Transforming STEM Education in Hispanic Serving Institutions in the United States

A Consensus Report

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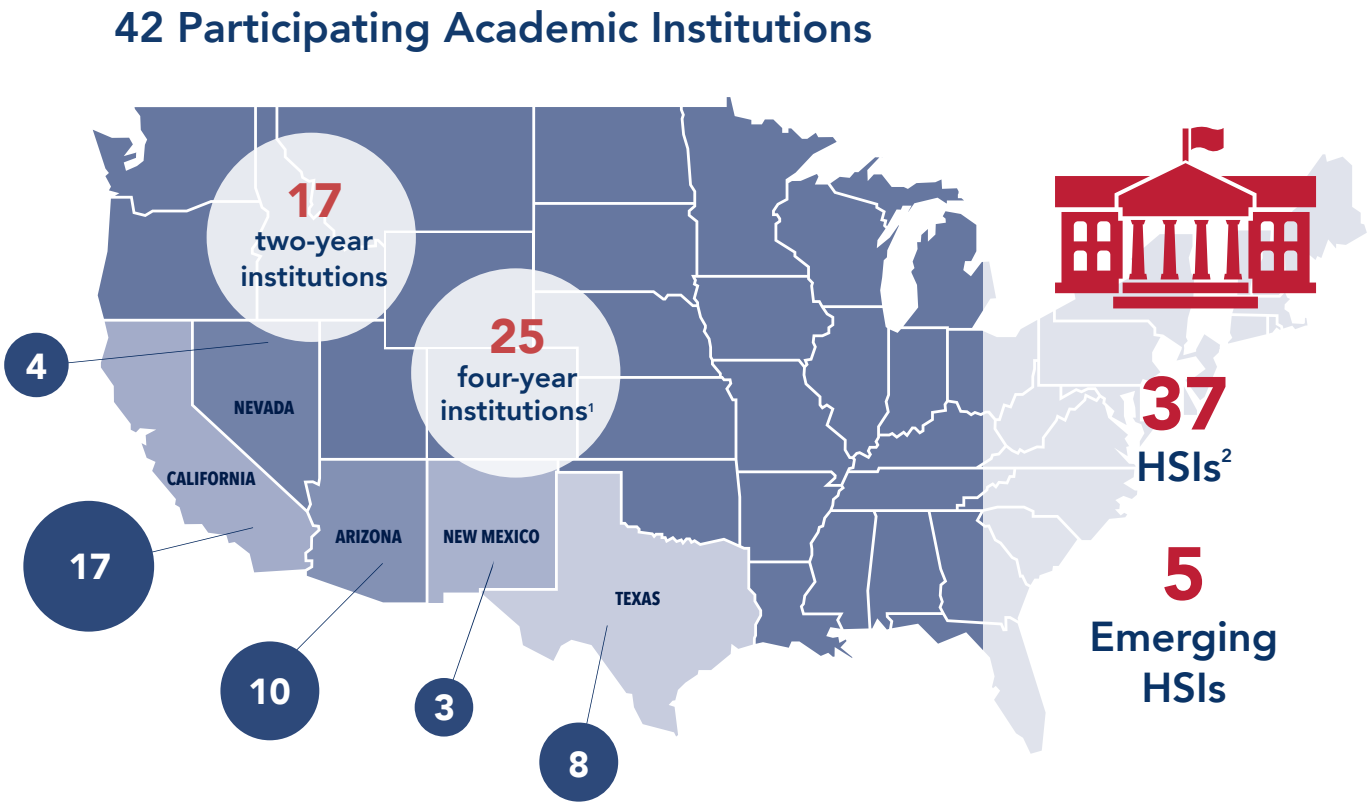
INTRODUCTION

The recent, rapid proliferation of higher education institutions with 25% or more undergraduate Hispanic student enrollment, particularly in the Southwest, coupled with the persistent gap in Hispanic student success in STEM fields, highlights a national need for building and strengthening capacity to better support all students at Hispanic Serving Institutions (HSIs). This report serves as an executive summary of key recommendations that emerged from extensive analyses of critical needs, challenges, and opportunities related to improving STEM education in HSIs. Inputs were generated during a 2017 working conference convened, in part, to inform the development of a HSI program through the National Science Foundation (NSF). The conference was intentionally designed to maximize opportunities for collaboration among students, faculty, and administrators from both 2-year and 4-year HSIs. Further details on the design, organization, and participants of the conference appear in the infographic below and in Appendix A.



[1] includes 6 Research I Institutions
[2] as designated by the US Department of Education (DOE) and/or Hispanic Association for Colleges and Universities (HACU)
[3] an additional four non-academic organizations also participated

REPORT STRUCTURE

Six major themes, encompassing 13 critical focus areas, emerged from our analyses. Subsequent sections of the report are organized by theme, beginning with an introduction to the theme and followed by critical focus areas within that theme. Each critical focus area includes one or more sets of recommendations for reviewing and prioritizing grant proposals on a competitive, merit basis. Rationales for each of our recommendations, derived from participant inputs, are also included. These recommendations, open to all stakeholders, are meant to inform the development of the NSF HSI Program, as guided by two pieces of 2017 legislation, the Consolidated Appropriation Act and the American Innovation and Competitiveness Act of 2017 (Report to NSF EHR, 2017). This report is not intended as an exhaustive collection of recommendations, but as a summary of predominant themes for readers to build upon, with attention to institutional and regional characteristics, resources, and needs.

Summary of Themes and Critical Focus Areas

The following major themes and critical focus areas emerged from our analyses.

