.	2	2	9	47	88	148	4.47
Students are asked to think about their difficulties in learning the subject matter.	6	6	34	59	42	147	3.85
Students are asked to pose questions to better understand problems.	2	1	16	43	87	149	4.42
Students are asked to think about how they could become better learners.	2	7	38	50	52	149	3.96
Students are asked to try creative ways to solve problems.	2	4	12	51	80	149	4.36

Students are asked to work together quite often in the problem-solving courses—this creates opportunities to develop collaborative skills while simultaneously providing other models of thinking through partner dialog. The "Student-student talk" scale most specifically relates to the ABET criterion D: "an ability to function on multidisciplinary teams." (http://ecee.colorado.edu/~mathys/ecen2250/abet/criterion3.html) While theses scores are somewhat lower than the "Metacognitive Demands" scale, the items show similar patterns, in which problem specific discussions are common (e.g., how did you solve this particular problem?) and more generalized, holistic questions (e.g., how do you typically solve problems like these?) are less common. An area for potential growth in these courses is to expand on reflection as it is typically practiced to create dialog that transcends specific problems, and can support development of rich self-awareness.

Table 6. Problem solving courses: Student-Student talk

STUDENT-STUDENT TALK [ABET 3g; D]In this problem solving course:	almost never	seldom	sometimes	often	almost always	n	Mean (scale = 1-5)
Students discuss with each other about how they solve problems.	1	2	19	47	80	149	4.36
Students discuss with each other about how they think.	1	8	21	59	60	149	4.13

Students discuss with each other about how well (or how poorly) they are learning.	4	20	43	47	35	149	3.60
Students discuss with each other about how they can improve their problem solving abilities.	3	17	37	49	42	148	3.74
Students critique one another's solutions.	7	10	43	49	40	149	3.70
Students improve upon one another's ideas in group problem solving exercises.	4	2	18	61	62	147	4.19

Students were asked to agree or disagree with statements based on their experiences in the PS course. Overall, the majority of participants met (54%) or received feedback from (55%) industry professionals in the course. Participants became more aware of the software development interview process (63%) —a practice with norms highly unlike typical interviews or classroom settings. More than three quarters practiced skills they think will be relevant to interviewing for competitive computing jobs (76%), and nearly the same proportion were more committed to getting jobs in computer science (74%). Nearly all said they applied computer science knowledge to real world problems (77%) and nearly all were more confident in problem solving (86%).

Table 7. Problem Solving Courses—Actions Reported

Because of my participation in the problem solving course (percent agree reported below)						
I met at least one computer science professional from industry	I received feedback from (an) industry professional(s)	I learned about the software development interview process	I practiced skills that will be beneficial to interviewing for competitive computing jobs	I applied my computer science knowledge to real-world problems	I am more confident in my problem solving ability	I am more committed to getting a job in computer science
54%	55%	63%	76%	77%	86%	74%

Means were slightly smaller than in other scales on the teamwork items, reported below. While a quarter to a third of students indicated no change, no students felt they regressed in any of these areas during the course. Means on items are not as variable as other scales, in fact, there is only 0.16 points difference between all six items. Items related to groupwork and collaboration were slightly less positive than other scales on this survey, yet all mean scores remain nearest 4 on a 5 point scale, in which responses correspond to "better after the course"—this indicates students have developed what would correlate to ABET criterion D (see above).

Table 8. Problem Solving Courses—Teamwork

[ABET 3D; D] Because of my participation in the problem solving course:	much worse	worse	about the same	better	much better	n	mean (scale = 1-5)
I know how to cooperate effectively as a member of a team.	0	0	37	77	34	148	3.98
I have high confidence in my ability to function as part of a team.	0	0	37	74	38	150	3.98
I can provide strong support for other members of any team that I am on.	0	0	38	70	40	149	3.99
I can troubleshoot interpersonal disagreements when working on a team.	0	0	46	68	32	149	3.83
I know how to be a good team member.	0	0	49	63	36	149	3.89
I know a lot about what it takes to help a team accomplish its task.	0	0	44	69	36	150	3.92

Participants in the problem solving courses were asked to describe how this course **compares to other courses they take in their major**. Students indicated patience and reflection were more a part of this course than others, and also described that multiple responses might be accurate in problem solving, while that skill might not be emphasized in the same way in other courses. A few quotes are shared below.

"The course emphasizes a lot more on the reasoning behind a particular solution while avoiding an 'ideal' solution as the only one possible."

"This class helped me think more before I actually start to do an algorithm"

"The students get a better understanding of issues that can occur in the real world (in problem solving). It is more hands on and you get to apply what you learned in other courses."

"This course is a lot different than other computing courses. This course teaches us different ways to approach problems and teaches us to think about different strategies rather than just one strategy. In other courses most students likely go to their first thought of how to solve a computing problem because they haven't been taught yet to think about the many different ways to go about solving a problem. The only similarity is that in both courses students see how other students solve problems which helps them learn different ways to think about the problem."

Students also described their "favorite part" of the problem-solving course.

"It makes you understand that problems may have different approaches. Also, it does teach me to understand that sometimes there are simple problems that we make it difficult."

"My favorite part of the course was being able to learn a new programming language as well as working with problems with a partner."

"Solving problems that made me think deeply and having discussions with fellow class mates."

"My favorite part of this course was learning to look at the problems in different ways and learning to think of more than just one strategy. Learning to ask questions (probing and clarifying) was also neat. I had never thought about asking questions, I would just assume. I also liked working in groups a lot, it was great because students work together and see how other students think and approach problems and it also gets us socializing."

Improving courses through a CAHSI signature practice—PLTL

Three institutions held PLTL trainings in the spring of the 2018-19 school year. The trainings recruited participants from at least 8 schools: Texas A&M Kingsville, Texas A&M Corpus Christi, University of Texas Rio Grande Valley, University of Texas at El Paso, New Mexico State University, University of Puerto Rico Mayaguez, Polytecnic University of Puerto Rico, and Inter-American University of Puerto Rico – Bayamón Campus. The Puerto Rico training served 57 attendees, and was led by Claudia Casas, who supervises peer leaders at UTEP. In New Mexico, NMSU held a training that served 14 attendees, which was facilitated by Mitsue Nakamura from UHD. Corpus Christi also held a PLTL training which reached 14 attendees, also facilitated by UHD representatives. Post-training surveys were emailed to all participants. Thirty-three responded, 16 faculty and 17 student attendees. Their responses appear below.

Responses from faculty regarding their understanding and value of PLTL, perceived support, and their willingness to adjust course practices were generally positive- faculty were least sure they would have the local support they needed to implement effectively, and were relatively less confident that they would be able to develop relevant activities.

Table 9. PLTL Training—Faculty/Instructor Preparation for Implementation

Faculty/instructor, n=16								
Because of the PLTL training:	Strongly agree	Agree	Somewhat agree	Neutral/not sure	Somewhat disagree	Disagree	Strongly disagree	Mean (scale = 1-7)
I see the value of PLTL for my students.	11	5	0	0	0	0	0	6.69
I have the support I need to implement PLTL.	5	6	3	2	0	0	0	5.69
I feel comfortable giving up some of my class or lab time for peer lead activities.	6	8	1	1	0	0	0	6.13
I know how to help peer leaders develop relevant activities.	7	6	1	2	0	0	0	6.06
I feel confident that I can implement PLTL AND still cover all course content.	7	8	0	1	0	0	0	6.31
Because of the PLTL training:	Strongly agree	Agree	Somewhat agree	Neutral/not sure	Somewhat disagree	Disagree	Strongly disagree	
I see the value of PLTL for my students.	69%	31%	0%	0%	0%	0%	0%	
I have the support I need to implement PLTL.	31%	38%	19%	13%	0%	0%	0%	
I feel comfortable giving up some of my class or lab time for peer lead activities.	38%	50%	6%	6%	0%	0%	0%	
I know how to help peer leaders develop relevant activities.	44%	38%	6%	13%	0%	0%	0%	
I feel confident that I can implement PLTL AND still cover all course content.	44%	50%	0%	6%	0%	0%	0%	

Similarly, students understood the value of PLTL, and yet were relatively less confident in their support network for PLTL, their confidence in facilitating, and their ability to motivate students. Continuous opportunity for engagement with other peer leaders as well as additional training opportunity throughout the semester may support student readiness to implement PLTL.

Table 10. PLTL Training—Student Preparation for Implementation

Students, n= 17 Because of the PLTL training:	Strongly agree	Agree	Somewhat agree	Neutral/not sure	Somewhat disagree	Disagree	Strongly disagree	Mean (scale = 1-7)
I see the value of PLTL.	7	8	1	0	0	0	1	6.00
I have the support I need to be a peer leader.	1	2	7	5	0	2	0	4.18
I feel confident that I will be able to help other students understand difficult concepts.	5	5	3	3	0	1	0	5.35
I feel confident that I will be able to motivate other students.	2	7	6	1	0	1	0	5.06
I feel confident I can facilitate an activity effectively.	2	8	4	2	0	0	1	5.12
Because of the PLTL training:	Strongly agree	Agree	Somewhat agree	Neutral/not sure	Somewhat disagree	Disagree	Strongly disagree	
I see the value of PLTL.	41%	47%	6%	0%	0%	0%	6%	
I have the support I need to be a peer leader.	6%	12%	41%	29%	0%	12%	0%	
I feel confident that I will be able to help other students understand difficult concepts.	29%	29%	18%	18%	0%	6%	0%	
I feel confident that I will be able to motivate other students.	12%	41%	35%	6%	0%	6%	0%	
I feel confident I can facilitate an activity effectively.	12%	47%	24%	12%	0%	0%	6%	

Overall, participants were satisfied with the presentation of workshops, the qualifications of the presenters, the resources available, and the content of the trainings.

Table 11. PLTL Training—Overall Satisfaction

Please rate your level of agreement with the following statements.	Very true	TRUE	Somewhat true	Not at all true	Mean (scale = 1-4)	N
The presenters clearly delivered the workshop material.	27	7	1	0	3.74	35
The presenters were knowledgeable about the topic.	25	10	0	0	3.71	35
The amount of resources available (e.g., online and paper materials) was satisfactory.	21	11	2	1	3.49	35
The overall quality of content was satisfactory.	23	11	1	0	3.63	35

I would recommend this training to colleagues interested in supporting student learning.	28	6	1	0	3.77	35

Faculty and students were somewhat confident in their self-reported understanding of the PLTL model—they were perhaps least knowledgeable about what makes a quality PLTL activity.

Table 12. PLTL Training—PLTL Design and Structure

PLTL design and structure	Very true	TRUE	Somewhat true	Not at all true	Mean (scale = 1-4)	N
I understand the role of peer leaders in the PLTL course.	23	10	2	0	3.60	35
I understand the role of faculty/instructors in facilitating PLTL.	20	11	4	0	3.46	35
I understand the elements of a high quality PLTL activity.	18	13	4	0	3.40	35
I understand the purpose of the weekly peer leader/PLTL faculty meeting.	20	10	5	0	3.43	35
I understand the role PLTL plays in retaining students.	21	11	3	0	3.51	35

Training results are relatively positive, though they suggest a need for continued engagement to ensure peer leaders and faculty are able to effectively implement the signature practice. Funding is needed to implement PLTL at many institutions—department chairs are searching for funding from institutional sources, and backbone team members have suggested funding sources such as MSEIP grants from the US Department of Education and IUSE opportunities with the National Science Foundation. As institutions take up PLTL in 2019-2020, the evaluation team will evaluate new adopters' implementation via self-report survey, and when possible, via participant observation of PLTL sessions and/or meetings with peer leaders.

Graduate Climate survey- understanding graduate student perspectives at two CAHSI schools

In the 2018-2019 school year, the CAHSI evaluation team piloted the graduate student climate survey. The instrument is built on the faculty-endorsed constructs of the undergraduate climate survey and enhanced by the literature regarding graduate student success. The instrument was piloted at three of the CAHSI founding institutions. Insufficient data was obtained from one institution, and so two are reported here.

Graduate students described how they value computer science as a discipline, though their responses indicate they are less certain of society's value of the discipline. Nearly all feel confident they will be prepared for jobs in their field, though 2 disagreed and 4 remained neutral.

It may be important to document cases of successful outcomes of MS and PhD graduates from programs to serve as models of successful employment following post graduate education.

Table 13. Graduate Climate Survey—Value of Computer Science

Value of Computer Science (** denotes negatively worded question)	Strongly agree	Agree	Neutral/ no opinion	Disagree	Strongly disagree	Mean (scale = 1-5)	N
Society values the work computer scientists and engineers do	21	25	4	5	1	4.07	56
**(Computer science/computer engineering) is boring	0	0	4	14	38	4.61	56
(Computer science/computer engineering) is an occupation that is respected by other people	27	18	9	1	1	4.23	56
(Computer science/computer engineering) help to make the world a better place	35	18	3	0	0	4.57	56
I expect (Computer science/computer engineering) will be a rewarding career	40	14	2	0	0	4.68	56
My (Computer science/computer engineering) studies will prepare me for a job in my field	26	24	4	2	0	4.32	56

About two thirds of graduate students responded favorably to each item, with graduate students most positive about the respect they receive from faculty, comfort they have asking for assistance, and their sense that faculty take them seriously.

Table 14. Graduate Climate Survey—Faculty Engagement

Faculty Engagement "In my computer science/computer engineering department..."	Strongly agree	Agree	Neutral/ no opinion	Disagree	Strongly disagree	Mean (scale – 1-5)	N
My professors care whether or not I learn the material	12	27	11	4	2	3.77	56
My professors treat me with respect	24	24	5	3	0	4.23	56
**My professors think I have less academic ability than I have	2	4	19	17	14	3.66	56
My professors inspire me to study computer science/computer engineering	19	22	10	4	1	3.96	56

	Strongly agree	Agree	Neutral/ no opinion	Disagree	Strongly disagree	Mean (scale = 1-5)	N
My professors provide guidance or instruction on how to collaborate effectively	12	27	11	3	3	3.75	56
My professors make positive comments when I do a good job in my computing courses	15	22	17	1	1	3.88	56
My professors take my comments and questions seriously	20	21	14	1	0	4.07	56
My professors give me career advice	18	19	15	2	2	3.88	56
I am comfortable meeting with my professors for academic help	24	23	7	2	0	4.23	56

Students were asked about their confidence in succeeding in their graduate programs. Nearly all were confident they could succeed (49 of 55), though students were less sure they could develop a research proposal (32 of 46) or defend their work (39 of 46).

Table 15. Graduate Climate Survey—Confidence in Computer Science

Confidence in computer science	Strongly agree	Agree	Neutral/ no opinion	Disagree	Strongly disagree	Mean (scale = 1-5)	N
I am confident in my ability to succeed in my computing graduate degree.	28	21	3	2	1	4.33	55
I am confident in my ability to develop a research proposal (if applicable).	15	17	9	4	1	3.89	46
I am confident in my ability to defend my work (if applicable).	17	22	5	1	1	4.15	46

The majority of students did not experience exclusion, yet there are instances of exclusion for each item. Respondents indicate faculty were not likely to make inappropriate remarks about women (3 of 56) or of minorities (3 of 56), students however were more likely to make statements about underrepresented groups (9 of 56 regarding minorities say "sometimes," 14 of 56 regarding women say "sometimes," while one says "frequently"). About a fifth of students feel excluded from their graduate cohort (11 of 56) and 9 feel isolated within their lab group. The evaluation team plans to investigate this in more detail, and if numbers are sufficient to describe the demographics of students who feel excluded, this information will be shared with departmental stakeholders.

Table 16. Graduate Climate Survey—Exclusion

Exclusion Scale Please rate the extent to which you have experienced the following:	not at all	sometimes	frequently	Mean (scale = 1-3)	N
I have felt excluded from departmental activities (e.g. workshops, talks, research) because of my background.	44	8	4	2.71	56
I have experienced discrimination in this department.	47	6	3	2.79	56
I have heard faculty make inappropriate remarks regarding minorities.	53	3	0	2.95	56
I have heard faculty make inappropriate remarks regarding women.	53	3	0	2.95	56
I have heard other students in the department make inappropriate remarks regarding minorities.	47	9	0	2.84	56
I have heard other students in the department make inappropriate remarks regarding women.	41	14	1	2.71	56
I have felt excluded in my department.	44	9	3	2.73	56
I have felt excluded while attending computing events off campus.	46	6	4	2.75	56
I have felt excluded while attending class.	49	5	2	2.84	56
I have felt excluded in my lab group.	47	7	2	2.80	56
I have felt excluded in my graduate student cohort (students who began at the same time as I did)	45	10	1	2.79	56

***All of the above set of questions are negatively worded. Means scores were calculated differently to account for the negative wording

The majority of students indicate development of skill and knowledge on the areas described below—specifically, students were most likely to report growth in critical thinking, communication and collaborative skills, and their understanding of research (40 or more out of 56).

Compared to when you entered your graduate degree program, how would you describe your:	Much better	Somewhat better	About the same	somewhat worse	Much worse	Mean (scale = 1-5)	N
Ability to succeed in coursework	21	11	19	4	1	3.84	56
Programming skills	14	22	17	3	0	3.84	56
Ability to troubleshoot coding errors	17	17	20	2	0	3.88	56
Communication skills	23	20	13	0	0	4.18	56
Ability to collaborate with peers	19	22	15	0	0	4.07	56
Ability to work effectively with people from diverse communities	16	21	17	1	0	3.95	55
Motivation to pursue a career in computer science	27	10	15	3	1	4.05	56
Ability to think critically	22	18	14	2	0	4.07	56
Ability to be an effective leader	20	15	18	3	0	3.93	56
Ability to do research	19	18	17	0	2	3.93	56
Understanding of the research literature in my field	17	23	14	0	2	3.95	56
Ability to formulate good research questions	14	22	18	0	2	3.82	56
Ability to interpret research results	16	19	19	0	2	3.84	56

Graduate students were mostly positive about their experiences with advisors, though they were most "neutral" about their advisors willingness and/or ability to support them emotionally (17 of 56 say neutral, 3 disagree, 1 strongly disagrees), as well as their willingness and/or ability to advocate for the student in the department (14 are neutral, 1 strongly disagrees). Making time for the advisee and giving useful feedback were also areas with many "neutral" or "disagree" responses.

