Implementing Course-Based Undergraduate Research Experiences (CUREs) in Hispanic Serving Institution (HSI) Community Colleges

A Consensus Report

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SUMMARY

This two-day conference, held in November 2022, was aimed at identifying the unique challenges that faculty, staff, students, and administrators in urban and rural Hispanic Serving Institution (HSI) community colleges face when introducing high-impact educational practices such as Course-Based Undergraduate Research Experiences (CUREs) in STEM curricula. While the impact of CUREs on student success parameters has been widely demonstrated in research intensive four-year institutions, little is known of the benefits of CUREs in community colleges and other two-year educational institutions, specifically those with significant percentages of historically underserved students. Participants of the two-day 2022 CUREs in HSIs Conference provided written comments to sessions and survey questions, which were later systematically analyzed. Analyses revealed nine major themes (Fig. 2). Themes were further grouped into categories; each category included *focus areas* or factors that need to be addressed to ensure successful implementation of CUREs in HSI community colleges.

INTRODUCTION

The Committee on STEM Education (National Science and Technology Council) states in its 2018 report (1) that the ability of the United States to retain its poise for innovation, its prosperity, and a competitive economy depends on its ability to nurture and spread STEM literacy among its citizens. Creating such an environment requires the participation of all Americans and, therefore, the establishment of a more diverse and skilled STEM workforce. Despite this urgent need, United States (US) student performance continues being surpassed by that of many countries (2), a fact amplified across US ethnic and socio-economic groups. Persistent gaps in underrepresented - more specifically Hispanic - college students in STEM have been reported elsewhere, and drive national and regional examinations of programs and interventions for the improvement of educational outcomes among minorities. A myriad of STEM policies and frameworks intended to target historically underrepresented students' motivation to pursue STEM careers are either being implemented or under consideration. Such policies place emphasis on engagement, practicality, and student-centered strategies for sustaining students' persistence in STEM fields (3), and align with national directives for increasing diversity, equity, and meaningfulness in STEM education (1).

The benefits that undergraduate research (UGR) has on student success and learning have been the focus of numerous studies over the last several years (for a literary review, see 4). UGR has been shown to have a positive impact on historically underrepresented students in STEM. UGR increases student self-efficacy, access to resources, collaborative opportunities, and an overall academic and social integration (5, 6, 7, 8), being all the more beneficial to students pursuing STEM fields (9). However, the number of available UGR opportunities is limited. Furthermore, the structure of UGR student selection is biased and tends to exclude historically underrepresented students (10).

Course-Based Undergraduate Research Experiences (CUREs) are high impact practices that have been proposed as a strategy for increasing access to the educational benefits of research for a larger and more diverse student population (10, 11). Embedded into the course curriculum,

CUREs provide students with the opportunity to work collaboratively, to use iterative scientific practices, and to conduct research that is relevant to the society at large (12). In spite of a large number of studies reporting the positive impact of CUREs on students enrolled in four- year STEM programs, little is known about the benefits that CUREs have on students attending community colleges or other two-year institutions. Recent estimates indicate that 41% of all undergraduate students enroll in community colleges (CCs), either to pursue a technical education and enter the workforce or to transfer to a four- year institution for completing a Bachelor's degree. The majority of these students come from historically underrepresented backgrounds (with Hispanic students comprising 54% of the student population). These students fall largely within the category of “non-traditional” and first generation, have family and caregiving responsibilities, hold jobs, may experience precarious financial situations, and enroll part time (13). Programs and initiatives have been funded to make the benefits of CUREs available to these specific student populations and to adapt CUREs to their career goals, cultural, personal, and financial situations. Examples of such programs include the Community College Undergraduate Research Initiative (CCURI), STEM-CURE Program (NSF HRD 1832543) (Maricopa County Community College District), NSF DUE 1928400 (Pima County Community District), or the E-CURE Program (NSF DUE 1953349) (University of New Mexico, Albuquerque).

Faculty and students in urban and rural CCs and two- year HSIs face unique institutional, academic, and contractual scenarios when implementing CUREs in STEM curricula that greatly differ from those experienced by faculty in research intensive four- year institutions. Scenarios include:

- Lack of research faculty, programs, and facilities
- Minimal collaboration with industry, government, or community organizations
- Lack of institutional support for CURE implementation
- Sparse resources for grant writing
- Lack of reliable access to large, public, or institutional research databases
- A non-traditional student body (10, 13)

To address these needs, more knowledge about the benefits, challenges and opportunities associated with CURE implementation and sustainability in a CCs and two- year HSI context needs to be developed.

The CUREs in HSIs CCs Conference topics were intended to address gaps, benefits, challenges and opportunities associated with CURE implementation in CCs and two-year HSIs. The conference was organized as a sequence of five breakout sessions that mirror the process of CURE implementation:

1. Identifying your CURE
2. Designing your CURE
3. Implementing your CURE
4. Assessing your CURE
5. CURE Sustainability and Institutionalization

Phoenix College (Maricopa County Community College District, MCCCD) was the lead institution and hosted the conference. The University of Arizona (UA, a designated HSI located in Tucson, AZ) and Central Arizona College (a rural HSI community college located in Coolidge, AZ) contributed their 2017 and 2020 HSI conference planning, management, data analysis, and

reporting and dissemination strategies experience (NSF DUE 1748526 and NSF DUE 1940949, respectively).