Advising, Mentoring, and Non-Academic Support Systems

1. Advising and mentoring systems are haphazard in focus and goals, and lack alignment with student needs
2. Non-academic support systems focused on family and community are key for equitable STEM success, yet severely underdeveloped

STEM Academic Structure and Related Support Systems

3. Structure and availability of top-tier STEM curricular offerings are inequitably designed for the success of non-traditional students
4. Academic support systems focused on STEM rigor and math readiness are not sufficient to support underrepresented minorities (URMs) and non-traditional students

Evidence Based Pedagogies

5. Evidence Based Pedagogies (EBPs), known to improve STEM achievement for diverse learners, are unevenly practiced across institutions
6. Where diverse EBPs are deployed in good numbers, scalability is behind

Equity, Diversity, and Culturally Responsive Practices

7. Culturally Responsive Practices (CRPs), known to enable and sustain academic interest and access for the students HSIs aim to serve, are inconsistently understood and practiced at HSIs
8. Where some CRPs exist, they are often non-STEM specific
9. CRPs are commonly viewed as tangential to the core academic mission

Research Experiences and High Impact Practices

10. High Impact Practices (HIPs) at HSIs are culturally isolated and not sufficiently inclusive
11. Resources at Research 1 (R1) HSIs are mostly inward-facing and not purposefully shared among co-located institutions and communities

Serving Hispanic Students at HSIs

12. Extramurally funded STEM programs are underutilized by the students HSIs seek to serve
13. Retention, persistence, and success are core charges of HSIs and their faculties, not just student responsibilities

Relevant Terms and Usage

In this section, we describe our usage of several terms in this report. We recognize some of these terms may be used differently (e.g., more broadly) in other contexts, and that readers may be familiar with alternate definitions. We do not aim to precisely define terms in generality or question alternate definitions, but to operationally describe their usage in the context of this report to streamline readability. Whenever appropriate, we include more specific notes regarding common and present use, as well as potential intersectionality of terms, as appropriate.

Non-traditional students include part-time and evening/weekend students at 2-year HSIs, and 4-year HSIs, as well as transfer students from 2-year HSIs.

Note: This term often includes distance learning students, adult learners, veterans, and second degree students, for example. Although such identities are not specifically addressed here, our present usage does not exclude them.

Students HSIs seek to serve include non-traditional students (as defined above), and Hispanic students at 2-year HSIs, and 4-year HSIs.

Underrepresented Minorities (URMs) include African American, American Indian/Alaska Native, and Hispanic students.

Note: This term often includes students with disabilities, women, and LGBT students, for example. Although such identities are not specifically addressed here, our present usage does not exclude them.

Evidence Based Pedagogies (EBPs) include, but are not limited to, flipped-classroom and other active learning pedagogies, collaborative learning spaces, and peer-led learning.

Culturally Responsive Pedagogies/Practices (CRPs) include strategies that recognize diverse cultural dimensionality, knowledge, values, and skills in all aspects of learning.

High Impact Practices (HIPs) include, but are not limited, to Undergraduate Research Experiences (UREs), including course-based and year-round research experiences), internships, writing-intensive courses, and first-year experiences.

Note: Following the focus of participants' discussion, the recommendations in this report center primarily on UREs. We recognize, however, UREs may be less accessible than other emerging, promising HIPs, such as STEM first-year experiences (Kezar & Holcombe, 2017) and Writing-for-Learning (Reynolds,et al., 2012).

RECOMMENDATIONS BY THEME AND CRITICAL FOCUS AREA

THEME:

Advising, Mentoring, and Non-Academic Support Systems

While Hispanic and non-traditional students regard mentorship and non-academic support systems as fundamental components for access to a sustainable STEM education and college success (Foltz, Gannon & Kirschmann, 2014; Southwest HSI Conference Transcripts, 2017; Strayhorn, 2012), institutions seem to lack intentionality, planning, and resource allocation for such systems, especially relative to investment in academic and curricular support systems tied to STEM course offerings, pedagogies, and STEM research opportunities (Southwest HSI Conference Transcripts, 2017). This imbalance between student need and institutional resource allocation may undermine the robustness of the STEM pipeline perhaps as much as the lack of STEM preparation, particularly for the student population HSIs seek to serve.

Advising, Mentoring, and Non-Academic Support Systems	
Focus Area	**Recommendation**
1. Advising and mentoring systems are haphazard in focus and goals, and lack alignment with student needs	• Create equitable access to mentoring and advising • Improve consistency, pertinence, and focus in mentoring and advising • Enhance mentoring and advising at critical transitions • Improve timeliness and frequency of mentoring
2. Non-academic support systems focused on family and community are key for equitable STEM success yet severely underdeveloped	• Establish family-based support systems • Develop community-based STEM identities

1. Advising and mentoring systems are haphazard in focus and goals, and lack alignment with student needs. Opportunities are needed to establish robust mentoring and advising in connection to (A) general academics; (B) STEM and discipline specific academics; (C) career; and (D) college experience and campus life, including finances, housing, work, and non-academic support systems (Estrada et al., 2016; Pentyala, Dilger & Rebecchi, 2016). Faculty must be involved at the discipline-specific level, and peer-mentors should be involved at the discipline-specific level and career level as well. Across these specific focus areas, opportunities are needed to create equitable access, improve consistency, pertinence, and focus, and improve timeliness and frequency of both mentoring and advising at HSIs.

RECOMMENDATIONS

CREATE EQUITABLE ACCESS TO MENTORING AND ADVISING

Inputs suggest that Hispanic students and URMs often do not, or cannot, access formal institutional resources. Further, non-traditional students are likely to receive informal mentoring or advising from part-time faculty and peers, who typically have limited knowledge of institutional guidance, policies, or pathways. Such lack of access leads to misinformation that negatively impacts persistence, time to degree, etc. (Santos & Reigadas, 2002). Efforts should focus on increasing student exposure to formal advising resources, as well as on increasing access to those resources for Hispanic, URM, and non-traditional students. Competitive proposals will consider the utilization of professional advisors to proactively reach the students that HSIs seek to serve, pursue intentional training of part-time/transient faculty in advising, develop both institutional and cross-institutional peer-mentor models, or otherwise increase access to mentoring and advising resources for students HSIs seek to serve.

IMPROVE CONSISTENCY, PERTINENCE, AND FOCUS IN MENTORING AND ADVISING

Inputs suggest prevalent advising and mentoring models follow an "any size fits all" approach: the same student may be advised differently by different advisors, and advisor/mentor messaging tends to be generic rather than individualized based on personal needs, goals, and challenges. In particular, career advising, general academic advising, and discipline-specific advising tend to be delivered interchangeably, placing the burden of assessing the general quality, relevance, and appropriateness of the advising/mentoring on the students, rather than on the institution. Further, mentoring and advising constitute complementary support systems for students (e.g., an advisor suggests what to do and a mentor provides support to get it done) but are often confounded in practice (Baker & Griffin, 2010; Crisp & Cruz, 2009). Efforts should particularly focus on understanding the need and importance of both mentoring and advising for the populations HSIs seek to serve. Competitive proposals will demonstrate an understanding of this difference, identify the type (e.g., mentoring, advising, or both) and focus of the proposed support model (e.g., academic or discipline-specific, career, general), justify the pertinence of the initiative, describe consistent goals and impact measures, and demonstrate substantial participation by diverse and diversity-minded peer and faculty role models representing the populations HSIs seek to serve.