Please answer the following questions regarding advising you receive from your graduate advisor/mentor:	Strongly agree	Agree	Neutral/ no opinion	Disagree	Strongly disagree	Mean (scale = 1-5)	N
My advisor treats me with respect.	34	17	5	0	0	4.52	56
My advisor believes in my potential to do well in this field.	32	17	6	1	0	4.43	56
My advisor supports me academically.	33	15	8	0	0	4.45	56

My advisor supports me emotionally.	19	16	17	3	1	3.88	56
My advisor makes time for me.	24	17	12	3	0	4.11	56
My advisor gives me feedback that is useful.	31	13	10	2	0	4.30	56
My advisor advocates for me in the department.	25	16	14	0	1	4.14	56

Of the participants who indicated race/ethnicity, 35 indicated they were Hispanic, which represented 63% of students who gave demographic information.

Table 19. Graduate Climate Survey—Race/Ethnicity

Please indicate your race/ethnicity. Check all that apply, or type a response in the box below.	Number	Proportion (does not =100%)
Hispanic/Latino/a/Chicano	35	63%
African American/black	1	2%
Asian, not from Indian subcontinent	3	5%
Asian, from Indian subcontinent	8	14%
Pacific Islander	0	0%
Native American	1	2%
Caucasian	8	14%
Other Race/ethnicity:	5	9%

About a third of students who responded to demographic items were women, and two thirds were men.

Figure 7. Gender of Respondents, Graduate Climate Survey

gender of respondents

17, 32%
36, 68%

■ male ■ female
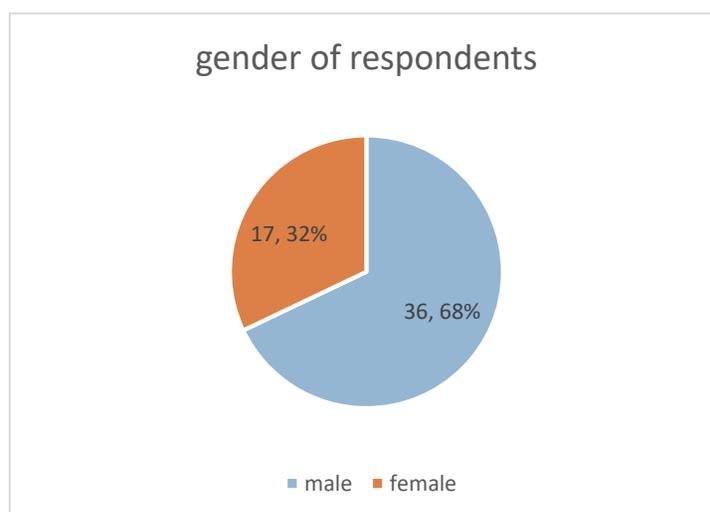
Climate survey data collection will transition to the Data management team in the fall of 2019. The current graduate survey results will be shared disaggregated by program with faculty and P.I.s at both institutions where data has been collected to date. The method will include dialog and further investigation based on faculty interest. As CAHSI transitions to be more data-driven at the local level, the evaluation team will support the use of data as needed to affect change.

Google Tech Exchange: Student Experiences and Recommendations for Future Semesters

A man shares slides in an auditorium—his presentation is interactive with an audience of about 20 college students from across the country. In this section of Machine Learning taught on Google's campus, the majority of the students are from Hispanic Serving Institutions engaged in CAHSI. Two instructors look on—one an associate professor from San Francisco State University, the other a full-time Google employee, pairing with the professor to instruct Tech Exchange students.

"I've been working on this for my dissertation- I just finished my PhD thesis on this topic. I was able to do work on Google translator and measure biases in the program." *The presenter shares a translation screen shot- and the class and the presenter look at the translated text. "I've been troubled by the bias in the system- what do you notice?" the students look at a few screen shots, and discuss with each other, then with the presenter. One Latina states, "It's because of the gender in nouns in Spanish" and describes why the gender assignment of nouns in so-called "romance" languages, including Spanish, leads to gender bias in translations. They look at the pronouns assigned words like "nurse" and "doctor," and discuss how the technical means of translating (e.g., using massive amounts of data as sources for making sense of language) creates or strengthens bias in language translation.*

In these ways, Google Tech Exchange participants had opportunities to consider user interfaces, technical attributes of apps, ethics, and how cultural and linguistic bias influences the tools we use every day. By discussing g the Spanish language, something known to many of the CAHSI participants, the Google mentors tapped into students' background knowledge and lived experiences to make connection to real-world technical problems.

This case study is based on a site visit made to Google in November of 2018 as well as focus group interviews held afterward with CAHSI Google Tech Exchange participants. The research questions addressed in this case study are:

1) How does the Google Tech Exchange influence CAHSI?
2) How does the technical exchange influence students engaged in the program?

How does the Google Tech Exchange Influence CAHSI?

The Google Tech Exchange **expands the capacity of CAHSI to prepare students for elite technical positions in their field**. Students described how extended opportunities for group work

changed their orientations towards collaboration. Students relayed at their home institutions, they often led group work, or worked separately and patched the project together after the fact. With Google Tech Exchange, they felt confident in the motivation of their peers, and they realized the very different educational backgrounds of each member from a different institution could strengthen, rather than inhibit, the outcome. Just as in the workplace, Google Tech Exchange participants brought varied academic backgrounds to solving a problem. One student described the change in group work at Google Tech Exchange when compared with at one's home institution:

> "So during the project itself, you're not only going to have your own ideas, there's going to be other people's ideas mixed together. I'm learning to be open to thinking of other people's ideas because if you don't, you're going to have a really bad time during projects. Every single person should be able to interact with each other's ideas and create something new."

Students describe how the context of the technical industry creates opportunities for making direct connections between school and work—the practical application is enhanced through the Google Tech Exchange Program. As Googlers collaborate with faculty, they have opportunities to ground theory in the practical application of knowledge.

> "A lot more practical than theoretical… I see a gap between academia and the industry. There are things that we do in school that aren't actually applicable to industry work. Coming here gave me valuable insight into what the computing industry is like."

CAHSI Tech Exchange participants described the interactions they had with Googlers when they attempted the Google-style interview, where students use a whiteboard and solve problems as they "think aloud" with interviewers. This style of interview is typical in the technical field, yet it is unlike many schooled interactions, and takes practice. A student describes how the Googlers provided feedback and continued communications with them as well.

> "We had mock interviews. The Googler who interviewed me was proactive in building connections with students. [The googler] communicated with me later."

As they participated in courses at Google, students described what have been dubbed "**High Impact Practices" in undergraduate education**. The following quotes focus on the educational practices utilized at Google that were active, practical, and applied to the authentic work of computer scientists. A student described that each class had a major project, and how that differed from their regular experiences at home institutions.

> "Every class had a major project, right? And that's not something we're used to back home. Especially taking I think four or three classes on average that are core classes. It was difficult, but it actually made us grow more as individuals,

in the sense that we got more knowledge of the technologies and just confident in building tools."

An additional benefit of the project was the access to differing curriculum emphases via the multiple institutional perspectives. As students worked together they became aware of new languages and new approaches, because their peers came from differing computing cultures.

"I probably learned the most during this semester. The different kinds of languages coding wise, different kinds of perspectives, different ways of approaches to accurately solve problems."

The Google Tech Exchange coursework created a new model of assessing learning- one where formative feedback was plentiful, and students were graded on their continuing efforts, not just on their performance during one or two tests. Students described how that approach changed their approach to learning.

"Basically, most of the classwork also was like this in certain groups. So it was a very different experience on what we're used to, but I liked it because in the university, it's very stressful to say, 'Hey, most of my classwork is now one test,' what if I fail, right? But if I'm just constantly doing work, I have less probability of failing. I have better chances of understanding the material because every assignment focuses on a certain subset of subjects. …Professors can better find out, I guess, where people are lacking, which I think is good. Also, the products are very good."

Another student spoke of the benefits of additional practice and emphasis on activity over memorization.

"We are used to reading the whole book and studying from the book… after the exam there's a high probability that you will forget those things, but here in Google you have to really understand the concepts and have to practice them. You can get a lot more practice here than at [my home university]."

The Google Tech Exchange provided a learning experience unlike that which CAHSI institutions have the capacity to offer, though through experimentation and participation in the faculty in residence program, faculty could learn to emulate to a greater degree. This case study also focuses on students' self-reported benefits from participating in Google Tech Exchange. **Data indicate students: 1) Improved their sense of community, 2) increased their motivation to succeed in computing, 3) improved skill in collaboration, and 4) increased their social networks. In addition, they shifted their mindsets towards growth orientations, increased their sense of belonging in computing, and expanded their understanding of computing career options.**

A student described how his perspective shifted at Google, and how building relationships will influence his work back at the home institution.

"I want so say that before this program, I was so, if I'm completely honest, in Computer Science, I had no friends. That's just the way it happened. I mean, it's kind of sad that I didn't have that many people, I had [peer from home institution], towards the end there, but being here I feel so ...connected. After leaving Google, I will feel so much more confident in what I know, and the things that I can do."

Another student described how group work will be attempted differently given the experience at the Google Tech Exchange.

"(I will be a different kind of team member.) I will have an open mind, hear people's perspectives. Because usually when you go in teams, you always have this idea, right? And you want to get the idea through, and you want to implement it, but here sometimes your ideas might not always be the best, so that's why you have to open up a little bit more and have a little bit more compromise—and all the projects that I've worked on here were through teams. And yeah, I've found myself in different positions where I had this set idea in my head, but after going through the team meetings, then you actually find out that there's better ideas."

The Google Tech Exchange sought to increase students' professional networks through Google connections. The program did this through explicit mentoring, where each student received a formal mentor, and through informal social gatherings, in which some participants noted finding mentors who connected with them beyond the structured "meet and greets." In some cases, formal mentors were not communicative, and the Google Tech Exchange staff were quick to add an additional mentor to supplement the support the student received.

"So, the Googlers are actually very flexible and having the opportunity to talk to the different Googlers from different teams was very beneficial."

"My mentor, specifically, he's always still asking when I'm free and he's telling me when he's free. And we can always schedule meetings to just talk about anything in general."

Another student described meeting a Googler at a social event, then asking with peers to connect with her afterwards to discuss career opportunities. To the students, Googlers appeared happy to provide support to Google Tech Exchange program participants in different ways.

From the incremental approach to learning to the sense of optimism and opportunity described by students, the environment at Google supports developing a growth mindset, or a sense that with effort, difficult tasks can be accomplished. A student described how shifting to that mindset influences one's confidence in ability.

"I would say that the biggest thing that the program did is it, it demystified a lot of the things in the industry. Usually when you look at projects that are like extremely well built, you kinda go, 'Wow, those guys are super good.' You have this image they just have a higher level than you, and then after talking with a lot of people who are working at Google, you realize that it's just, literally for the most part, just learning as you go, what you need at the moment. Rather than, 'I can do this in one go,' it's like no, there's no such thing. It's an extremely gradual process, and you just grind through it and you eventually make what you want to make. It's just staying consistent really."

The Google Tech Exchange program helped students feel like they belonged and were capable in this field. The effort made in bringing talks by Googlers from less so-called "elite" institutions assisted in building confidence and reducing feelings that students were not capable enough to work at Google.

"I've had major Imposter Syndrome coming here, I didn't think that I fit in at all, I didn't think that I was at the level of my peers, but being here really boosted my confidence, because there was so much support."

"Hearing the talks during some of the classes on how people came to Google— they're not people, like not everyone there came from Ivy League schools and did everything perfectly. There was a lot of people who had a bunch of setbacks and failures. They overcame them and they're able to work at Google."

Students described how their time at Google assisted them in exploring all of the different ways they can participate in the computing field.

"'Project manager', I didn't know that was a thing, I didn't know that was a theme I might be interested in. I knew I loved coding now, I strongly love doing it, but maybe not for the rest of my life, now I know of the possibility of switching from Software Engineering to Project Management, that is a totally different thing but within the same context, right? So I didn't know that was a thing, until coming here and taking a class and seeing how these people work and what they do."

Overall, the opportunity to participate in the Google Tech Exchange was viewed as a positive from the students' perspective. The students gained valuable insight into the workings of industry, discovered new ways of learning that supported their development as well as their 'mindsets' towards difficult tasks, and began to feel they could fit in at elite technical companies such as Google.

Great Minds in STEM conference survey results

The HENAAC conference for the 2018-2019 school year was held October 17-20, 2018 in Pasadena, CA. There were an estimated 3,400 attendees. It hosted several student competitions including the following:

- HENAAC College Bowl
- Research Poster Competition
- CAHSI Hackathon

There were 1,768 students who attended the conference. These students represented 141 different colleges and universities. Of the students who attended, 69% were male and 31% were female.

Additionally, there were 1,226 professionals in attendance. The breakdown of professionals by sector is listed in the chart below:

Figure 8. Percent Professional By Sector, GMiS Attendance, 2018

Percent Professionals by sector (N=1226)

53%	4%	15%	14%	9%	4%

■ Corporate ■ Government ■ Military ■ Academic (K-20) ■ Nonprofit ■ Guests

Chart recreated from http://www.greatmindsinstem.org/pdf/2018/2018ConferenceStats-FINAL.pdf
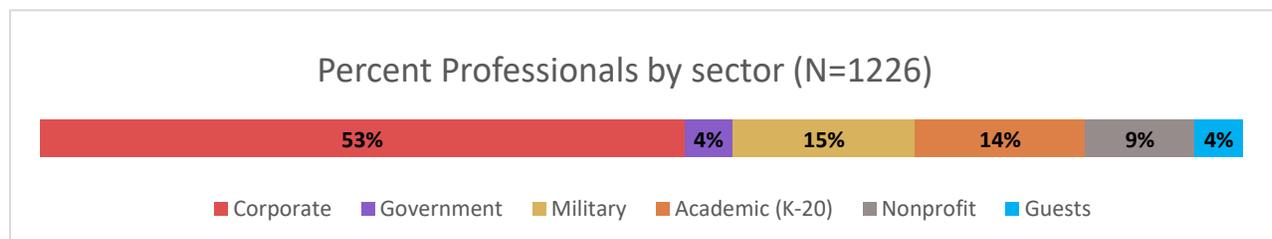
Evaluation data collection – GMiS conference

For the 2018 conference, 59 conference participants from CAHSI completed the follow-up survey. In the most recent years, the survey was sent out between five and six weeks after the conference. This year it was sent out to students about three weeks after HENAAC took place. The survey was sent out to 185 students. The response rate was 31.9%, which is a large improvement over the previous two years (12% in 2017 and 14.5% in 2016). The higher response rate may be related to sending out the survey sooner than the previous two years.

The CAHSI/HENAAC survey respondents represented the following 16 universities

- California State University Dominguez Hills
- California State University Stanislaus
- California State University Long Beach
- El Paso Community College
- Florida International University
- Kean University
- New Mexico Institute of Mining and Technology
- New Mexico State University

- Northeastern Illinois University
- Texas A&M University Corpus Christi
- The University of Texas at El Paso
- University of Houston - Downtown
- University of Puerto Rico at Arecibo
- University of Puerto Rico at Bayamón
- University of Puerto Rico at Mayaguez
- University of Puerto Rico, Rio Piedras

Of those who responded to the survey, 31% were female and 69% were male. These percentages mirror the rates of females and males that attended the conference (31% female and 69% male). An ethnicity breakdown of attending students is represented in the chart below. As can be seen from the chart, the majority of students attending the conference were Hispanic (70%).

Figure 9. College Student Registrants' Reported Ethnicities, GMiS conference

College student registrants reported ethnicities

Multi Racial/Ethnic, 10%
Other/No Response, 3%
White, 5%
African American, 3%
Asian/Pacific Islander, 9%
Hispanic, 70%

Chart recreated from http://www.greatmindsinstem.org/pdf/2018/2018ConferenceStats-FINAL.pdf
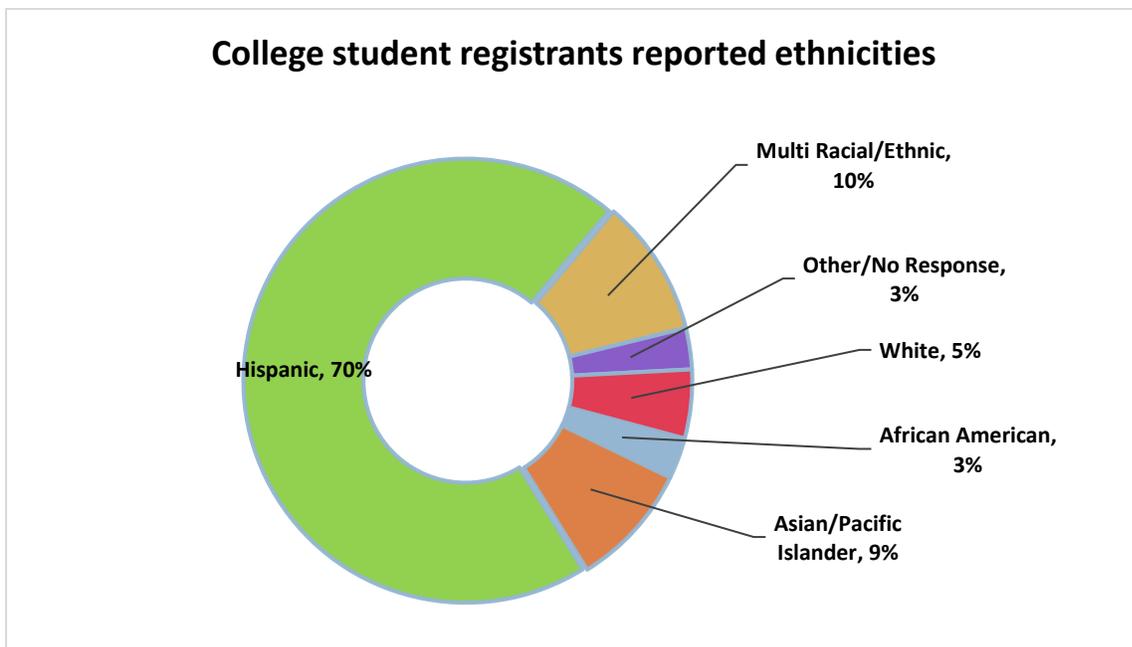
The majority of students who listed their majors were from Computer Science departments (86%, 36 of 42 respondents). The other students listed the following disciplines: Computer Engineering departments (2%), Electrical Engineering (5%), and Computer Technology (7%).