This CUREs in HSIs Conference Consensus Report serves as a resource and a summary of the recommendations that emerged from analyses of needs, challenges, barriers, opportunities, and strategies to improve CURE implementation, sustainability, and institutionalization in STEM HSI two-year and community college courses.

Seventy-five (75) in-person participants and seventy-five (75) online participants representing seventy-one (71) institutions attended the conference. Of these seventy-one institutions, forty-seven (47) were HSIs (twenty-eight (28) two-year HSIs; nineteen (19) four-year HSIs) (see Fig. 1 for a detailed distribution of participating institutions).

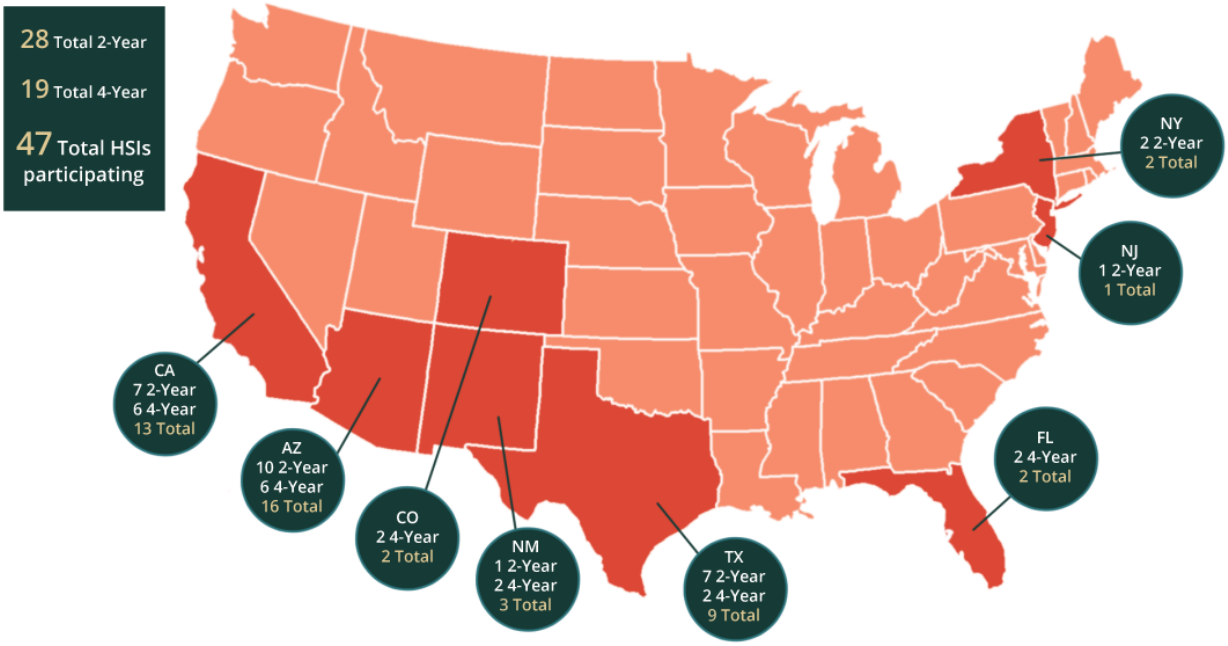

Figure 1. 2022 CUREs in HSI CCs conference participating institution distribution map

REPORT STRUCTURE

1. Summary of Themes and Focus Areas

Participants of the two-day 2022 CUREs in HSIs Conference provided written comments during the conference that were shared using Google Forms and surveys. These data were integrated and analyzed. Four categories were identified from the data collected (see below), and within each category nine themes emerged (Fig. 2).

Category 1: Support for CUREs

The themes that emerged in this category were:

- Administrative and institutional level support needed for CUREs
- Industry and community partners needed for CUREs

Category 2: Developing culturally inclusive CUREs

The themes that emerged in this category were:

- Institutional and department level challenges with developing culturally inclusive CUREs
- Classroom level challenges (for students, for faculty) with developing culturally inclusive CUREs
- What successful culturally inclusive CUREs look like

Category 3: Evidence of CUREs impact

The themes that emerged in this category were:

- Evidence of impact needed for CURE support
- How success is defined
- Prioritizing High Impact Practices for student success

Category 4: Moving forward

The following theme that emerged under this category was:

- Next steps in development and implementation of CUREs

Figure 2. 2022 CUREs in HSI CCs conference themes and focus areas

Fig. 2 represents a compilation of the nine themes that emerged from analyses of participants' input. Themes indicate that normalization of CUREs in HSIs requires educating professionals at various levels (administration, faculty, and students) about the benefits of CUREs by providing evidence of CURE impact on student success. Barriers to CURE development, implementation, and institutionalization affected the three academic bodies and were identified as *focus areas*, as they negatively impact the normalization of CUREs as a high impact instructional practice.