ENHANCE MENTORING AND ADVISING AT CRITICAL TRANSITIONS

Inputs suggest initiatives that triage students to receive advising tailored to individual goals and needs, or present consistent messaging about all—not just some—degree options (e.g., degrees related to career and technical education vs. associate degrees that allow for transfer into a 4-year STEM degree), both before and after transfer, may shrink dropout and improve transfer rates. Efforts should thus focus on increasing student exposure to career-appropriate, personalized, and consistent advising and mentoring. Competitive proposals focused on 2-year/4-year transitions will establish models for substantive cross-institutional advising and/or mentoring collaborations between 2-year/4-year institutions that leverage peer mentors (e.g., successful 4-year transfer students) as well as STEM faculty mentors, from at least one 2-year HSI and one 4-year school.

IMPROVE TIMELINESS AND FREQUENCY OF MENTORING

Input suggests mentoring seems to happen too late or not at all, and often infrequently enough to provide impactful support. Efforts should focus on providing intentional, regular mentorship (not just advising) support at critical stages of students' college careers. Competitive proposals may develop, or otherwise leverage, vertically integrated mentor and peer-mentor models focused on academic, career, or other mentorship foci, and with attention to frequency of contact as well as content.

2. Non-academic support systems focused on family and community are key for equitable STEM success yet severely underdeveloped. Opportunities are needed to (A) extend and diversify non-academic support systems that involve parents, family, and culture (Kiyama, 2011), and (B) leverage students' community-oriented interests towards integrating STEM courses and degree programs with local or regional needs.

RECOMMENDATIONS

ESTABLISH FAMILY-BASED SUPPORT SYSTEMS

Inputs, particularly undergraduate Hispanic students' comments, suggest parents and families pervasively view sociocultural dimensions of a student's life (e.g., family obligations) as at least equal in importance to academic responsibilities and demands. Such perceptions and related obligations, rooted strongly on long-standing cultural identities and community values, stand in conflict with the possibility of assuming an often culture-free STEM student identity, even amid robust academic support systems (Stephens et al., 2012). Efforts should focus on raising institutional awareness about the tension between family and academic responsibilities for Hispanic STEM students and creating robust support systems that address this tension specifically and successfully. Efforts should also focus on leveraging strong familial/community ties to raise greater interest in STEM. Competitive proposals may describe strategies for enabling the development of STEM identities that integrate with, rather than challenge, students' sociocultural identities. Examples of competitive proposals may include early STEM recruitment efforts of the whole family prior to college admission, and the development of in-person, virtual, or video-based parents-for-parents communities in the early college years.

DEVELOP COMMUNITY-BASED STEM IDENTITIES

Student participants clearly identified the prospect of giving back to their community (e.g., treating diseases, environmental concerns) as a particular dimension of their personal identity and an important motivator for choosing and persisting in STEM (Southwest HSI Conference Student Survey, 2017). Yet, traditional approaches for garnering interest in STEM among youth point to high average starting salaries and convey a culture-free, individualistic view of what professionals might do in STEM occupations. Such strategies further limit STEM recruitment and retention among students whose STEM interest is genuinely rooted in desires to respond to tangible community needs. Efforts should focus on extending faculty and academic units' understanding of local, regional, and national needs of interest to the student populations HSIs seek to serve (e.g., health disparities, inequitable access to quality math education, water needs among rural, farming communities, etc.), towards creating new and scaling existing programs that explicitly link STEM and community. Competitive proposals could include the creation of collaborative STEM degree programs designed to address a community's local needs (e.g., the need of engineers in specific domains such as agriculture or food safety), discipline-specific projects that have direct community impact, and the application of discipline specific emerging STEM expertise to local outreach or volunteer community services (e.g., mathematics tutoring in K-12 schools, GED adult learners support).

THEME:

STEM Academic Structure and Related Support Systems

Articulation agreements between 2- and 4-year schools and guided pathway programs (Bailey, Jaggars & Jenkins, 2015) effectively contribute to reducing time-to-degree and increasing retention and degree completion rates. Though increasingly widespread, such initiatives are not in place everywhere. Where they exist, a dominant focus on articulation agreements and guided pathways as a solution for streamlining transitions and increasing retention is limiting in at least two ways. First, pathway programs benefit primarily full-time students who can adapt to often rigid program structures, such as attending classes offered and designed with traditional full-time students' availability in mind. Second, both agreements and guided pathways are typically blind to the heightened cognitive academic demands students experience after transfer (e.g., greater rigor, problem solving, and conceptual reasoning abilities expectations), particularly in mathematics and quantitative STEM courses. Although the students HSIs seek to serve may have genuine and sustained interest in STEM during college, challenges associated with their ability to progressively succeed in their sequencing of math courses tends to reduce retention within STEM majors considerably.

STEM Academic Structure and Related Support Systems	
Focus Area	**Recommendation**
3. Structure and availability of top-tier STEM curricular offerings are inequitably designed for the success of non-traditional students	• Increase equitable access to top-tier offerings for STEM majors
4. Academic support systems focused on STEM rigor and math readiness are not sufficient to support URMs and non-traditional students	• Cultivate early math-readiness prior to college • Establish equitable and asset-based math and STEM rigor support systems while in college

3. Structure and availability of top-tier STEM curricular offerings are inequitably designed for the success of non-traditional students. Opportunities are needed to enable better access to innovative, impactful STEM classes and programs (e.g., courses grounded in EBPs, interdisciplinary courses) for part-time and other non-traditional students before and after transfer to a 4-year school (Estrada et al., 2016).

RECOMMENDATIONS

INCREASE EQUITABLE ACCESS TO TOP-TIER OFFERINGS FOR STEM MAJORS

Inputs suggest that the current STEM academic structure acts as a gatekeeper for non-traditional students, both at 2-year and 4-year HSIs. Efforts should focus, both for granting and 2-/4-year academic institutions, on re-evaluating the STEM academic structure with the success of non-traditional students in mind. Transformative proposals may undertake the conceptualization of a successful part-time STEM student profile, and enable logistic or structural changes needed to better support top-tier curricular access to such students at 2-year and 4-year HSIs. Additionally, competitive proposals focused on technical or associate degrees may aim to raise the profile of such degrees (e.g., the creation of a STEM-T, for Trade program) so as to intentionally foreground the goals and needs of part-time and other non-traditional 2-year HSI students.