One of the survey questions asked students about their plans after graduation. More than half of the students (19 of 33) planned to work industry. Nearly a quarter of the students (8 of 33) planned to work and then pursue additional education. Five others planned to pursue further education immediately, while one planned on teaching.

Figure 10. GMiS Survey—Aspirations Following Graduation

What do you plan to do after graduation?
N=33

Work in industry
58%

Work then additional education
24%

Further education
15%

Teach
3%
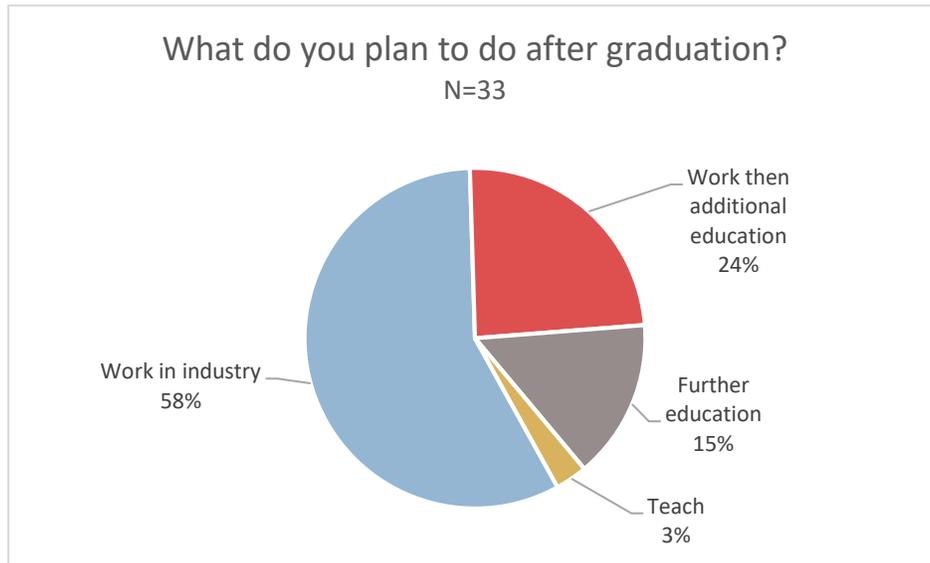
Student expectations of GMiS conference

The vast majority of students who responded (46 of 54, 85%) stated that the GMiS/HENAAC conference met (39%) or exceeded (46%) their expectations. Two students (4%) stated that it somewhat met their expectations. Only one student (2%) stated that the conference did not meet their expectations, while 5 students (9%) did not have any expectations or did not know what to expect.

Figure 11. GMiS conference—Expectations for Conference

To what degree did attending the HENAAC conference meet your expectations?, N=54

- Did not have any or did not know what to expect 9%
- Did not meet my expectations 2%
- Somewhat met my expectations 4%
- Met my expectations 39%
- Exceeded my expectations 46%
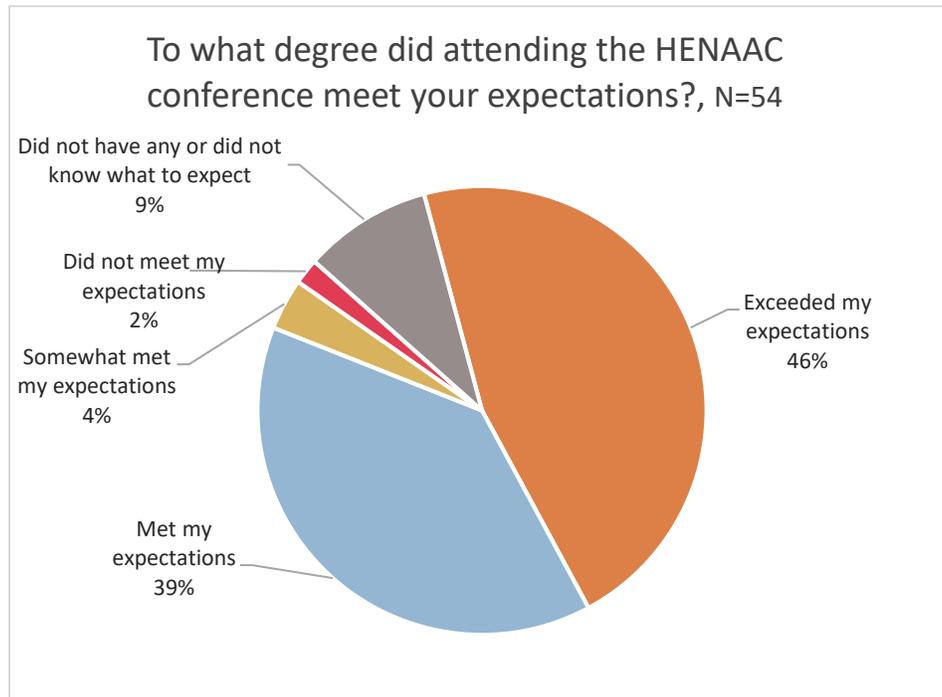
Expanding Student Networks

The GMiS/HENAAC Conference helped students increase their network. Nearly one half of the students (22 of 51, 43%) reported that they had contacted another student that they met at the conference. Four more students indicated they had plans to contact another student. The same amount (22 of 51) of students also stated they had contacted a faculty member they met at HENAAC. Another 10 students noted that they had plans to contact a faculty member.

The GMiS/HENAAC conference also helped to open doors for academic scholarships, internships, and fellowships for students. Over 70% (36 of 51) respondents inquired about internships based on their experience at the conference. Additionally, twenty of the 51 students who responded (39%) noted that they had applied for academic opportunities (e.g., research, etc) following the conference.

Students were asked if they had applied to graduate school. Only 2 of 50 (4%) said they had. Six respondents (16%) indicated that they planned on applying, while 30 (60%) stated they had not applied.

GMiS/HENAAC Conference Influence on Educational and Career Paths of Students

GMiS/HENAAC influenced students' educational and career paths in many positive ways. Students were asked to respond to eight questions regarding how the conferenced influenced

their educational and career paths. More than 50% of students responded positively (answered "a great deal" or "a good deal") in six of eight questions. In five of those six questions, students answered 70% or more positive. The two highest questions were, "increased my dedication to my major" and "provided opportunities to get career advice." The two questions that scored under 50% positive were "helped me find a mentor" and "increased my interest in graduate school."

Figure 12. GMiS Survey—Benefits of Conference
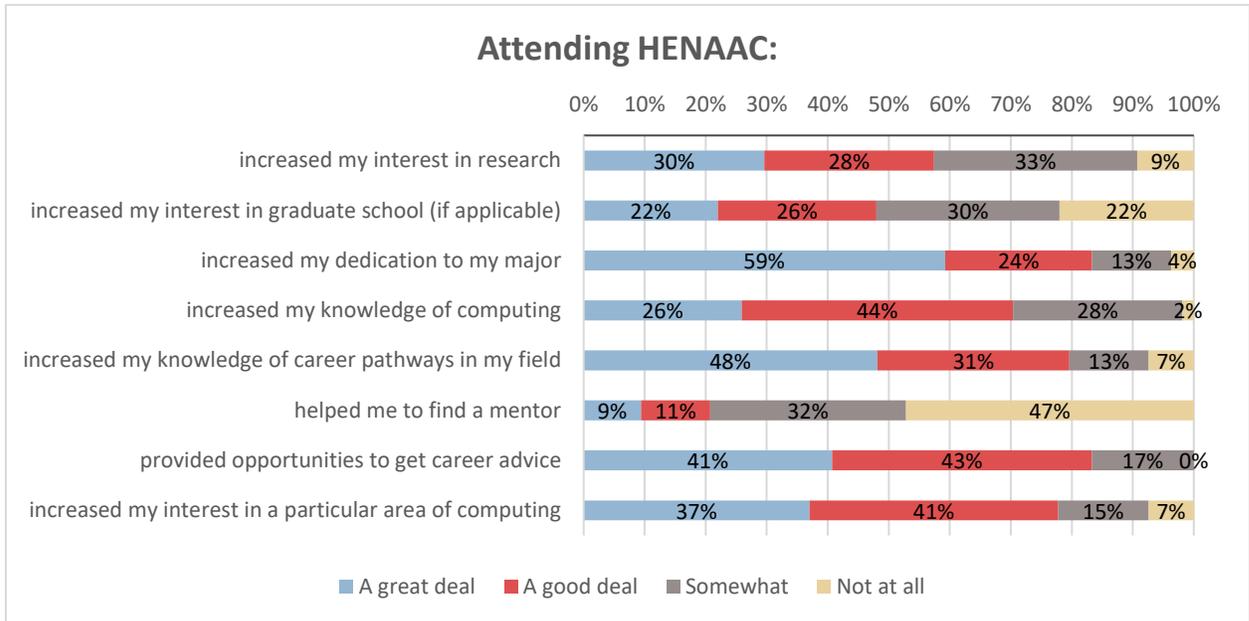
Students were asked about education and career related activities they had engaged in AFTER they had attended the conference. The chart below provides specific detail on the responses. Some notable observations are that 76% of students "have inquired about career opportunities based on my experience at the conference", and 71% "have inquired about internships based on my experience at the conference." Only 4% of students indicated that they had applied for grad school based on their experience at HENAAC, but another 12% responded that they planned to do so. When asked if they had inquired about grad school opportunities based on information from the conference, 16% said they had. Another 24% planned to do this.

Figure 13. GMiS survey—Student Follow-Up Actions

Please list the activities you have engaged in SINCE the HENAAC conference.

Activity	Yes	No	I PLAN to do this	Not applicable
I have inquired about internships based on my experience at the conference.	71%	16%	6%	8%
I have inquired about career opportunities based on my experience at the conference.	76%	16%	8%	0%
I have applied for graduate school based on the information from the conference.	4%	60%	12%	24%
I have inquired about graduate school opportunities based on information obtained at the conference.	16%	42%	24%	18%
I have applied for academic opportunities (e.g., research, etc) following the conference.	39%	39%	18%	4%
I have contacted a faculty member or professional that I met at the conference.	43%	31%	20%	6%
I have contacted a student I met at the conference.	43%	47%	8%	2%

Respondents were asked how they most benefitted from the HENAAC conference. This was an open-ended question, so there was a large variance of answers. Some common themes to the answers were:

- Networking
- Received interviews for jobs
- Advice on interviewing
- Job offers
- Learning about jobs within their field (what kinds and how many there are)
- Motivation to continue in their field

Some notable responses to this question are listed below:

"I was able to network with professionals and other students, I found a mentor, I found strength to continue this journey. I learned about job opportunities and learned more about myself."

"I got a chance to speak with recruiters instead of just submitting my resume on the internet."

"I participated at the College Bowl and won a $500 scholarship. I was motivated to continue my path and see all the different possibilities of career choices."

"I was able to learn more about my career and I became inspired again."

"The Hackathon opened my eyes to new technologies and opportunities I did not know existed."

"I got a job offer."

"Understanding how competitive the job market is and what is needed to set yourself apart."

Suggestions for Future Conferences

- Group students from different schools together in order to get to know others and find out about the various challenges they have faced.
- Expand focus to include more graduate school students as well as undergraduates.
- More talks on how to deal with the problem of lack of Hispanic representation in the STEM community ,particularly how to deal with discrimination when encountered.
- Allow more flexibility in interviewing. Some interviews were held during times students would have liked to also attend presentations.

Social Network Approach -how are regions engaging deeply?

The social network analysis includes items regarding how participants interact with other participants, and the extent to which they engage deeply through cooperative, low-commitment activities (level 1, e.g., sharing information about REUs) through integrated activities (level 3, e.g., developing shared content like the GMiS conference workshops) The table below defines the types of relationships CAHSI stakeholders may have with one another.

| Cooperative Activities: involves exchanging information, attending meetings together, and offering resources to partners. (Example: Informs other departments of a national or regional event for computing students) | Coordinated Activities: Include cooperative activities in addition to intentional efforts to enhance each other's capacity for the mutual benefit of programs. (Examples: Sharing curriculum materials, discussing shared mentoring practices, sharing evaluation materials.) | Integrated Activities: In addition to cooperative and coordinated activities, this is the act of using commonalities to create a unified center of knowledge and programming that supports work in related content areas. (Example: Working together to fund, provide content, and recruit participants for a co-sponsored event.) |

The table below shows the network relationships as they relate to individuals' involvement with colleagues in CAHSI. There is a separate table for each region, in which backbone respondents are also included. The shapes indicate region or backbone affiliation.

The regions appear to interact differently from one another, yet most show a dense network with many lines, which indicate activities at the cooperative level are happening for each individual with at least 2 others. This redundancy is important—individuals

Backbone (squares) and **West** Region (pentagons) mapped by cooperative activities	Backbone (squares) and **Southwest** Region (trapezoids) mapped by cooperative activities
Backbone (squares) and **North** Region (diamonds) mapped by cooperative activities	Backbone (squares) and **Southeast** Region (parallelograms) mapped by cooperative activities
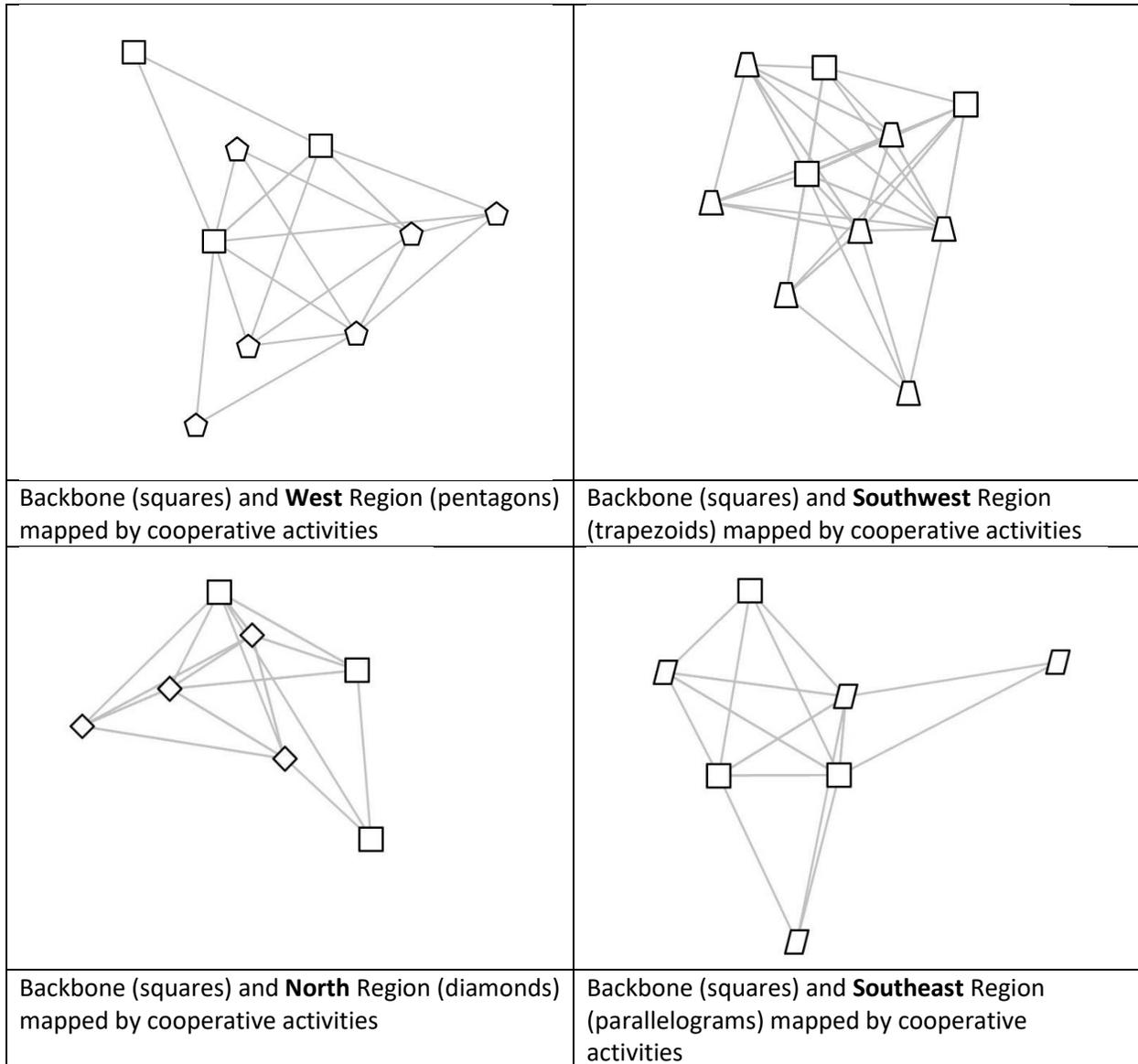
Figure 14. SNA Results—Regional Activity Mapping of Cooperative Activites

with less than 2 ties to the network may easily drift out of the network if their link is severed for any reason. The West region shows tight integration with 2 backbone members, who in turn are connected to the third backbone member. There are two pairs of pentagons closely tied to one another, with 1 that appears more separated from the network. The southwest region appears the tightest, particularly with backbone integration, though this may be due to the location of backbone staff in the Southwest region. The north region shows a dense core with peripheral

connections to the backbone. The southeast region shows three backbone and two southeast members tightly connected, with two members separated in divergent directions from the core.[1]

Backbone (squares) and **West** Region (pentagons) mapped by integrated activities	Backbone (squares) and **Southwest** Region (four-sided shapes) mapped by integrated activities
Backbone (squares) and **North** Region (diamonds) mapped by integrated activities	Backbone (squares) and **Southeast** Region (parallelograms) mapped by integrated activities (all 4 SE members are mapped in the same location)

___

[1] Neither of the two divergent Southeast members completed the survey in the 3.5 months it was held open for completion.

At the level of integrated activities, we note the ways in which network maps change dramatically across the board. We note that the regions that worked together to host and provide content for an onboarding meeting were more likely to report "integrated activities" than those that did not (e.g., southeast did, north held an onboarding at the backbone location). It is clear that regions are beginning to come together and are communicating with their partners at a basic level. As regions finalize their plans for strategic action, it is possible they will create richer, more connected networks with appropriate redundancy.

Collective Impact Survey: Strategic Actions and Regional Priorities

The Collective Impact survey served to map the strategic actions and priorities undertaken within the overall CAHSI network and within each region. The findings provide an asset map of CAHSI's strengths in strategic initiatives regionally and nationally and highlights areas where there is currently less collective effort. In this way, the survey results show the current landscape of CAHSI initiatives and efforts within the network to advance its vision.

Top Priorities

By and large, undergraduate education was the main priority for CAHSI members. When asked to rank their top three priorities, over 2/3 of CAHSI members chose undergraduate education as their top priority. Other prominent areas of focus included workforce development/career readiness and K-12 education, though to a much lesser degree. Along with graduate education, many CAHSI members chose those latter two areas as their secondary priorities. Workforce development and faculty professional development were also the most common third priorities of CAHSI members. Thus, overwhelmingly, undergraduate education, and, to a lesser extent, career preparation, K-12, and graduate education were the main foci of CAHSI members' strategic initiatives. Very few CAHSI members chose policy (whether national, state-level, or institutional) as a priority.

Figure 16. Top Priorities of CAHSI Members, CAHSI Network

Top Priorities of CAHSI Members, CAHSI Network

■ #1 priority   ■ #2 priority   ■ #3 priority

Priority	#1	#2	#3
Undergraduate Education (or bridging to undergraduate)	69%	26%	0%
Workforce Development or Career Readiness	14%	29%	24%
K-12 education	11%	15%	12%
Graduate education (bridging to graduate)	6%	18%	15%
Faculty professional development	0%	6%	26%
K-12 teacher professional development	0%	6%	9%
Institutional or departmental policy	0%	0%	3%
State-level policy	0%	0%	12%
National policy	0%	0%	0%

% marked as priority

When examined by region, clear differences in regional priorities emerge. For instance, the North region is primarily focused on undergraduate education, while other regions have varying priorities. The Southeast is focused on undergraduate and K-12 education. The West is the region least focused on undergraduate education but is also concentrating on graduate education and workforce development. The Southwest is the only region that listed faculty professional development as a priority with a small number of members focusing on this priority. Therefore, a strong focus on undergraduate education is a common thread across all CAHSI regions, yet each region has other strengths and interests in addressing disparities in Hispanic representation in computing.

Figure 17. #1 Priorities by Region

#1 Priorities by Region (n=38)

■ Southwest ■ Southeast ■ West ■ North

Undergraduate Education (or bridging to undergraduate)
- 68%
- 66%
- 40%
- 100%

K-12 education
- 13%
- 33%
- 0%
- 0%

Graduate education (or bridging)
- 0%
- 0%
- 25%
- 0%

Workforce development or career readiness
- 9%
- 0%
- 35%
- 0%

Faculty professional development
- 9%
- 0%
- 0%
- 0%

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

% marked as #1 priority in ranked choice
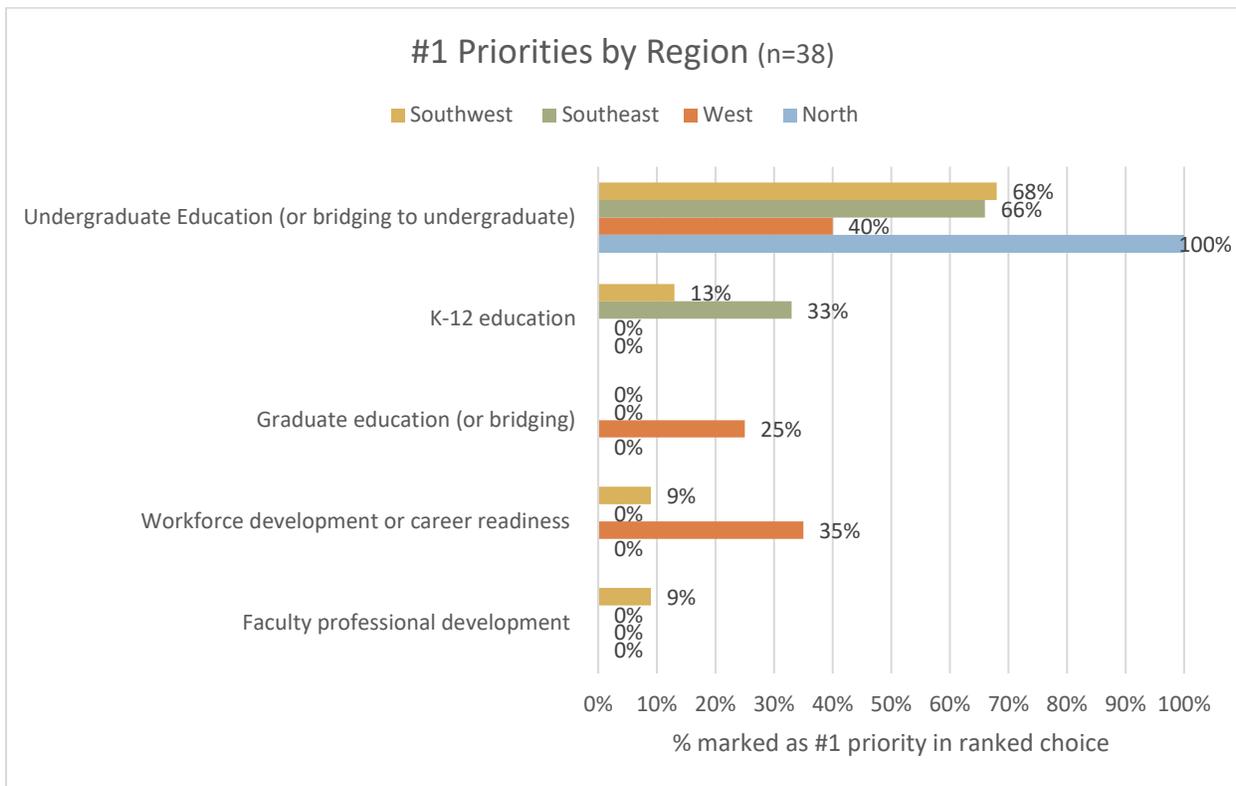
Veterans with more than 10 years of experience with CAHSI are most committed to advancing undergraduate education. Newcomers have more diverse interests, including graduate education and workforce development/career readiness. Therefore, CAHSI seems to be attracting and recruiting members with a balanced, healthy mix of interests and foci along the computing education pathway. Undergraduate education continues to be a core focus of CAHSI, yet the educational and career pathway targeted by CAHSI is broadening largely because of newer members.

Figure 18. Top Priority, by Length of Affiliation with CAHSI

Top Priority, by Length of Affiliation with CAHSI

■ 10+ years (n=6) ■ 3-9 years (n=9) ■ 1-2 years (n=9) ■ Less than a year (n=11)

Undergraduate Education (or bridging to undergraduate): 83%, 71%, 63%, 62%

K-12 education: 17%, 14%, 0%, 15%

Graduate education (or bridging): 0%, 14%, 0%, 8%

Workforce development or career readiness: 0%, 0%, 38%, 15%

% marked #1 priority, ranked choice
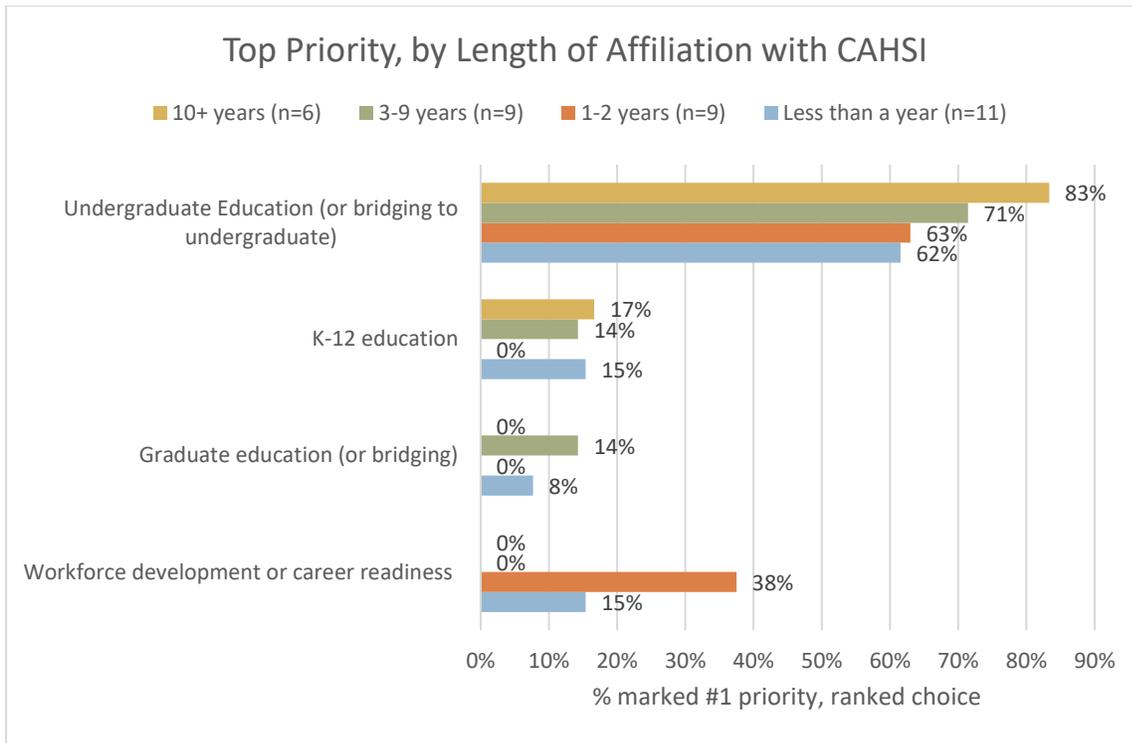
Collective Impact Survey: CAHSI Members' Implementation of Mutually Reinforcing Activities

Currently, CAHSI participants are moderately engaged in CAHSI signature practices as new members are becoming integrated into the network and gaining familiarity with the practices. The most common signature practice has become problem-solving courses, largely due to the Faculty-in-Residence program at Google and the strong partnership between CAHSI and Google. Likewise, the Faculty-in-Residence program created strong connections among faculty that formed the foundation for a productive, ongoing community of practice related to the problem-solving course. This community of practice has been sustained throughout the year through regular communication. Therefore, more than half of survey respondents were engaged in the problem-solving course and the community of practice related to the course. The other CAHSI signature practices do not have quite as strong uptake. About half of CAHSI participants feel that they are implementing PLTL to "some extent" or a "great extent." With the expansion of CAHSI, fewer members and affiliates are engaging in the ARG model or Fellow-Net. In particular, Fellow-Net has not seen widespread uptake. Therefore, the model of introducing faculty to problem-solving and sustaining their engagement through an ongoing community of practice could be transferred to other signature practices to introduce them to newcomers and to enhance and sustain their uptake among the CAHSI community.

Figure 19. Mutually Reinforcing Activities: CAHSI Signature Practices, CAHSI Network
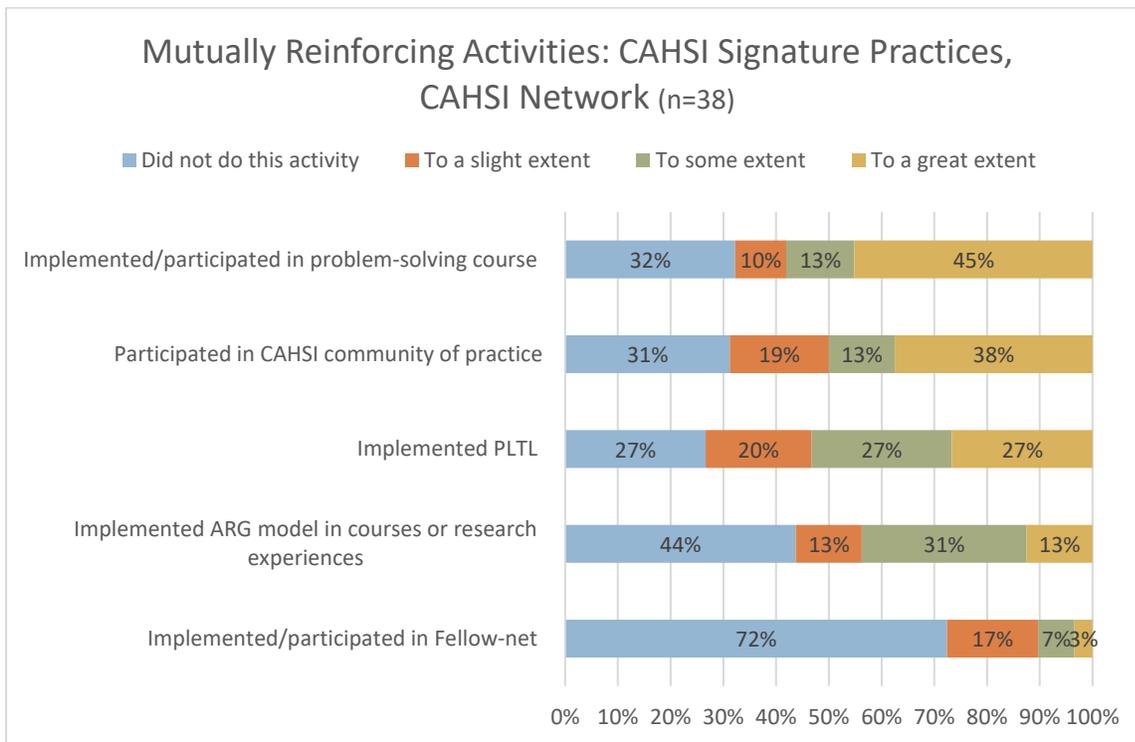
There is some regional variation in the use of signature practices, especially in the long-standing practices of PLTL and ARG. Peer-Led Team Learning is well-established in the Southwest, but less common in the North and Southeast. Likewise, ARG is relatively well-established in all of the regions, with the exception of the Southwest. UTEP is the strongest provider of ARG in the Southwest region. In particular, ARG leaders in the North and Southeast have a long, rich history of implementing the model and they have provided momentum for ARG in those regions.

Table 20. Mutually Reinforcing Activities: CAHSI Signature Practices, by Region

Strategic Activity	North (n=3)	Southeast (n=3)	West (n=10)	Southwest (n=17)	National Average
	% reported "to some extent" or "to a great extent"				
Implemented problem-solving course	67%	75%	44%	53%	**58%**
Implemented PLTL	33%	33%	44%	59%	**53%**
Participated in CAHSI community of practice	100%	100%	50%	35%	**50%**
Implemented ARG model in courses or research experiences	67%	100%	60%	18%	**44%**

| Implemented/participated in Fellow-net	0%	33%	0%	12%	**10%**

Veterans and newcomers differed in their uptake of CAHSI signature practices. Overall, veterans, especially those with 10+ years of experience with CAHSI, were much more likely to be engaged in CAHSI signature practices than newer participants in the network. Newcomers were most likely to participate in problem-solving which suggests that the problem-solving course is an effective recruitment and engagement tool to grow the CAHSI community. In contrast, the newest participants in CAHSI (with less than one year of experience) are much less likely to have implemented ARG. Although, relatively new members (with 1-2 years of experience) have more than double the uptake rate of ARG, suggesting that it may take more time to become fully trained in the model. Data in future years will help to determine whether the newest participants have adopted the ARG model. Veterans are most likely to have implemented PLTL, but the uptake rate among other cohorts of CAHSI members ranges from 1/3 to about half of participants. Only veteran members have implemented Fellow-Net, suggesting that more training and encouragement may be needed to foster greater uptake of the Fellow-Net model among newer members of the network.

Table 21. Mutually Reinforcing Activities: CAHSI Signature Practices, by Length of Affiliation

Strategic Activity	Less than one year (n=11)	1-2 years (n=9)	3-9 years (n=9)	10+ years (n=6)	National Average
	% participating in the activity to "some extent" or a "great extent"				
Implemented/participated in problem-solving course	63%	44%	22%	83%	**58%**
Implemented PLTL	36%	55%	44%	83%	**53%**
Participated in CAHSI community of practice	45%	55%	33%	66%	**50%**
Implemented ARG model in courses or research experiences	18%	44%	33%	100%	**44%**
Implemented/participated in Fellow-net	0%	0%	13%	33%	**10%**

The majority of CAHSI members were active in student support initiatives in the past year. Many members attended the Great Minds in STEM conference with students from their institutions. CAHSI and other computing-related clubs and chapters have expanded as more than half of members were involved in student professional clubs to "some" or "great" extent in the past year. Members were also highly involved in providing professional development and skill-building opportunities for their students.

Mutually Reinforcing Activities: Student Support, CAHSI Network (n=38)

Legend: ■ Did not do this activity ■ To a slight extent ■ To some extent ■ To a great extent

Activity	Did not do this activity	To a slight extent	To some extent	To a great extent
Participated in GMiS conference	23%	10%	23%	45%
Supervised/participated in student clubs or chapters	26%	19%	13%	42%
Provided skill-building experiences for students (hackathons, etc.)	20%	13%	37%	30%
Provided professional development for students (workshops, trainings, etc.)	16%	13%	42%	29%

There was little regional variation in levels of student support provided by CAHSI participants and departments. Overall, participants in the Southwest region were somewhat less likely to provide skill-building experiences for students or to have attended the GMiS conference. Similar to other regions, about half of Southwest survey responders had less than five years of experience with CAHSI so the differentiation in activities does not seem related to the length of involvement with CAHSI by Southwest regional members. Overall, CAHSI regions were moderately to highly engaged with student support activities.