Inputs also point to major differences in academic institutions' definitions of transfer students across the Southwest (e.g. "transfer" as someone with 2-year credits taken after high school and before 4-year enrollment vs. anyone with 2-year credits). Such discrepancies lead to conflicting perspectives on transfer students' success and leaves the burden of their preparation mostly in the hands of 2-year HSIs. Competitive proposals at the regional level may thus also undertake conceptualizing a successful STEM transfer student profile and enable logistic or structural changes to support such students at 4-year HSIs, rather than placing the burden of preparing transfer students exclusively upon 2-year HSIs.

4. Academic support systems focused on STEM rigor and math readiness are not sufficient to support URMs and non-traditional students. More opportunities are needed to increase students' readiness to enter college-level math and progress to and succeed in advanced STEM courses on both sides of the 2-/4-year transition.

RECOMMENDATIONS

CULTIVATE EARLY MATH READINESS PRIOR TO COLLEGE

Most often students are identified as not being ready to enter college-level math at the start of their college careers, which is much too late (Villarreal, Cabrera & Friedrich, 2012). Efforts should be made to improve math proficiency prior to college, particularly in years K-14. Competitive proposals will consider novel cross-institutional approaches focused on bridging the mathematics rigor divide across transitions, as well as scaling up (in numbers) and scaling out (across institutions) successful programs. Examples of competitive proposals may include collaborative summer bridge programs for 2-year HSIs and high-school students, summer bridge programs supported by peer-mentors, co-taught by high school and 2-/4-year faculty, or extending summer programs into the first year of college. Summer math-intensive programs lasting longer than one week should garner enough financial support to offset any enrollment costs.

ESTABLISH EQUITABLE AND ASSET-BASED MATH AND STEM RIGOR SUPPORT SYSTEMS WHILE IN COLLEGE

Upon enrolling in 4-year STEM courses, students encounter a substantial jump in rigor and cognitive demand, both in content delivery and assessments, particularly in mathematics. Efforts should focus

on increasing availability and access to academic support systems, both outside the classroom (e.g., supplemental instruction, targeted tutoring) and inside the classroom (e.g., course-based undergraduate research experiences, universal design) focused on improving performance and achievement in foundational courses, particularly mathematics, as well as curricular/extracurricular high impact practices (Estrada et al., 2016). Transformative proposals will focus on substantive collaborations between 4-year schools and 2-year feeder schools around addressing transitional rigor, pedagogies, cognitive-demand, disruptive thinking, and problem solving. Examples of competitive proposals may include cross-institutional teaching assignments for 2-/4-year STEM faculty, cross-institutional faculty training in Evidence Based Pedagogies, cross-institutional peer-learning communities, and cross-institutional STEM curricular design, implementation, and assessment. (See also Focus Areas 5 and 10 in this report.)

THEME:

Evidence Based Pedagogies

A fast-growing body of literature has shown Evidence Based Pedagogies (EBPs) have a significant positive effect on STEM learning and may be particularly well suited for improving engagement, self-efficacy, performance, and degree attainment among ethnic minorities (Eddy & Hogan, 2014; Mulnix, Vandegrift & Raj, 2016). The implementation of EBPs is, however, fairly non-uniform across regions, institution types, and even institutional units (Stains et al., 2018). Further, EBPs are often practiced or rejected based on teaching tradition, faculty preference, or faculty rank, rather than evidence of success. This undermines possibilities for scaling EBPs within and beyond STEM disciplines and detracts from quality implementation, leading to classroom experiences that are highly interactive, yet incoherent and ineffective for student learning. HSIs are thus uniquely positioned to take a leadership role in improving and scaling the implementation of EBPs across multiple levels, with a particular focus on enhancing the academic experiences of the students they seek to serve.

Evidence Based Pedagogies	
Focus Area	**Recommendation**
5. Evidence Based Pedagogies, known to improve STEM achievement for diverse learners, are unevenly practiced across institutions	• Improve commitment to deploying EBPs at two-year HSIs • Broaden participation in EBP-based initiatives at four-year HSIs • Increase EBP-grounded collaborations across two-year/four-year HSIs
6. Where diverse EBPs are deployed in good numbers, scalability is behind	• Elevate knowledge about locally available EBP-based initiatives among faculty and students • Scale EBPs across and within disciplines • Deepen knowledge about systemic impact of EBPs at HSIs

5. Evidence Based Pedagogies, known to improve STEM achievement for diverse learners, are unevenly practiced across institutions. Opportunities are needed to (A) raise awareness about, (B) implement, and (C) deepen understanding of what good EBP design consists of and requires, particularly in institutions seeking to serve a large percentage of Hispanic students in STEM.

RECOMMENDATIONS

IMPROVE COMMITMENT TO DEPLOYING EBPs AT TWO-YEAR HSIs

Inputs from 2-year HSI faculty identify institutional support as essential for committing faculty time to pedagogical and curricular innovations because such innovations are viewed as outside the basic training mission of 2-year institutions, difficult to deploy, and not always valued. Efforts at 2-year schools should focus on increasing institutional commitment to supporting not just professional development of faculty, but also sustainable implementation of EBPs and appropriate assessments of their success. Competitive proposals to raise awareness about and broaden implementation of EBPs at 2-year HSIs should include full-time and part-time faculty, as the latter group is more often in contact with non-traditional students and URMs, who take classes outside traditional working hours. Competitive proposals will describe the degree of institutional commitment to the proposed initiative and may consider cognitive and non-cognitive assessments of the proposed initiative's success. Competitiveness may be enhanced by partnering with a 4-year HSI, as suggested in Focus Area 5 in this report, and/or by incorporating a mentoring dimension to the proposed initiative (see Focus Area 1 in this report).

BROADEN PARTICIPATION IN EBP-BASED INITIATIVES AT FOUR-YEAR HSIs

Inputs from 4-year HSI faculty suggest traditional students are often disproportionately represented in EBP-rich initiatives, even when research suggests such initiatives may be of particular value to URMs and other non-traditional students. Extramurally funded pedagogical projects at 4-year HSIs should focus on increasing participation of non-traditional students and URMs—Hispanic students in particular—in classes and other teaching and learning initiatives grounded on EBPs (see also Focus Area 12 of this report). Efforts should also target deepening faculty and administrators' knowledge on how EBPs (classroom pedagogies as well as career-related learning) specifically serve Hispanic students in STEM at HSIs, for example by identifying characteristics of implementation models that are particularly successful in serving this population within HSIs. Competitive proposals will evaluate not just general participation but specific participation by the students HSIs seek to serve and will contribute to identifying and replicating program design characteristics that specifically support Hispanic students while being inclusive of all students.

INCREASE EBP-GROUNDED COLLABORATIONS ACROSS TWO-YEAR/FOUR-YEAR HSIs

Inputs suggests most collaborations between 2-year and 4-year institutions surround articulation agreements and involve administrators rather than faculty (see also introduction to Focus Areas 3 and 4, STEM academic structure and related support systems, in this report). More efforts are needed to establish substantive cross-institutional collaborations around the practice of teaching and learning, including EBPs. Competitive proposals may focus on academic rigor (e.g., high-stakes institutional assessment sharing and cross-institutional assessment design), pedagogies (e.g., student-centered, inquiry-based, flipped-classroom, etc.), and/or curriculum (e.g., problem-solving based, vs. information-recalling based), and will be driven by faculty teaching pre- and post-transfer courses at both 2-year and 4-year institutions.

6. Where diverse EBPs are deployed in good numbers, scalability is behind. Opportunities are needed to elevate institutional knowledge about existing projects and scale them across disciplines and within academic units, involving faculty with different teaching philosophies, backgrounds, and ranks.

RECOMMENDATIONS

ELEVATE KNOWLEDGE ABOUT LOCALLY AVAILABLE EBP-BASED INITIATIVES AMONG FACULTY AND STUDENTS

At institutions with a significant number of extramurally-funded EBP initiatives (typically 4-year, rather than 2-year HSIs), projects tend to be siloed within individual academic units, limiting institutional knowledge about, student access to, and faculty participation in EBP initiatives. Efforts should aim at centralizing access to and knowledge about EBP-based courses and programs from one or more local institutions. Competitive proposals will tackle the creation of institutional resource hubs of available EBP initiatives, searchable by students and faculty, within and across schools. EBP resource hubs will be well integrated with STEM academic requirements and will outline incentives for participation in EBP offerings for both students and faculty. Competitive proposals will also identify features of centralized resource hubs that specifically incentivize participation in EBP-rich offerings by student populations HSIs seek to serve (see also Focus Areas 9 and 10 of this report).

SCALE EBPs ACROSS AND WITHIN DISCIPLINES

Efforts should aim to scale promising EBP initiatives horizontally across disciplines and/or vertically across diverse faculty ranks and backgrounds. Competitive proposals will describe institutional commitment to the scalability of the project and address how the project will broaden faculty participation beyond groups who are already strong advocates of EBPs.

DEEPEN KNOWLEDGE ABOUT SYSTEMIC IMPACT OF EBPs AT HSIs

Efforts should aim to deepen institutional knowledge of the collective success of EBP-based projects in serving Hispanic students, other URM students, and non-traditional students specifically within the larger student body. Competitive proposals may undertake efficacy and effectiveness research that can characterize what it means to leverage EBPs to better serve Hispanic students within the larger student population (Earle et al., 2013; Stains & Vickrey, 2017). For example, projects may address how the scope of the research represents institutional-level realities, how data are to be made available for further research, and how results are to be used to make new recommendations on robust EBPs that conclusively serve Hispanic students.

THEME:

Equity, Diversity, and Culturally Responsive Practices

The words "serving" and "Hispanic" centrally characterize the term "Hispanic-Serving Institution (HSI)", yet culture is often overlooked (i.e., STEM is regarded as culture-independent) and Culturally Responsive Practices (CRPs) are often misunderstood (e.g., they are viewed in terms of cultural artifacts, rather than values and identity) in STEM practitioners' discourse at HSIs (Garcia, 2017a). Participant comments suggest the lack of systemic understanding about, and disposition towards CRPs, is deep and pervasive, and that an equity lens may be useful for broadening institutional and discipline-specific comprehension of what it means to serve, and to serve Hispanic students, at HSIs. Coming to such understanding requires diverse and diversity-minded faculty, mentors, and institutional leadership. Overall, confounding equity with equality and avoiding intentional integration of STEM with culture and identity may perpetuate elitist and individualistic academic views that act as implicit gatekeepers to diversified STEM talent, particularly Hispanic talent, because of its deep roots in cultural norms.

Equity, Diversity, and Culturally Responsive Practices	
Focus Area	**Recommendation**
7. Culturally Responsive Practices, known to enable and sustain academic interest and access for the students HSIs aim to serve, are inconsistently understood and practiced at HSIs	• Leverage CRPs to serve students at HSIs • Leverage CRPs to increase Hispanic student participation proportionally to Hispanic student enrollment
8. Where some CRPs exist, they are often non-STEM specific	• Increase STEM faculty knowledge about and participation in CRPs • Establish non-academic CRP-based support systems for STEM students
9. CRPs are commonly viewed as tangential to the core academic mission	• Link CRPs to core academic missions • Scale CRPs within and across institutions

7. Culturally Responsive Practices, known to enable and sustain academic interest and access for the students HSIs aim to serve, are inconsistently understood and practiced at HSIs.
Opportunities are needed to develop inclusive, action-oriented understanding of what CRPs are and the roles CRPs may play in serving all students at HSIs, in particular the growing Hispanic student body.

RECOMMENDATIONS

LEVERAGE CRPs TO SERVE STUDENTS AT HSIs

Efforts should shift from making high impact and evidence based practices available to all students (service as equality oriented), to re-conceptualizing the deployment of such practices so that they effectively benefit the populations HSIs seek to serve (service as equity oriented). Competitive initiatives should intentionally address how a culturally responsive lens is to be used to enhance high impact practices and EPBs towards a more substantive notion of "serving" students at HSIs. Examples of competitive initiatives may include the integration of cultural and academic support systems within and across institutions and the cultural contextualization of classroom content, norms, or pedagogies within disciplines.