Table 22. Mutually Reinforcing Activities: Student Support, by Region

Activity	North (n=3)	Southeast (n=3)	West (n=10)	Southwest (n=17)	National Average
	% reported "to some extent" or "to a great extent"				
Provided professional development for students (workshops, trainings, etc.)	100%	100%	70%	65%	**71%**
Participated in GMiS conference	100%	100%	80%	53%	**68%**
Provided skill-building experiences for students (hackathons, etc.)	100%	100%	89%	47%	**67%**
Supervised/participated in student clubs or chapters	100%	100%	56%	41%	**55%**

While undergraduate education remains the core focus of the CAHSI network, other stages along the educational pathway are relatively well represented among strategic actions. Workforce development initiatives and K-12 outreach activities were the most common of these other activities along the computing education pathway. About a third of CAHSI members are engaged in graduate education initiatives, so that is not quite as common a focus as K-12 or career readiness. Strategic actions related to math pathways are the least represented aspect of CAHSI strategic efforts related to the broader educational pathway.

Figure 21. Mutually Reinforcing Activities: Computing Pathways, CAHSI Network

Mutually Reinforcing Activities: Computing Pathways, CAHSI Network (n=38)

- Did not do this activity
- To a slight extent
- To some extent
- To a great extent

Activity	Did not do this activity	To a slight extent	To some extent	To a great extent
Provided or coordinated K-12 outreach activities	16%	29%	19%	36%
Implemented workforce development or career readiness initiatives	19%	19%	26%	36%
Implemented graduate education initiatives	58%	3%	13%	26%
Worked on increasing student success on math pathways	37%	27%	27%	10%

There was some regional variation in strategic actions related to computing educational pathways. While workforce development initiatives were most common, the Southwest region demonstrated less engagement in these initiatives according to survey respondents. The North region was not active in graduate education or math pathways but did report a strong focus on K-12 outreach and workforce initiatives. The West was the only region that reported high rates of engagement in efforts related to enhancing student success along math pathways.

Activity	North (n=3)	Southeast (n=3)	West (n=10)	Southwest (n=17)	National Average
	% reported "to some extent" or "to a great extent"				
Implemented workforce development initiatives	100%	100%	80%	41%	**61%**
Provided/coordinated K-12 outreach activities	100%	67%	67%	41%	**55%**
Implemented graduate education initiatives	0%	67%	50%	29%	**39%**
Worked on increasing student success on math pathways	0%	0%	70%	24%	**37%**

For the most part, CAHSI participants were highly involved in implementing student support programs and initiatives, although there was less engagement in faculty and K-12 educator support initiatives. CAHSI participants were most engaged in professional development pment for K-12 teachers. About half of survey respondents participated in faculty professional development (most survey respondents were higher education faculty members), and another 1/5 participated in a slight amount of faculty development. Coordinated and collaborative research projects were somewhat common among CAHSI members. Finally, fewer CAHSI participants were highly engaged in providing faculty development within or outside of their departments.

Figure 22. Mutually Reinforcing Activities: Faculty and Educator Support, CAHSI Network

Mutually Reinforcing Activities: Faculty and Educator Support, CAHSI Network (n=38)

Legend: Did not do this activity | To a slight extent | To some extent | To a great extent

Provided PD or training for K-12 teachers: 48% | 13% | 6% | 32%
Participated in professional development for faculty: 39% | 19% | 23% | 19%
Engaged in research with other CAHSI members: 32% | 32% | 23% | 13%
Provided professional development for faculty: 33% | 30% | 27% | 10%
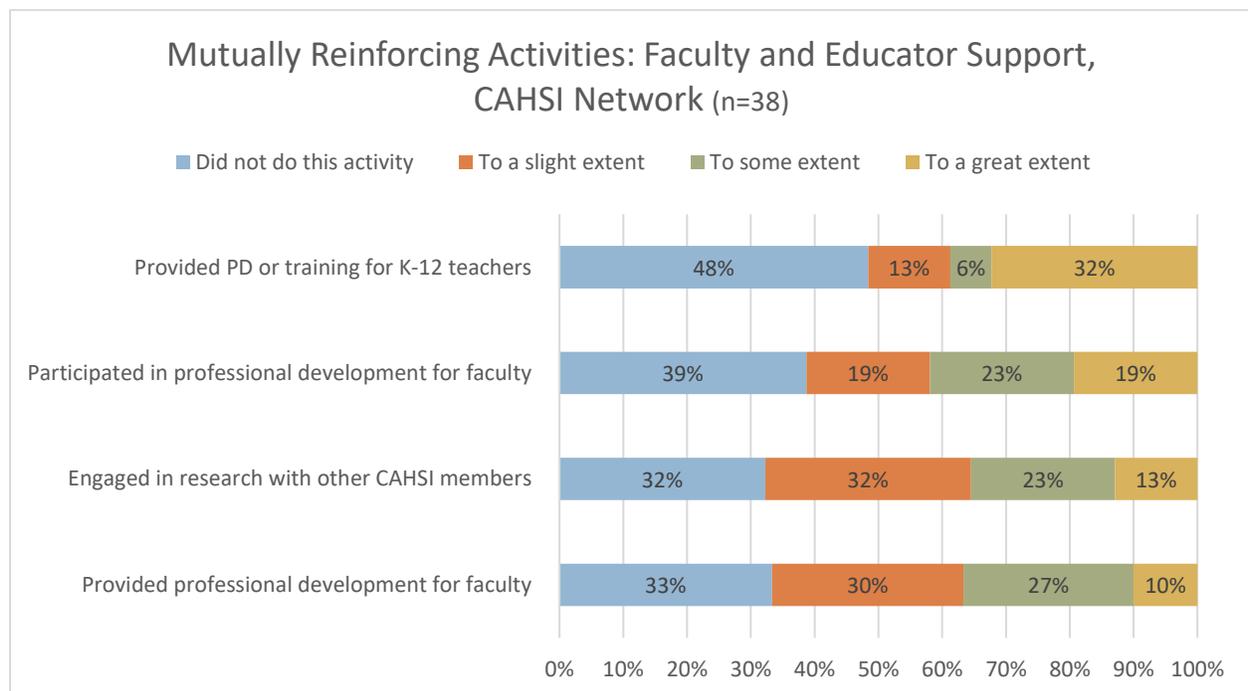
Strategic actions related to faculty and educator support varied slightly by region. CAHSI members in the North and Southeast regions were most likely to have participated in faculty professional development. Participants in the North region were also more likely to have provided professional development for K-12 teachers, while participants in the Southwest region were slightly more likely to have provided faculty professional development opportunities. Regions were largely equivalent in the extent of their research collaborations with other CAHSI participants, but the West was slightly less engaged in research among the CAHSI network.

Table 24. Mutually Reinforcing Activities: Faculty and Educator Support, by Region

Activity	North (n=3)	Southeast (n=3)	West (n=10)	Southwest (n=17)	National Average
	% reported "to some extent" or "to a great extent"				
Participated in professional development for faculty	100%	67%	30%	41%	**42%**
Provided PD or training for K-12 teachers	100%	33%	44%	29%	**39%**
Provided professional development for faculty	33%	33%	22%	41%	**37%**
Engaged in research with other CAHSI members	33%	33%	20%	41%	**35%**

In contrast to many other strategic actions, there was less overall involvement in systems-level or policy change. About half of CAHSI participants had actively worked to develop new degree or certificate programs in the past year. In the past, evaluation data have demonstrated that new degree programs have helped to bolster enrollment and graduation rates and expanded computing degrees to diverse groups of students. For instance, the Computer Technology degree program at California State University-Dominguez Hills has broadened participation in computing at that institution by enrolling and graduating high numbers of underrepresented minority students and attracting students who may not have been drawn to a traditional computer science degree. Therefore, these new degree programs (many in CyberSecurity) hold promise that they may increase the number of computing graduates and broaden participation in computing at CAHSI institutions. On the other hand, fewer CAHSI participants were highly engaged in policy work at the departmental institutional level. Very few CAHSI participants were highly engaged in policy at the state or national level, yet this is to be expected as this type of advocacy requires a deep level of knowledge, skill, and experience in policy and the issues surrounding Hispanics, computing education, student retention and the contexts of Hispanic-Serving Institutions.

Mututally Reinforcing Activities: Systems and Policy Change, CAHSI Network (n=38)

Legend: ■ Did not do this activity ■ To a slight extent ■ To some extent ■ To a great extent

Activity	Did not do this activity	To a slight extent	To some extent	To a great extent
Developed new degree or certificate programs	36%	10%	13%	42%
Worked on changing institutional or departmental policies	38%	21%	24%	17%
Worked on changing cross-institutional pathways (e.g. articulation agreements, system-wide changes)	52%	17%	17%	14%
Worked on changing state or national-level policies	63%	17%	13%	7%

There were a few differences related to involvement in systems-level or policy initiatives among regions. For instance, the Southeast participants were less likely to focus on institutional-level change, including departmental policies or new degree programs. The Southeast survey respondents were all from Puerto Rico and this may reflect the turmoil on the island in the fiscal and higher education environment. Otherwise, members in the West were most likely have focused on changing institutional or departmental policies, while members in the North were more likely than other regions to have advocated for state-level or national change.

Table 25. Mutually Reinforcing Activities: Systems and Policy Change, by Region

Activity	North (n=3)	Southeast (n=3)	West (n=9)	Southwest (n=16)	National Average
	% reported "to some extent" or "to a great extent"				
Developed new degree or certificate programs	100%	33%	66%	47%	**55%**
Worked on changing institutional or departmental policies	33%	0%	55%	35%	**41%**
Worked on changing cross-institutional pathways	33%	33%	22%	31%	**31%**
Worked on changing state-level or national policies	66%	33%	11%	13%	**20%**

In sum, CAHSI has made great strides in accelerating the development and implementation of emerging practices such as the problem solving course. This can serve as a model for how to quickly launch, implement, and build communities of practice around emerging models. CAHSI regions have made substantial progress in engaging in strategic actions. Veterans are more likely to engage in the signature practices, while newcomers are more likely to engage in problem solving or other emerging areas, such as workforce development or graduate education. In particular, the problem solving course seems to be an effective tool to recruit and engage new participants in CAHSI. Undergraduate education remains the core focus of CAHSI, while other priority areas are emerging across the regions. In all, the regions have worked together to plan and implement strategic actions and mutually reinforcing activities that address local needs, contexts, and expertise.

BACKBONE ORGANIZATION

The backbone organization provides coordination and coherence of goals, strategies, and activities within any collective impact effort. The Backbone is responsible for providing a guiding vision and strategy for local efforts, promoting and marketing CAHSI at a national level, supporting strategic actions, and establishing common measures. The CAHSI backbone held four regional onboarding meetings to orient all CAHSI participants (newcomers and veterans alike) to the vision and strategies of CAHSI and to introduce newcomers to the collective impact model. The backbone also established visioning documents for the backbone itself and for CAHSI regions. The backbone also coordinated communication and document sharing strategies and developed marketing and branding materials for the CAHSI community. The goal of the evaluation is to measure the connections and communication processes between the backbone and the regions, the dissemination of information and resources by the backbone and to provide formative information about support needed from CAHSI participants.

Backbone Support: An independent, funded staff dedicated to the initiative provides ongoing support by guiding the initiative's vision and strategy, supporting aligned activities, establishing shared measurement practices, building public will, advancing policy, and mobilizing resources.

Social Network Analysis: Backbone Support

In collective impact, the backbone serves to support all members in improving the participation of Hispanics in computing. The degree centrality of two of the backbone members described a network where two of three had connections with nearly all people in the network, including the advisory board. Social network theory describes those with high numbers of "non-redundant ties" as having the best opportunity for divergent ideas, as they are immersed in

multiple communities across the network. The relative connectivity of the backbone is high as would be expected given the role of support provided.

Backbone staff had the highest degree centrality of any group of members—one member is connected to all other members in the network, while another is connected to all but one. Backbone members were rated by members in the community on their value and the level of trust they have of the members of the backbone. Backbone members earned the highest mean and median scores in overall value across all network roles and rank second behind the leads in terms of trust scores. This indicates a highly functioning backbone unit that is deeply connected to the core CAHSI staff and leadership at each region. As CAHSI grows it will be important to consider how backbone staff might distribute connections to be more efficient—the redundancy in connections is valuable early on as CAHSI INCLUDES deepens work in partner organizations, but as it expands, the network will need to adjust to support larger numbers.

Table 26. SNA Results: Scores that Backbone Members Received from Others in the CAHSI Network

|	Degree Centrality (max 27)	Non-Redundant Ties	Closeness Centrality	Relative Connectivity	Overall Value (1-4)	Power/Influence (1-4)	Level of Involvement (1-4)	Resource Contribution (1-4)	Total Trust (1-4)	Reliability (1-4)	In Support of Mission (1-4)	Open to Discussion (1-4)
Backbone 1	27	21.75	1	100%	**3.8**	3.75	3.83	3.82	**3.78**	3.67	4	3.67
Backbone 2	26	21	0.96	96%	**3.55**	3.45	3.64	3.55	**3.72**	3.64	3.9	3.64
Backbone 3	12	8.57	0.64	55%	**3.52**	3.17	3.83	3.55	**3.66**	3.58	3.9	3.5

In the mutually reinforcing activities section, we illustrated how the backbone connects at the regional level to support the work of CAHSI. This further illustrates the ways connections with the backbone are utilized regionally and support the connectivity of members in each region.

Collective Impact Survey: Visioning and Guidance from the Backbone

In the past year, the CAHSI backbone provided varied and high-level guidance to regional and local members and affiliates to support their strategic planning and actions. When asked to mark the areas in which the backbone had provided the most support, almost half of members

reported that the backbone had provided essential support in guiding and visioning, onboarding and providing resources and training. Nearly a third of members responded that the coordination and communication regarding activities and strategies was vital. Fewer members reported that the backbone had assisted with securing and mobilizing funding, data use and decision making, and assistance with policy or advocacy.

Figure 24. Most Important Areas of Support Provided by CAHSI Backbone

Most Important Areas of Support Provided by CAHSI Backbone (n=27)

Area	Percentage
Providing a guiding vision	44%
Onboarding/Introduction to CAHSI	44%
Resources/training on CAHSI signature practices	44%
Communication/coordination about strategy/activities	29%
Providing or securing funding	21%
Data use	9%
Assistance with advocacy or policy	9%
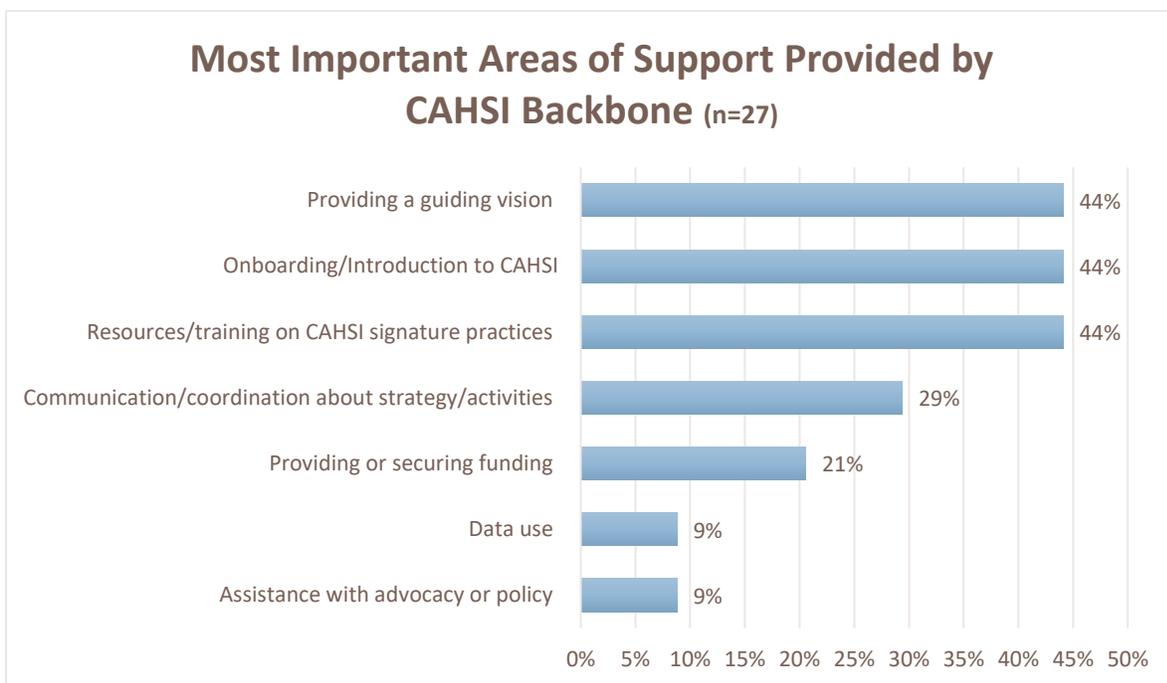
Across the board, regions experienced and valued in similar ways the types of support provided by the backbone. There was little to no regional variation in the importance of or support provided related to communicating and coordinating strategies, assistance with securing funding, assistance with advocacy or policy, or data use. The Southeast received more support in resources and training in practices, perhaps connected to their higher rates of external dissemination about CAHSI practices (see next section). The North region received more value in onboarding, perhaps in part because the institutions did not have a longstanding working relationship with one another compared to some of the institutions in the other regions with more established relationships. Finally, members in the North received more support in the communication of the CAHSI vision, while members in the Southeast received less support in this area. Again, this discrepancy may have resulted from a new institution entering the alliance in

the North region and the developing of working relationships across that region. In contrast, the Southeast region was more established with existing perceptions of CAHSI and working relationship. Nevertheless, there was great consistency among regions in the support provided by the backbone to assist in the collective effort of members and partners.

Figure 25. Support from Backbone, by Region
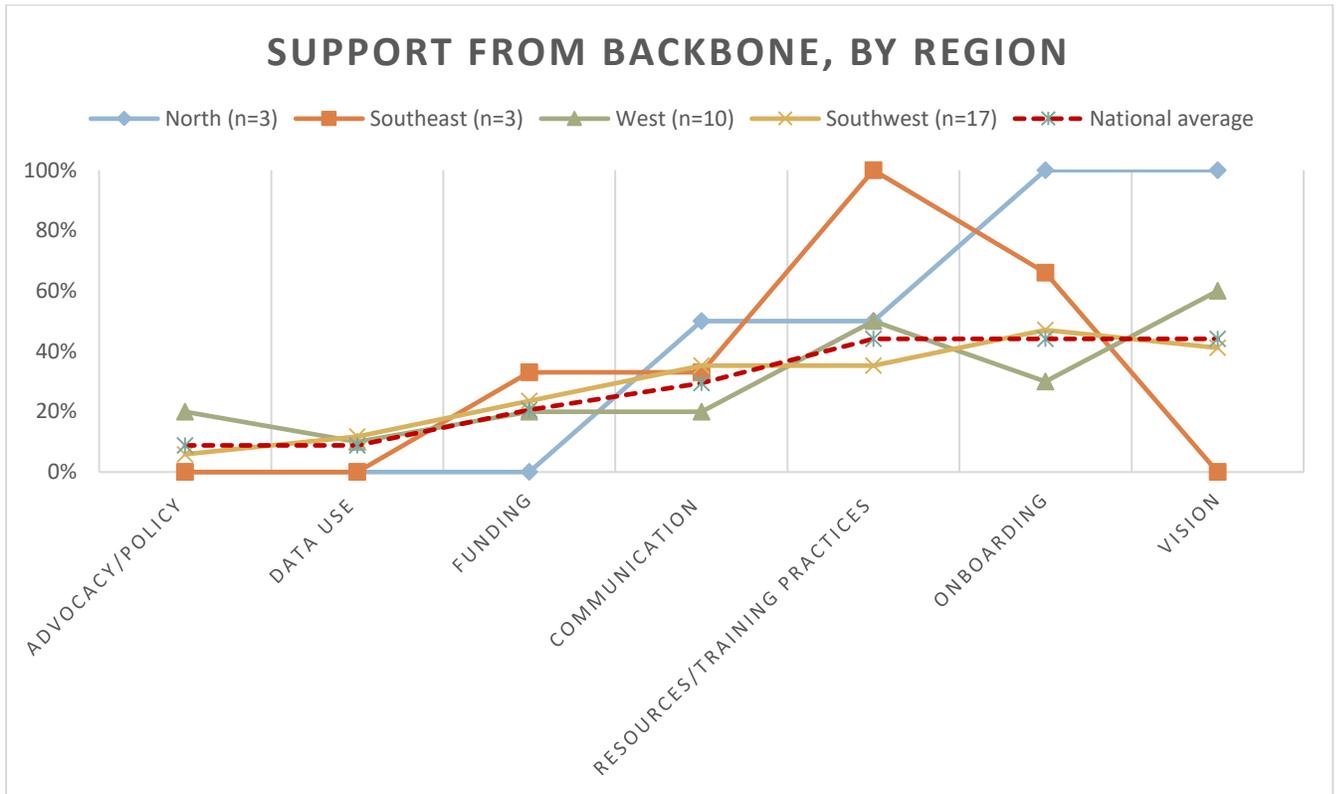
Surprisingly, veteran members reported more support from the backbone than members with medium lengths of involvement with CAHSI (3-9 years), who reported the least involvement with and support from the backbone. In particular, veterans with more than 10 years of affiliation with CAHSI sought support in securing additional funding and support for trainings and resources related to CAHSI practices. As leaders within CAHSI, these longstanding members may be more focused on the long-term funding and sustainability of CAHSI and on disseminating CAHSI's practices and resources to a larger audience. Newer participants with less than two years of affiliation with CAHSI also sought more support from the Backbone because they are still becoming acquainted with the vision and practices. Newcomers received the most benefit from onboarding, although veteran members also reported substantial benefit from onboardings. The onboardings may have helped veteran members to see CAHSI in a new light as they also gained insight into the collective impact effort and were introduced to the visioning and strategic planning documents created by the backbone.

SUPPORT FROM BACKBONE,
BY LENGTH OF AFFILIATION
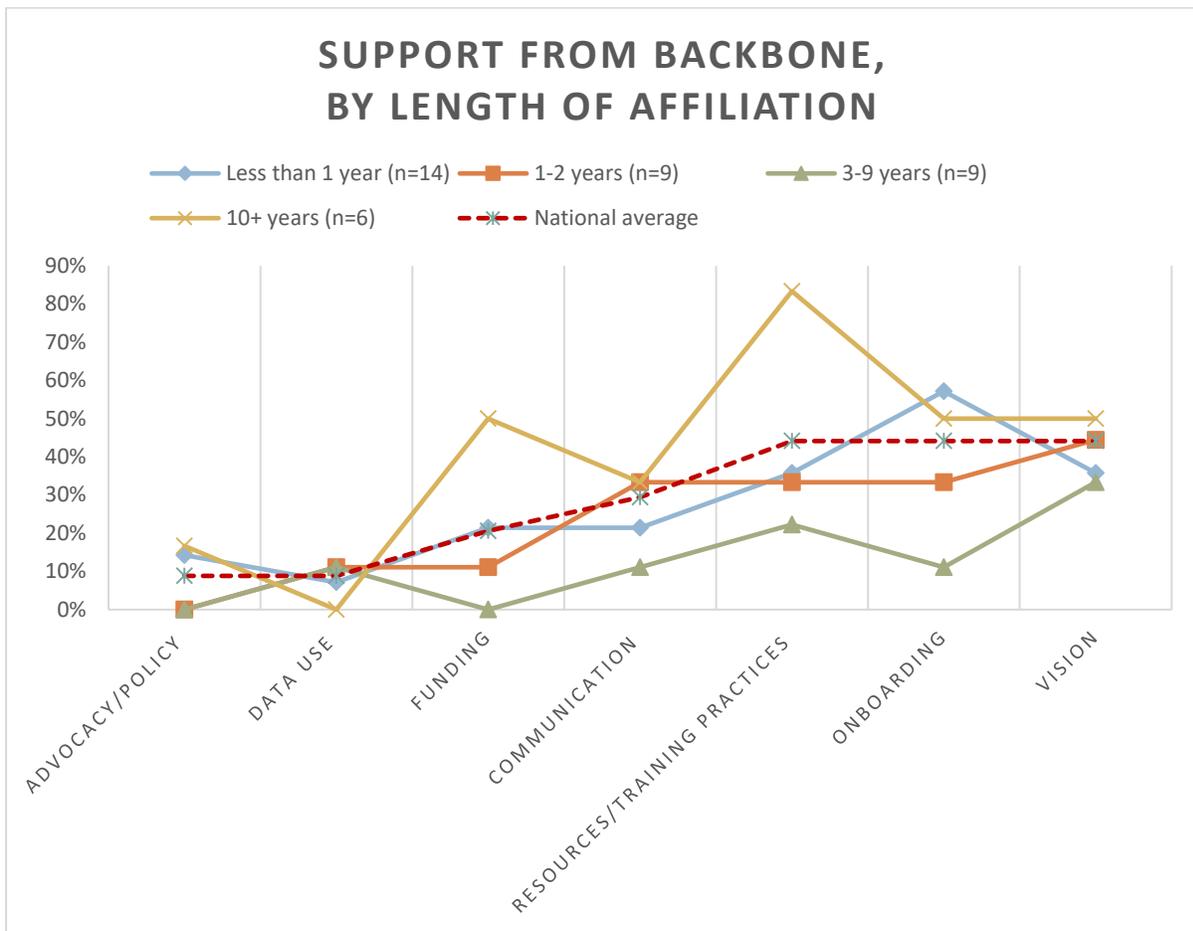
Interviews with key stakeholders (backbone members, regional leads and co-leaders, connectors and coordinators) affirmed the centrality and importance of the support of the backbone in advancing CAHSI's efforts. The backbone viewed their greatest accomplishment as bringing the regions together for onboardings and creating visioning documents to serve as aspirational guides and roadmaps to move the collective work forward. The strategic plans helped members to think strategically and critically about their unique institutional and regional contexts and needs and how they could best address the problem of Hispanic underrepresentation in computing within those contexts. The backbone identified an ongoing challenge in helping members to see the problem as systemic, requiring systems-level, cultural change, and to broaden participants' mindsets to undertake more creative solutions to institutional or other barriers. For instance, a backbone member stated, "The challenge is moving the conversation toward being a problem-solver with low resources. What can you do with low resources?" The backbone also reflected that they could expand the community of practice model to other signature practices and could provide more coaching for regions and members.

The backbone also affirmed its commitment to helping members to look at their data because "to think strategically, you have to understand the data." Data will help institutions and regions to understand the aspects of the problem that they are not addressing and who they need to engage to be successful.

Stakeholders at the regional level affirmed that the backbone had provided vital support in visioning and in general guidance and advice on strategies and practices. Some stakeholders mentioned that the backbone had provided an essential service in reviewing their materials and providing feedback on their efforts to promote CAHSI within their regions. Stakeholders also noted that the onboardings were beneficial in helping to cement the regional efforts and to introduce the strategic planning process. A coordinator commented on the ongoing and important support provided by the Backbone:

> What do they not do? The backbone just has such an influence on everything. But I think they're really just there for support. I know that I can turn to anybody in the backbone really and say, "Hey, this is what we need. This is where I'm struggling. What do you have?" and they're always available with resources or answers to any questions. I think not only are they really just the driving force of "okay this is really where we want to go as an alliance." They're also like, "What can we do to serve you?" So they've been really great about just providing resources at any time.

Support Needed from Backbone

In an open-ended question about how the backbone can better support local efforts, there was general consensus that the Backbone had provided important support for collective impact work and respondents offered some suggestions about the most important types of support that they need from the backbone. The primary response was that the backbone could better support local progress by providing faculty professional development and training, especially in ARG and PLTL. Other respondents noted that they needed ongoing guidance, advice, and support as well as access to information about opportunities, events, and activities. Some respondents felt that resources and materials are helpful, especially related to the signature practices. Finally, some respondents also noted that they could benefit from help with seeking and securing funding. Faculty often have little time for grant writing—especially in teaching-intensive institutions—so support in identifying and securing funding and proposal writing is beneficial. Sample comments are as follows:

> Materials online; such as content for courses, content for training students in ARG and PLTL, content for training faculty in ARG and PLTL, more trainers that can put on low-cost local workshops.

It's been really helpful to receive resources (signature practices, training modules, etc.)

Provide guidance and tools to promote CAHSI in our region.

Keep doing what they have been doing, be there for us to answer questions, offer advice, give examples, backup support as needed.

Help us with marketing our cybersecurity and other technology degree programs, and helping our students get jobs.

Clear direction on industry collaboration would be helpful too. For instance, what else are we seeking from them if they are unable to provide "Google" kind support?

Disseminating information and opportunities that respond to our necessities. Keep doing what they are doing.

The Backbone could perhaps hold a meeting with our institution as a whole (sort of an onboarding meeting). Better timing of relaying information would also be beneficial (giving regions ample time to disseminate information prior to deadlines.

Figure 27. Support Needed from Backbone

Support Needed from Backbone

Category	Percent
Training workshops/faculty development	24%
Offer guidance and advice	18%
Disseminate timely information	18%
Provide resources and materials on practices	18%
Funding opportunities	18%
Institutional onboarding	12%
Marketing materials	12%
Assistance with industry partnerships	6%
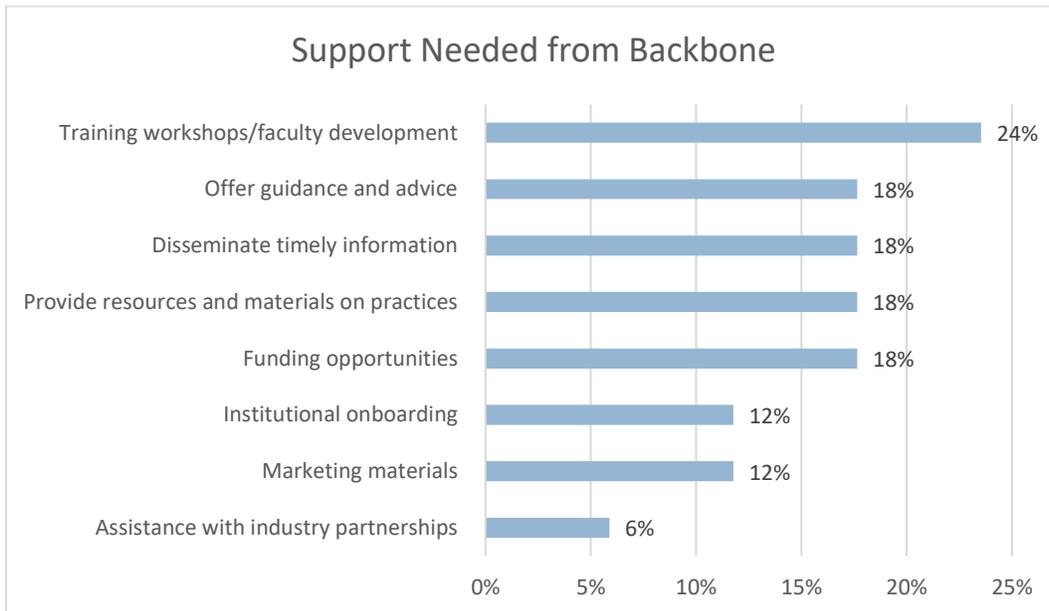
Following is a Word Cloud comprised of survey responses to the open-ended question about how the backbone could better support local efforts at collective impact.

Figure 28. Word cloud, Open-ended responses about Backbone Support

In conclusion, the CAHSI backbone is at the heart of the network and has developed strong ties and levels of trust with regional leadership and members. The backbone has provided support in many areas, including providing a guiding vision, introducing members to CAHSI's values and strategies, providing a strategic framework for action, and providing general advice, guidance, and coaching when needed. The work of the backbone has been absolutely critical to the organization and functioning of the regions. Stakeholders see the backbone as a central support mechanism for lending coherence and coordination to the vision and activities of regional and local affiliates. In addition to offering vision and strategy to the collective impact effort, the backbone has successfully built trust and relationships that can be capitalized on to sustain motivation and engagement among members.

COMMON MEASURES

The use of data and common measures to track progress, inform decisions, and improve practice is central to the work of collective impact initiatives. CAHSI INCLUDES made progress in their use of common measures in the past year through the hiring of a postdoctoral researcher

to facilitate the collection and use of common progress measures. While the specific measures are still being finalized, the data management team will be responsible for tracking institutional and regional progress in achieving enrollment, graduation, and other goals. The data management team will also monitor CAHSI's national progress in increasing the representation of Hispanics receiving credentials in computing fields. Additionally, the data management team will measure departmental climate as another metric to track CAHSI's progress in creating equitable, inclusive learning environments for students and faculty.

SHARED MEASUREMENT: All participating organizations agree on the ways success will be measured and reported, with a short list of common indicators identified and used for learning and improvement.

Collective Impact Survey: Common Measures

At this point in time, CAHSI members are more likely to share information about already proven, evidence-based strategies than to use data to make decisions or identify needs. About 2/3 of CAHSI survey respondents have shared evidence-based strategies with the network in the past year. A relatively high number of CAHSI members have also used data to improve individual initiatives or programs. CAHSI members are less likely to be highly engaged in using data to make decisions or identify needs or where to allocate resources. Very few CAHSI members are personally using data to monitor their progress toward meeting CAHSI's goals and vision.