LEVERAGE CRPs TO INCREASE HISPANIC STUDENT PARTICIPATION PROPORTIONALLY TO HISPANIC STUDENT ENROLLMENT

Broad guidelines that convey support for students in STEM who attend HSIs, without specifically including language and resources that address the need for Hispanic students to be sufficiently represented among beneficiaries, may suggest grant-supported HSI successes where there is in fact little to no Hispanic participation. Efforts should focus on increasing participation among Hispanic students and other URMs in initiatives offering high impact, evidence based, and culturally responsive practices, while maintaining participation of non-URM students. Institutions must be cognizant about the balance of their initiatives, as many institutions tend to more heavily enact high impact and evidence based practices yet engage minimally and insufficiently in CRPs. Participant comments suggest diverse and diversity-minded students, faculty, and mentors are needed to create an equity mindset around serving an increasingly diverse student body, so that Hispanic and URM student participation and benefits are commensurate with enrollment numbers for these student populations. Competitive initiatives will go beyond proposing practices that fit the focus of HSIs and move towards outlining strategies to ensure substantial impact on the particular populations HSIs seek to serve.

8. Where some CRPs exist, they are often non-STEM specific. Opportunities are needed to (A) increase participation of diverse and diversity-minded STEM faculty and mentors in CRPs, (B) intentionally deploy STEM-specific CRPs, and (C) promote the integration of existing CRPs with STEM disciplines.

RECOMMENDATIONS

INCREASE STEM FACULTY KNOWLEDGE ABOUT AND PARTICIPATION IN CRPs

Efforts should focus on raising awareness about CRPs among STEM faculty, mentors, and advisors. Competitive proposals will aim at establishing an action-oriented knowledge base on the nature, value, and success of CRPs in improving STEM education at HSIs. Efforts should also focus on increasing diverse and diversity-minded STEM faculty participation in CRPs. Participant comments suggest the existence of a spectrum of CRP-related initiatives, ranging from those where a focus on collaboration, diversity, and community creates fertile ground for informal CRPs to take place (implicit STEM CRPs), to those where specific CRPs are intentionally deployed to support STEM learning (intentional STEM CRPs). Depending on the institution and level of CRP deployment, competitive proposals could fit at various points along

this spectrum. Examples of competitive initiatives may include cultural contextualization of STEM-specific course content and/or pedagogies and cross-disciplinary faculty collaborations to integrate cultural and academic support systems specifically for STEM students.

ESTABLISH NON-ACADEMIC CRP-BASED SUPPORT SYSTEMS FOR STEM STUDENTS

Participant comments suggest STEM faculty and administrators are disconnected from cultural and equity dimensions in teaching and learning. Issues may include lack of formal CRPs in the classroom or interdisciplinary efforts to integrate culture and academics, as well as lack of perspective on norms, dispositions, and non-academic initiatives that help bridge culture/equity gaps outside the classroom. Efforts should focus on increasing STEM faculty participation in non-academic support systems for Hispanic students and otherwise extending the institutional support mission for STEM students beyond formal and informal academic training. Competitive initiatives could consider CRPs focused on strengthening community and family support systems for STEM students, including using existing frameworks such as funds of knowledge from Hispanic communities (Kiyama, 2011). Examples of competitive initiatives may include in-person and virtual URM/Hispanic STEM parent communities and STEM-parent listening sessions for STEM faculty. (See also Focus Area 1 in this report.)

9. CRPs are commonly viewed as tangential to the core academic mission. Opportunities are needed to formally recognize CRP-based initiatives as part of the institutional academic mission at HSIs and establish mechanisms for their growth and scalability.

RECOMMENDATIONS

LINK CRPs TO CORE ACADEMIC MISSIONS

In the absence of institutional values centered on diversity- and equity-minded ethos at HSIs, CRPs will most likely struggle to thrive, be admonished by non-believers, and be perceived as activities that are tangential to the academic mission. Likewise, faculty who are engaged in CRPs under these circumstances are often susceptible to being misunderstood by their own departments and insufficiently valued for their teaching or research on CRPs. Institutional values for this work must therefore be clear and explicitly reflected in and aligned with both institutional leadership and university-wide programmatic efforts. Efforts should focus on formally recognizing CRP-based initiatives as part of the institutional academic mission at HSIs. Competitive initiatives could consider mechanisms for flagging CRPs among course offerings, thus presenting these opportunities to all students, and leveraging CRP frameworks that honor Hispanic students' communal ties and otherwise awaken diverse STEM identities.

SCALE CRPs WITHIN AND ACROSS INSTITUTIONS

Implementation of CRPs should include robust data collection and assessment efforts to bolster understanding of their impact on Hispanic student success and other students at HSIs. Evidence can then be used to identify opportunities for scaling such efforts, both within and across institutions. HSIs should also consider engaging in regularly scheduled, university-wide efforts to assess overall campus climate as well as individual departmental climate. Data could help locate academic departments and colleges that may be more amenable towards adopting CRPs and help identify areas that are ready for scaling. Competitive initiatives will consider well-documented environmental scans of an institution to identify the conditions needed for scaling, including the leadership mindset towards CRPs.

THEME:

Research Experiences and High Impact Practices

HSIs are traditionally defined by student enrollment demographics as opposed to institutional mission (Santiago, 2006). While a taxonomy exists to classify different types of HSIs (Garcia, 2017b; Nuñez, Crisp & Elizondo, 2016), the role of research-intensive HSIs, particularly R1 HSIs, is not well characterized. Most R1 HSIs are geographically situated in the Southwest, where Hispanic students are predominantly served through 2-year HSIs. Their geographic location ideally positions these research-intensive HSIs to enable 2-year students to access High Impact Practices (HIPs), including undergraduate research experiences, before and after transfer to the R1 HSI, and to broaden their institutional research mission toward effecting change in regional communities. Consequently, charting the role R1 HSIs should play in linking STEM HIPs to community and culture is central to supporting the students HSIs seek to serve.

Research Experiences and High Impact Practices	
Focus Area	**Recommendation**
10. High Impact Practices at HSIs are culturally isolated and not sufficiently inclusive	• Make HIPs relevant to students at HSIs • Make HIPs academically accessible to students at HSIs
11. Resources at R1 HSIs are mostly inward-facing and not purposefully shared among co-located institutions and communities	• Increase access to specialized resources at R1 HSIs

10. High Impact Practices at HSIs are culturally isolated and not sufficiently inclusive. Faculty typically seek to engage in research with students who are academically ready, see the opportunity as relevant and important to their careers, and have the time (HSI Conference Transcripts, 2017). These characteristics (academic readiness, perception of relevance, and ability to commit extracurricular time) are not highly prevalent among the students HSIs seek to serve. Thus, relevant and accessible opportunities are needed to transform traditional research practices at 4-year institutions (including R1 HSIs) to better serve Hispanic students.

RECOMMENDATIONS

MAKE HIPs RELEVANT TO STUDENTS AT HSIs

Inputs suggest a disconnect between research foci and issues faced in Hispanic communities, and a lack of institutional disposition towards encouraging or rewarding STEM undergraduate engagement projects that have cultural and community ties. Efforts should target innovative ways for reversing these trends and elucidating the relevance of engagement in research and HIPs for the populations HSIs seek to serve. Competitive proposals will build upon student interest in or ties to community and culture as a means to (1) increase Hispanic and URM student participation in HIPs, including internships, industry-higher education co-ops, undergraduate research, and (2) enrich the dimensionality of R1 HSIs' research mission to better encompass culture and community. Examples may include partnerships with local non-profit, governmental, or industry entities to develop STEM engagement opportunities with a direct community impact, bilingual research projects, and bilingual dissemination efforts.

MAKE HIPs ACADEMICALLY ACCESSIBLE TO STUDENTS AT HSIs

Efforts should focus on increasing access to HIPs among the populations HSIs seek to serve, particularly within the first two years of college. This includes broadening preparedness measures to include factors beyond GPA, enhancing faculty disposition to support URMs with non-traditional assets in research (e.g., community ties, self-efficacy), and promoting course-based research experiences (HSI Conference Transcripts, 2017). Competitive proposals will involve newer and more inclusive metrics to assess preparedness as well as several different engagement experiences (e.g., service learning projects, diverse faculty panels, research methods courses tied to relevant community issues, and course-based undergraduate research). Assessment efforts should also involve tracking the impact of HIP initiatives (e.g., using 0-credit courses, or labeling/badging courses as engaged, writing-intensive, or honors).

11. Resources at R1 HSIs are mostly inward-facing and not purposefully shared among co-located institutions and communities. Opportunities are needed to extend access to expertise, facilities, capacity, and other specialized resources available at research-intensive HSIs to feeder 2-year HSIs and other institutions and communities (HSI Conference Transcripts, 2017). Specialized resources include (A) expertise: discipline-specific as well as cross-disciplinary research, training, and innovation centers and institutions; (B) facilities: STEM, humanities, and health sciences libraries and museums, STEM laboratories, and collaborative spaces; and (C) capacity: capabilities to design, develop, and deploy high impact practices at-scale.

RECOMMENDATIONS

INCREASE ACCESS TO SPECIALIZED RESOURCES AT R1 HSIs

Inputs suggest research and innovation centers should purposefully promote HIPs and public engagement as part of the educational mission at R1 HSIs. Collaborative proposals from R1 HSIs should justify how their specialized resources can be leveraged broadly and meaningfully by co-located and regional 2-year HSIs, high school systems, and the public (e.g., restructuring siloed HIP initiatives within R1s to a more central model that will broaden access to 2-year HSIs and those transferring from 2-year HSIs; visiting faculty or faculty exchange programs between 2-year and 4-year HSIs). Additionally, efforts within R1 HSIs should focus on developing Undergraduate Research Experiences beyond the model of traditional laboratory-based research experiences (e.g., leveraging synergistic areas such as data science that allow secondary use of data; community-based qualitative social science research).

THEME:

Serving Hispanic Students at HSIs

With the growing number of HSIs and dedicated extramural funding to support them, competitiveness in securing awards might be progressively tied to an institution's commitment to truly serving Hispanic students beyond admitting them in sufficiently high numbers (Garcia, 2017b). HSIs that retain and graduate high proportions of the Hispanic students they admit will attract more of these students and develop disruptive know-how about what it means to serve them in general and as STEM majors. Thus, identifying areas in which institutional-level commitment is critical to catalyze systemic change in supporting the populations HSIs seek to serve is a timely effort. First, we propose that service is not realized unless Hispanic students sufficiently participate in opportunities garnered under the HSI designation. Hence, institutions must intentionally promote and track Hispanic student participation and engagement. Second, the lenses of equity, diversity, and culture are fundamental to Hispanic students and must be present in HSIs academic structure and STEM curricular and pedagogical foci (Garcia, 2017a). Finally, we propose service must evolve from proportional participation of Hispanic students in STEM to proportional retention and success, and thus institutional-level action is needed to unlock opportunities for change.

Note. In addition to the following recommendations, Focus Areas 6 and 9 also include recommendations that identify institutional-level actions needed to serve Hispanic students at HSIs.

Serving Hispanic Students at HSIs	
Focus Area	**Recommendation**
12. Extramurally funded STEM programs are underutilized by the students HSIs seek to serve	• Improve institutional level messaging and dissemination • Broaden performance-based participation criteria
13. Retention, persistence, and success are core charges of HSIs and their faculties, not just student responsibilities	• Elevate institutional responsibility towards retention and success • Increase STEM faculty proactive involvement in retaining students

12. Extramurally funded STEM programs are underutilized by the students HSIs seek to serve. Opportunities are needed to increase Hispanic and URM students' participation (at least proportionally to Hispanic representation numbers at an institution) in programs designed to support the student populations HSIs seek to serve.

RECOMMENDATIONS

IMPROVE INSTITUTIONAL LEVEL MESSAGING AND DISSEMINATION

Inputs suggest underutilization of existing programs by Hispanic students may be due to issues of awareness and reach (e.g., lack of timely information, information overload, academic isolation) as well as identity and relevance (e.g., students perceive programs as deficit models or as disjointed from their identity or peripheral to their plan of study). Efforts should focus on developing innovative dissemination strategies to channel information on available programs so that students are aware of those specifically relevant to them in a timely manner. Efforts should also focus on developing deficit-free messaging strategies that intentionally attend to the strengths of a diverse student body, including culturally rich and community-grounded identities of Hispanic populations (Harper, 2010). By aiming to achieve proportional participation by Hispanic students and other URMs, competitive proposals will explore ideas that may help re-conceptualize the role HSIs play in supporting centralized communications and effective messaging, such as the recruitment and training of diversity-minded peer ambassadors to promote STEM programs, novel peer-to-peer communications strategies/forums, etc.