Figure 29. Data Use, CAHSI Network

Data Use, CAHSI Network (n=35)

Legend: Did not do this activity | To a slight extent | To some extent | To a great extent

Activity	Did not do this activity	To a slight extent	To some extent	To a great extent
Shared evidence-based strategies	14%	17%	40%	29%
Used data to improve initiatives	17%	11%	46%	26%
Used data for decision-making	18%	21%	47%	15%
Used data to identify local or regional needs	24%	18%	47%	12%
Used data to track progress in meeting CAHSI's vision	24%	27%	45%	3%

Data use differs dramatically by region. Members in all of the regions are using data to track progress toward CAHSI's goals at about the same rate. However, there is stark difference in the use of data to identify needs or make decisions. Members in the North region are using data for these purposes to a greater extent than members in the Southeast, who are not currently using data for these ends. Members in the West also generally engage in more data use than members from other regions. Using data to identify needs is not prevalent in several of the regions, such as the Southeast and the West.
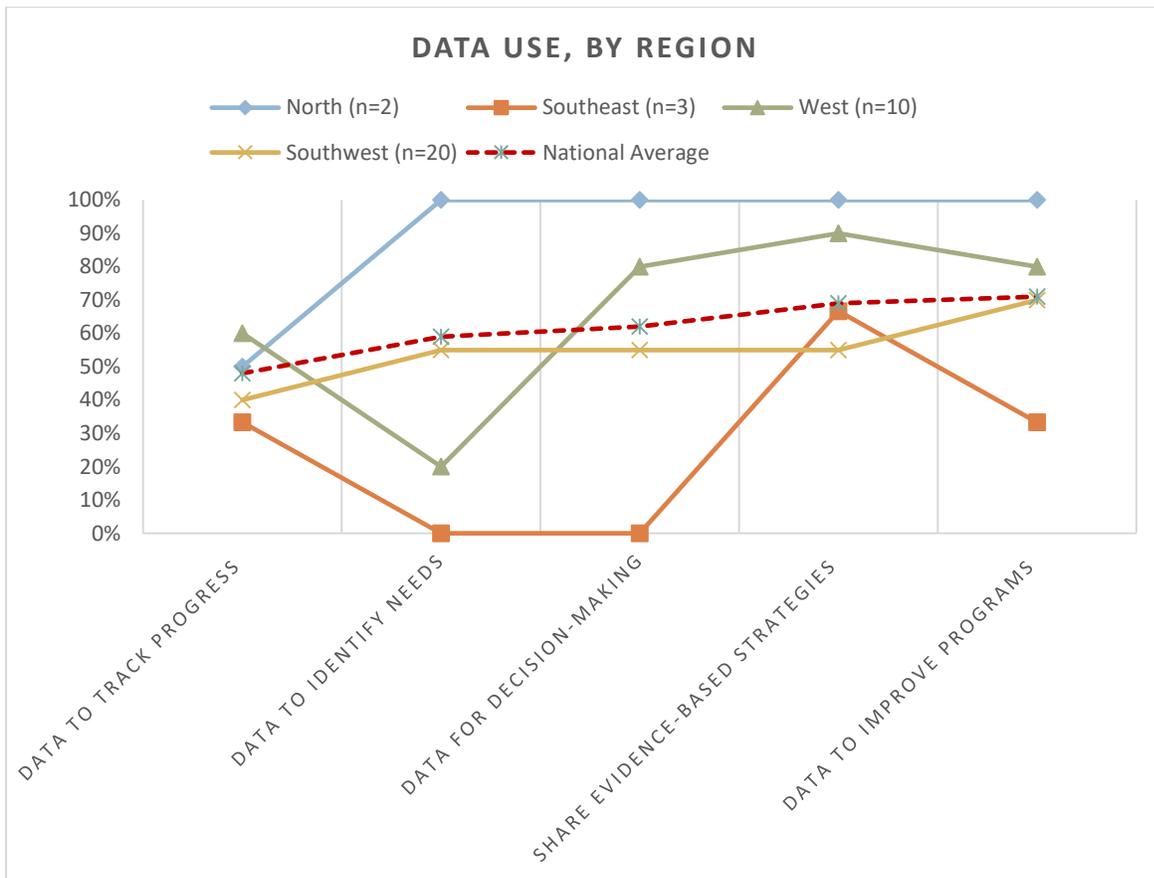
In interviews, stakeholders noted that they have renewed interest in data and are starting to think more broadly about what type of data are important and what kinds of outcomes are pertinent. For instance, a leader in one of the regions commented that involvement in the CAHSI community has shifted regional thinking from enrollment and graduation as the only relevant metrics, to broader conceptions of student identity and professional development as important and meaningful outcomes and metrics. On the other hand, many stakeholders are just beginning to think more systematically about data as way to track progress toward a collective goal or to make decisions beyond simply programmatic choices. In this sense, most stakeholders felt that they needed some guidance on common measures across the entire collective impact effort, as

summarized by a connector: *"I feel like we definitely need somebody to tell us that data we're collecting as an alliance. I feel like each institution needs to figure out exactly what numbers everyone else is collecting so we can have that baseline measurement. Or at least consistency in the our data."*

In conclusion, CAHSI participants have made some progress in thinking about and reflecting upon data more systematically. Many CAHSI members are used to looking at data related to specific programs or initiatives at their institution, but the move to thinking about data across a network is a shift for them. Many had a keen interest in exploring their data and how it may compare to the region or network overall. Moreover, the combination of evaluation, research team, and data management team has helped to broaden stakeholders' approach to data as more than simply graduation rates, but encompassing more complex, nuanced constructs such as identity or self-efficacy.

CONTINUOUS COMMUNICATION AND DISSEMINATION OF INFORMATION

Through its collective impact effort, CAHSI INCLUDES has broadened and expanded its reach in the Southwest, Southwest, Northeast and West regions. The broader CAHSI INCLUDES community offers the opportunity for the regional networks to come together to build consensus on a common mission and goals, identify and align common strategies and activities, and to improve practice and strategies through common measures. The CAHSI INCLUDES community held 10 in-person meetings in the past year, including onboardings of each region, an all-hands meeting in Phoenix, a research workshop, an advisory board meeting, the CAHSI Summit at Great Minds in STEM, and the NSF INCLUDES Convening. These events served as forums for engaged stakeholders to convene around CAHSI's vision, engage in strategic planning, and network with each other to solidify relationships and strategies. The coordinators and connectors that have been brought into the collective impact effort in the past year have also contributed to the communication and coordination of regional activities and the dissemination of information within the regions.

Continuous Communication: Frequent and structured open communication across the many players to build trust, assure mutual objectives, and create common motivation.

Social Network Analysis: Continuous Communication

The social network analysis addresses the frequency with which major stakeholders communicate. The social network of CAHSI INCLUDES stakeholders can be seen as an interconnected community with multiple redundant streams of communication. The regions cluster near one another, yet there are clear signs of cross-region communication, such as from

a "diamond" to a "pentagon", indicating a relationship between North and West staff and/or leaders. The three backbone "squares" are situated in the center, with densely packed lines of connection emanating from each square. This is the frequency of connections that occur "at least monthly." Each member has communication with at least two individuals monthly, the patterns for the least connected members are such that one backbone and one regional connection occurs at least monthly. In the second network image, below, the lines represent weekly communication. At the level of weekly communication, we begin to see isolates in the network—individuals with no communication about CAHSI on a weekly basis. Given the important roles the SNA survey respondents play in the CAHSI network, these isolates are problematic, as they did not receive the survey unless they were co-leads, leads, or staff partially funded by CAHSI, such as coordinators and connectors (or in some cases, in roles where their time has been negotiated to serve CAHSI on a regular basis). In one case, an isolate is the sole local participant in CAHSI.

Figure 31. SNA Results—Monthly Activity Collaboration; Weekly Activity Collaboration
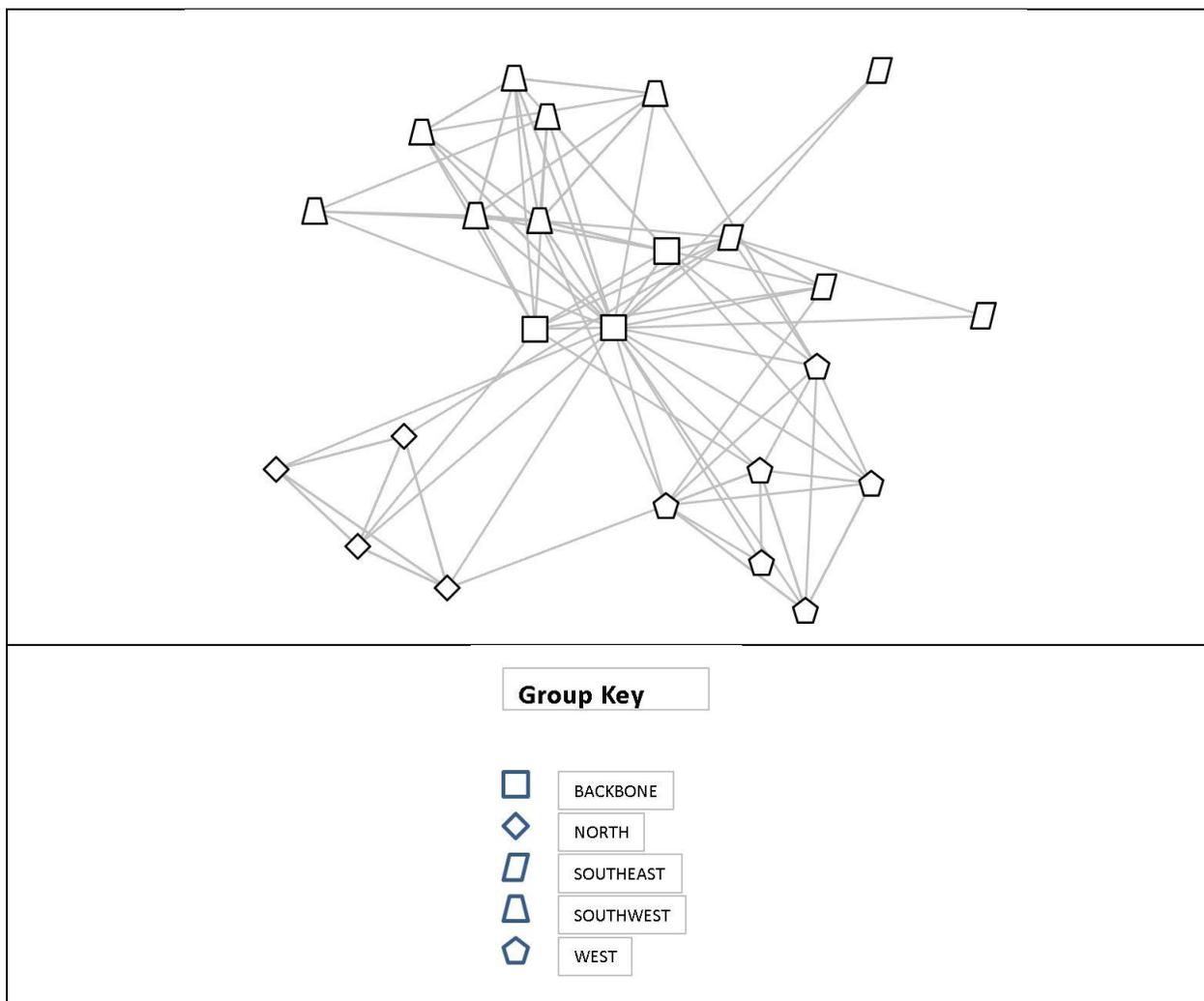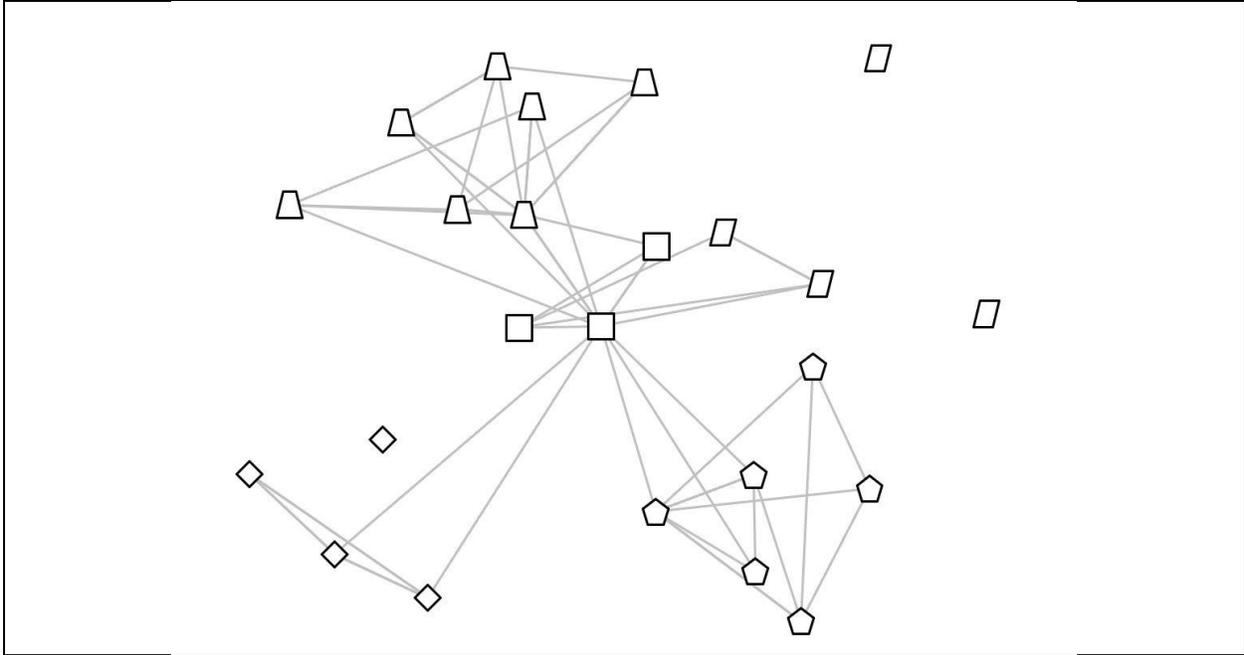
While cross-regional ties exist, they are least common in the network. Maximizing knowledge sharing *ACROSS* regions is not an element of CAHSI that is built directly into the structure of the organization, and so developing additional opportunities for large group informal meetings of CAHSI stakeholders nationally could be vital for success. In a case where strong cross-regional relationships exist for leads and co-leads, an intensive professional development program created the impetus for building a relationship.[2] Similarly, leadership calls across the regions create opportunities to share knowledge across regions. At this time, coordinators and connectors do not report many cross-regional relationships. Giving them opportunities to build rapport in informal ways may assist in transmitting the network's knowledge across regions.

The design of CAHSI is such that the connectors are meant to spark connections and keep momentum in communication within regions, and the backbone is inteded to stitch together the regional networks. We hypothesized that connectors would have high "degree centrality," which "is based on the number of direct connections to others." In addition, connectors and coordinators might be seen as "high value" participants in the CAHSI collective impact network, because of their dedicated time to the initiative.

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[2] Multiple participants in CAHSI leadership participated in the Faculty-in-Residence program and continued connections beyond the intensive summer workshop.

Connectors

	Degree Centrality (max 27)	Non-Redundant Ties	Closeness Centrality	Relative Connectivity	Overall Value (1-4)	Power/Influence (1-4)	Level of Involvement (1-4)	Resource Contribution (1-4)	Total Trust (1-4)	Reliability (1-4)	In Support of Mission (1-4)	Open to Discussion (1-4)
Connector A	6	3.31	0.56	30%	3.5	3	3.75	3.75	3.87	4	4	3.6
Connector B	9	5.3	0.6	37%	2.9	2.2	3.75	2.75	3.87	4	4	3.6
Connector C	11	7.26	0.63	51%	3.5	3.11	3.75	3.63	3.77	3.67	3.86	3.78
Connector D	12	8.61	0.64	45%	3.04	2.33	3.6	3.2	3.77	3.83	3.8	3.67
Mean	9.50	6.12	0.61	0.41	3.24	2.66	3.71	3.33	3.82	3.88	3.92	3.66
Average	10.00	6.28	0.62	0.41	3.27	2.67	3.75	3.42	3.82	3.92	3.93	3.64

Results of the network analysis indicate moderate degree centrality of connectors across the national network, moderate relative connectivity, high total trust in connectors, and moderate overall value in the network. We note that the connector scores are lowest in "power/influence" which brings down the "overall value" scores. The number of connections in the national network (as evidenced in degree centrality) tend to vary on time in the position, length of involvement with CAHSI, as well as size of the region/number of sub-region staff and co-leads. As the baseline year for these staffing positions, we imagine deepening and broadening of network ties within and across national and regional staff and leadership will occur in coming years.

Within regional staff and leadership, it is clear that communication occurs frequently, and trust is high. In most regions, the backbone has a central position in the network. As networks build regionally, the methods of communicating more broadly as well as the messages amplified regionally by connectors, in particular, are consequential for making change and impact.

For one new member, the connections to the CAHSI network have been impactful. Leadership coaching and mentoring have been significant in the new member's case.

> "(Lead from another region) assisted us very generously in providing text that led to us successfully getting some Google funding for the coming year where we will be running a research thing. We took the model, I included (lead) as a consultant on it and so forth. And (lead from another region) is leading a cyber security event, (lead) answered loads of questions. (lead from another region) and I have talked about a few things and I'm looking forward to learning more. He has a strong multi-school S-STEM grant and I'm looking to see if I can use that."

A participant in a leadership role described an understanding of collective impact and describes why continuous communication is important for understanding how to move forward.

*"When you come together you have a common agenda, you have to have regular meetings, you're going to have to have metrics performance, you decide what metrics you want to use... so you know when you are successful. And what you want to do there in difference to collaboration is that **everybody builds together on their strengths**. So, you don't want anybody to adopt anything new or for your idea to be on the table, what you want is to build on each other's strengths. And **in order to do that you need to understand what everybody does. So, some meetings are just understanding what each of us have to contribute to the group**. You define objectives and that's what the common agenda kind of do. And then you measure it and you see how much progress you go along with that. For that, we need the backbone."*

Another new leadership member of CAHSI describes not only the communication itself, but the style of communication as effective.

"I appreciate that this collective impact (community) has been trusting individual leaders. We do our work. Not too much micromanaging, and we are respected... There are constant reminders. From CAHSI, I found that I really like to learn from (members of the organization). CAHSI is very gentle but pushing for change in a very nice way."

Still, communication has not always worked seamlessly. Members struggled across sub-regions to collaborate, in some cases.

"There's quite a big geographical distance between our lead and the region that we have here. Cross geographical (collaboration), it's been difficult. We do meet on the regular as well and we try to focus on our same problems but given that their geographical composition is a little bit different, their solutions are different than ours."

Communication from the backbone in this first year has ssometime felt rushed—stakeholders who received information to distribute more broadly did not always have the time they need to act on the communications, particularly because they spend plenty of time with students in preparing and motivating their involvement in conferences or initiatives.

"Communication is very important, knowing what everyone else is doing is good. And I guess, also just being aware of things on time. Sometimes we would have issues that emails would be sent out and we would have a week to tell students, or like three days to tell students something. And that's a little bit frustrating, because then our students miss those opportunities because of timing. It may take a while (to engage students in the opportunity). If I feel a student is qualified for it, I'm going to have to reach out to them, have them make that decision and then walk them through the process."

Stakeholders stated that a newsletter would be valuable for standardizing information sharing across the national network.

"I think that the backbone should have a newsletter that goes out that connects all of the CAHSI regions, because I'm sure everyone is doing things, but we don't know what's going on. Because, for example, if someone's doing an online event that our students could participate in, we could reach out and say, "Hey, can we partner in that?" So that would be good. Because I feel like the only way I know what's going on is when you attend those (Connector and Coordinator) meetings."