BROADEN PERFORMANCE-BASED PARTICIPATION CRITERIA

Inputs suggest that underutilization of STEM programs may also be due to implicitly exclusionary selection criteria. Over-reliance on the use of GPA to predict success, coupled with strict GPA thresholds (e.g., GPA of 3.0 or above), diverts opportunities away from students who would most likely be retained were they able to access resources associated with federally, institutionally, and privately funded programs. Efforts should focus on reconceptualizing program selection criteria to include measures assessing non-cognitive domains (e.g., motivation to succeed, self-efficacy, persistence, commitment to community), and slightly wider GPA ranges, most notably, the 2.5-3.0 GPA band (HSI Conference Transcripts, 2017). Competitive proposals will include program selection and retention criteria based on reliable and valid measures for assessing non-cognitive domains and leverage collaborations with educational researchers with expertise on assessing success based on such measures. Competitive proposals may also include selection criteria based on broader GPA ranges and rely on historical institutional data for re-assessing success in recruitment and retention.

13. Retention, persistence, and success are core charges of HSIs and their faculties, not just student responsibilities. Opportunities are needed to facilitate a broader sense of institutional obligation and disposition among faculty and administrative HSI leaders towards retaining the Hispanic students they admit.

RECOMMENDATIONS

ELEVATE INSTITUTIONAL RESPONSIBILITY TOWARDS RETENTION AND SUCCESS

Inputs from participants, as well as higher education literature, suggest that students often are typified from a deficit perspective: less favorable student outcomes are attributed to students' shortcomings (e.g., lack of effort, commitment, persistence, or academic ability) rather than institutional ones (Harper, 2010). This student-deficit approach not only undermines students' experiences and academic outcomes, but also negates HSIs responsibility to grow along dimensions that help serve the students they admit.

Efforts should focus on channeling institutional investments in diversity, student engagement, and STEM scholarship towards exploring integrated asset-based models that intentionally leverage Hispanic students' strengths from the moment they are admitted. Competitive proposals will descriptively reference existing institutional asset-based support systems and/or articulate how a project will contribute to enrich them further.

INCREASE STEM FACULTY PROACTIVE INVOLVEMENT IN RETAINING STUDENTS

Participants articulated that retention is everyone's responsibility, including faculty. Most STEM faculty, however, do not see retention as their responsibility. In fact, both faculty and some administrators interpret calls to retain students as pressure to dilute academic rigor and lower discipline-specific mastery expectations. Efforts should focus on (1) expanding faculty and administrators' knowledge about non-cognitive dimensions strongly mediating Hispanic students' STEM success, (2) supporting their implementation in STEM classrooms, and (3) increasing STEM faculty commitment to the success of all students, in lieu of the more narrowly interpreted commitment to retain students HSIs seek to serve (HSI Conference Transcripts, 2017). Competitive proposals will suggest activities that increase faculty involvement in retention strategies, by reconceptualizing student retention as student success, for example.

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APPENDIX A

The Southwest Conference on Transforming STEM Education in Hispanic Serving Institutions

Conference Structure

With support from the National Science Foundation, the University of Arizona (UA) organized a three-day working conference in Tucson, AZ, on November 18-20, 2017. The conference brought together STEM education stakeholders, including faculty, students, and administrators from more than 40 HSIs across five states and three federal/state organizations. The conference was structured into five tracks:

1. Enabling transitions from 2- to 4-year HSIs
2. Charting the role of Research 1 (R1) HSIs in undergraduate STEM education
3. Innovative pedagogies and curricula
4. Mapping HSI opportunities and challenges to recruitment, retention, and persistence
5. The meaning and role of culturally responsive STEM education at the college level

During the first *two days* of the conference, each track engaged in a series of guided discussion sessions focused on needs/gaps, challenges and barriers, and successes and lessons from existing initiatives, student support systems, faculty development, and opportunities relevant to the theme of the conference. All discussions were moderated using a predefined set of prompt questions and meticulously documented by the scribes. In addition to the guided discussion sessions, both days included student panels and debriefing from each track.
The *third day* of the conference was dedicated to synthesis and development of summaries from each track. Selected participants contributed to this process (*See List of Contributors to Track Summaries*, below).

Data Sources and Analysis Procedures

Data sources included pre- and post-conference surveys, more than 350 pages of detailed scribe notes from conference tracks, student panels, moderator and track summaries. Anonymous inputs from conference participants were collected on paper and online. Members of the conference leadership team, both independently and collectively, reviewed and analyzed the data. Regular meetings were held among members of the conference leadership team to discuss emerging themes and reach consensus on recommendations.

Conference Leadership

- *Conference Chair:* Guadalupe Lozano, PhD, Associate Research Professor, UA Department of Mathematics
- *Conference Co-chair:* Vignesh Subbian, PhD, Assistant Professor, UA College of Engineering
- *Technical Program Chair - STEM:* William Yslas Velez, PhD, Professor, UA Department of Mathematics
- *Technical Program Chair - Research:* Marla Franco, PhD, Director of Assessment, Research & Grant Development, UA Student Affairs and Enrollment Management
- *Technical Program Chair - Social Sciences:* Anna O'Leary, PhD, Associate Professor, UA Department of Mexican American Studies

Conference Participants

The conference included students, faculty, administrators, and other stakeholders from institutions and organizations across five states (AZ, CA, NM, NV, and TX). More than 50 Southwestern Institutions were invited to participate in the conference. Of these, representatives from 42 academic institutions participated. Please see infographic on Page 1 for institutional representation.

Participating Academic Institutions

Allan Hancock College
Antelope Valley College
Arizona State University
Arizona Western College
California Polytechnic State University, San Luis Obispo
California State Polytechnic University, Pomona
California State University, Channel Islands
California State University, Dominguez Hills
California State University, Los Angeles
California State University, Sacramento
Canada College
Central New Mexico Community College
Chabot College
College of Southern Nevada
El Camino College
Glendale Community College
Luna Community College
Maricopa Community College District
MiraCosta College
Mt. San Antonio College
Nevada State College
Northern Arizona University
Phoenix College
Pima Community College
San Francisco State University
San Jose State University
Santa Ana College
Schreiner University
South Mountain Community College
Texas A&M University
Texas A&M University-Kingsville
Texas State University
Truckee Meadows Community College
University of Arizona
University of Arizona, South
University of California, Riverside
University of Houston
University of Nevada, Las Vegas
University of New Mexico
University of Texas at Arlington
University of Texas at El Paso
University of Texas Rio Grande Valley

Participating Non-Academic Institutions

United States Department of Agriculture (USDA)
Science Foundation Arizona (SFAz)
National Instruments (NI)
National Science Foundation (NSF)

Contributors to Track Summaries

The following participants contributed to developing preliminary summaries of discussions from the conference tracks. Among these, participants marked (*) served as reviewers for this Final Report.

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