Collective Impact Survey: Continuous Communication and Dissemination of Information

While the social network survey measured the strength and frequency of the relationships and interactions within the network, the collective impact survey measured the dissemination of information within the network. Overwhelmingly, CAHSI members were highly involved in communicating various professional and educational opportunities to students. This was the most common type of information shared by network members. CAHSI members also communicated opportunities for faculty, including trainings and professional development opportunities, although less so than for student opportunities. To a lesser extent, CAHSI members communicated externally about CAHSI's vision and practices through publications, presentations, or social media. Thus, the primary form of information sharing within the CAHSI network was internal communication related to educational and professional opportunities for students. External communication outside the network about CAHSI's vision or practices was less common, especially on social media.

Figure 32. Continuous Communication and Dissemination, CAHSI Network

Figure 32. Continuous Communication and Dissemination, CAHSI Network
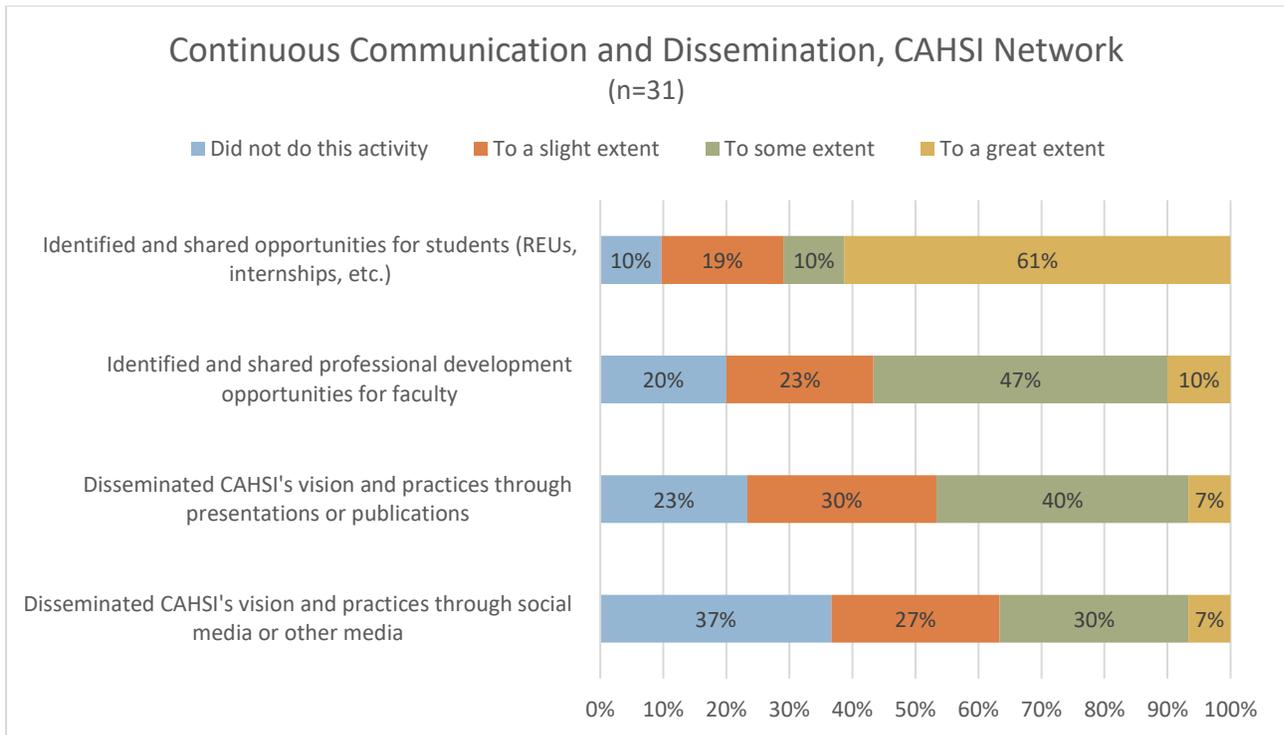
Regions, for the most part, engaged in similar rates of communication and dissemination of information. The Southeast region engaged in more dissemination of CAHSI's vision and practices through formal presentations and through social media. The other regions clustered around the national average rate with around 30% of members engaged in disseminating information about CAHSI to an external audience. Regions also engaged in similar rates of sharing information about opportunities with faculty. Results diverged slightly in regard to disseminating opportunities to students, where the Southwest members disseminated opportunities at a less frequent rate (perhaps because they depend more on the backbone for this dissemination because the backbone is located within the region) and members of the North and Southeast disseminated student opportunities at a higher than average rate.

CONTINUOUS COMMUNICATION AND DISSEMINATION, BY REGION

North (n=2) — Southeast (n=3) — West (n=10) — Southwest (n=16) — National Average
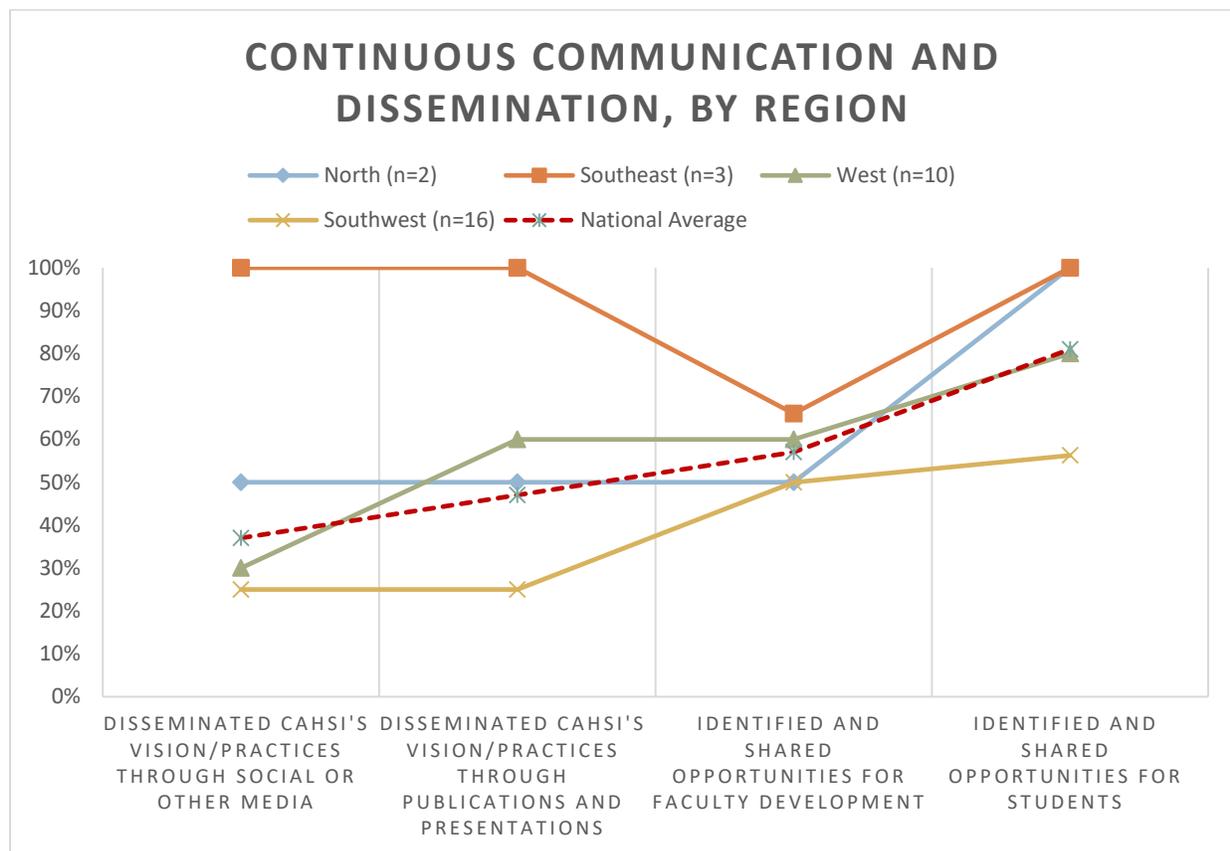
Not surprisingly, members who were highly involved in the CAHSI network were much more likely to disseminate information about CAHSI to a broader, external audience and to share opportunities and information internally with students and faculty. These CAHSI ambassadors were responsible for high levels of communication and information sharing within and outside of the network. Those who attended one or two events were just as likely as highly engaged members to share information with students and faculty, yet much less likely to share information about CAHSI to a broader audience. Therefore, these highly involved members are key to broadening CAHSI's influence by sharing its strategies and vision with a national audience.

CONTINUOUS COMMUNICATION AND DISSEMINATION, BY ATTENDANCE AT CAHSI EVENTS IN PAST YEAR
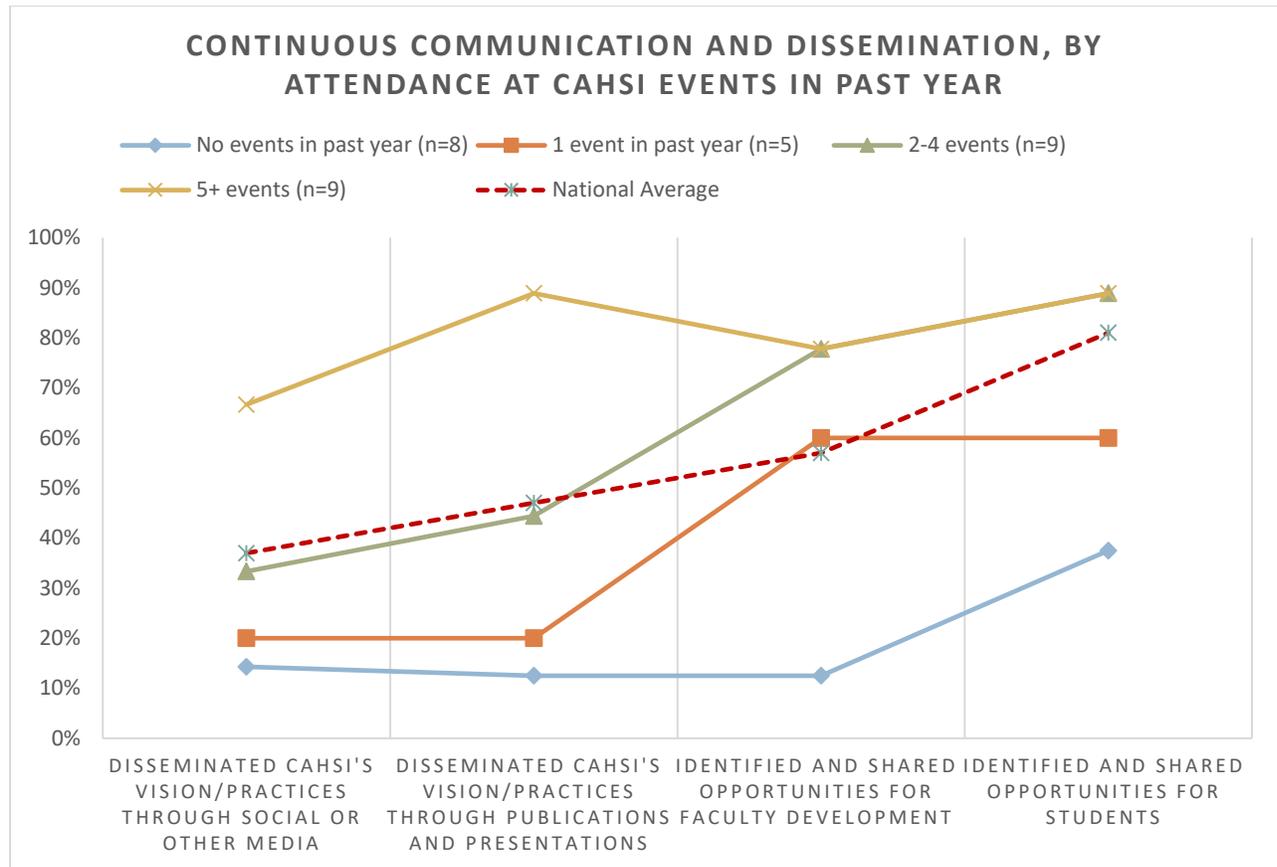
Continuous communication has developed quickly in the CAHSI INCLUDES project, and has for the most part permeated the leadership, staff, and backbone members. The regional communication is, by design, more frequent. Connectors, the staff position developed to serve as liaisons between groups, are viewed as worthy of trust by those who connect to them, and of moderate value, when compared to other roles. This is primarily because of the perceived lack of power of the position. Connections exist among all regional members, and the regions are tightly connected to the backbone staff, with a few exceptions. The cross-region connections could be improved to fully utilize the network structure. In addition, members vary in their dissemination of information based on their role and length of involvement with CAHSI. Many members were active in communicating about student or faculty opportunities. On the other hand, long-time veterans were more responsible for communicating CAHSI's vision and practices to a national audience.

CONCLUSION

In conclusion, CAHSI has made great strides in articulating its vision, inspiring energy and momentum among stakeholders, and laying a foundation for strategic planning and action. Evaluation data demonstrate the strength of the connections and activities within regions and the centrality of the backbone to the work of the overall network. Many newcomers have begun to actively embrace CAHSI's values and practices. CAHSI veterans have provided leadership, expertise in CAHSI signature practices, and have played a greater role in articulating CAHSI's vision and practices to a broader audience. CAHSI has also expanded its repertoire of significant practices. In particular, the problem-solving course is a model for the accelerated development and uptake of an emerging practice. As CAHSI continues to expand and grow, newcomers are bringing new ideas, practices, and areas of interest to the network. The challenge and opportunity in coming years will be to capitalize on this energy and to facilitate processes for the cross-pollination of efforts, ideas, and practices across regions.

APPENDIX: METHODS

The external evaluation of the CAHSI INCLUDES Alliance is a mixed-methods evaluation that contains formative, summative, and needs assessment components. This section outlines the methods used to develop, distribute, and analyze the primary evaluation instruments, the social network analysis survey and collective impact survey. This section also describes the methods used for stakeholder interviews.

Methods: SNA survey

The social network analysis was developed to map the social network and its health throughout the life of the CAHSI INCLUDES Alliance grant. Year 1 data serves as baseline information about the functioning of CAHSI, and is further analyzed at the regional level. The evaluators utilized the Partner tool, developed by Danielle Varda and her team from the University of Colorado, Denver. The tool was adapted to focus on computer science education and is based on the theory of social network management and optimization. Questions address whom is connected to whom and the quality of those relationships (e.g., trust, value), what contributions individuals bring to the collaborative, the extent to which the collaborative is reaching its goals, and how the change to collective impact might influence the CAHSI community. The evaluators utilized the analysis tools provided by PARTNER to develop social network maps on multiple variables, including types of joint activities with which members engage together and frequency of communication. See https://visiblenetworklabs.com/partner-tool-resources/ for more information on the resource. The survey was distributed to backbone staff, regional leads, co-leads, coordinators and connectors electronically. The survey was held open for 2.5 months and reminders were sent to individuals who had not completed the survey.

Methods: Interviews

CAHSI leads, co-leads, connectors, and coordinators were asked to participate in interviews with evaluation team members. Interviews were audio recorded and transcribed using an online transcription service. Transcripts were analyzed using content analysis methods and incorporating the 5 elements of collective impact as themes of interest. Interview data was utilized to illustrate and provide examples of how collective impact is understood from multiple perspectives within CAHSI, and quotes appear throughout the evaluation report, as they are relevant to the five elements of collective impact. Quotes are representative of the larger findings and themes that arose from the interview data.

Methods: Collective Impact Survey

The Collective Impact Survey was developed to measure the vitality, strengths, and gaps in the CAHSI network related to the five elements of collective impact. The survey was designed and framed within the elements of collective impact and grounded within the research and literature on collective impact. While the literature on collective impact served to frame the survey themes, the survey items were developed specifically for CAHSI. Most of the items were drawn from and based on the visioning documents created by the CAHSI backbone to be able to measure the health of the network and progress towards the goals and expectations laid out in the regional visioning documents. Open-ended items were added to provide more context and depth in certain areas, such as understanding of the common agenda. The evaluators then compiled lists of all CAHSI network participants. The survey was designed to measure the vitality of the network within the regions and therefore was not sent to backbone or advisory board members. The survey was sent to regional and industry partners identified by connectors but only one respondent completed the survey so partner data could not be used for comparative purposes. Thus, the survey only represents the CAHSI "insider" perspective. The survey was sent to: Regional leads, co-leads, connectors, coordinators and all faculty/professional attendees of HENAAC, all-hands meetings within the past two years, and regional onboardings. The survey was sent electronically to 152 recipients and 50 responded. However, not all recipients completed the survey. Only 37 recipients completed the entire survey, although this represented all regional leads, co-leads and connectors and a representation of other veteran and newcomers without an official role in CAHSI. The survey was held open for 6 weeks and 5 reminders were sent during that time.

Analytic methods

The quantitative data were entered into SPSS or Microsoft Excel where descriptive statistics were computed. Frequencies and/or means are reported for most of the items, These items were rated on a 5-point or 7-point Likert scale. Centrality and density of the social network data were computed. Tests of statistical significance, such as t-tests or one-way ANOVAs, were not conducted because they were not appropriate given the data. Although inferential statistics were not computed, group differences are reported, when relevant, using descriptive statistics, such as crosstabs and means.

Write-in responses to the open-ended questions and stakeholder interviews were coded using domain analysis methods. Each new idea raised in a written response was given a unique code name. As these same ideas were raised by later respondents, each segment was added to an existing code reflecting that idea. At times the write-in answers were brief and represented a single category, but more frequently, responses contained ideas that fit under multiple categories, and these were coded separately. Codes were organized into larger, descriptive categories, or "domains." Domains were generated deductively, from the research and

evaluation questions and theoretical concepts guiding this study (e.g., five elements of collective impact), and inductively, from the data itself. The coding framework was organized into taxonomies linked by a semantic relationship, such as "a is a kind of b," or "a is a result of b." Componential analysis allowed for examination of outcomes and differences among groups, such as gender, ethnicity, organizational affiliation or career rank.