For students, CUREs have to entail meaningful research that reflects their values and societal concerns ("Cultural Inclusiveness"), align with their notion of success ("Defining Success"), and provide a positive academic experience ("CURE Impact on Student Success").

For faculty, CUREs have to be made into as light a lift as possible. That involves support, training, resources ("Support for Faculty Training," "Support for CUREs"), undergoing a personal cultural shift focused on "Prioritizing High Impact Practices" in their courses, and making their CUREs inclusive and relevant ("Cultural Inclusiveness"). The support necessary is in the form of funding for professional development, materials, reassigned time for developing and evaluating their CUREs and establishing partnerships at different levels, and a general recognition that this process would require a shift in thinking about science education.

Institutions have to engage in ways to support CURE implementation and normalization ("Support for CUREs") by providing resources to faculty ("Support for Faculty Training") and by prioritizing high impact practices in their strategic and academic plans ("Prioritizing High Impact Practices"). Establishing partnerships with industry and community organizations is a very effective way to facilitate the development of CUREs that are culturally inclusive and relevant/responsive, as well as to gain access to resources and opportunities for faculty professional growth and student career development. A summary list of these focus areas is shown below:

STUDENTS

1. Make CUREs culturally inclusive and relevant/responsive
2. Provide evidence of CUREs impact on student success parameters
3. Consider student definition of academic and career success

FACULTY

1. Design CUREs that are culturally inclusive and relevant/responsive
2. Have access to support from institution for CURE design and implementation
3. Resources for faculty training
4. Prioritizing CUREs in course curriculum as high impact practices
5. Weigh in faculty definition of student success

INSTITUTIONS

1. Embracing and supporting culturally inclusive, relevant, and responsive pedagogy
2. Provide financial and institutional support CUREs
3. Support faculty training
4. Prioritizing high impact practices
5. Establishing partnerships with industry and community organizations

Momentum exists for CURE development and implementation through those who have either implemented CUREs or wish to do so. It appears that, if the appropriate support is provided, there is a good chance that CUREs would become a standard and institutionalized practice. Many of the themes and focus areas that emerged in this report provide elements of discussion and consideration that could potentially make the normalization of CUREs a reality.

2. Glossary of Relevant Terms Used

We describe below the usage of terms adopted for this report. Some of the terms may be more broadly used in other contexts or have alternate definitions. It is not the purpose of this glossary to question alternate definitions, but rather to facilitate comprehension and readability.

Culturally Inclusive Pedagogies/Practices include curriculum and teaching approaches that promote the growth of a sense of belongingness for all students.

Culturally Relevant or Responsive Pedagogies/Practices include pedagogical strategies that recognize cultural diversity, values, prior knowledge, prior experiences, referential frameworks and performance styles of ethnically diverse students in all aspects of learning in order to make it more relevant and effective.

Course-Based Undergraduate Research Experiences (CUREs) are high impact practices that have been proposed as a strategy for increasing access to the educational benefits of research for a larger and more diverse student population. Embedded into the course curriculum, CUREs provide students with the opportunity to work collaboratively, to use iterative scientific practices, and to conduct research that is relevant to the society at large.

High Impact Practices include, but are not limited, to Learning Communities (LC), Undergraduate Research Experiences (UREs), Course-Based Undergraduate Research Experiences (CUREs), internships, externships, and first-year experiences.

Hispanic Serving Institution (HSI) is a term that designates any accredited, degree-granting, public or private nonprofit institution of higher education with 25% or more total undergraduate Hispanic or Latino full-time equivalent student enrollment.

Industry and Community Partners include individuals associated with industry, federal or local government institutions, municipalities, research centers, and profit or non-profit organizations who participate in the design and implementation of CUREs by offering resources, intellectual, technical, and/or material support, in addition to internship or externship opportunities for students participating in CUREs.

Non-traditional students include part-time and evening/weekend students at two-year HSIs and four-year HSIs, as well as transfer students from two-year HSI colleges or community colleges.

STEM is an acronym for an umbrella term used to group together the distinct but related technical disciplines of **S**cience, **T**echnology, **E**ngineering, and **M**athematics (including Computer Sciences).

Transfer Students include students who have completed 12 or more credit hours at two-year or community colleges and finish their degree at a four-year university.

RECOMMENDATIONS BY THEME AND FOCUS AREAS

CATEGORY: SUPPORT FOR CUREs

Theme: Administrative and Institutional Support Needed for CUREs

Focus Area: Institutional Support for CUREs - Institutionalization

Better cooperation between college departments at the administrative and institutional level is needed to support CUREs. This includes more centralized management of grants for CUREs and better cooperation with college or university departments. It also includes a cohesive plan for supporting CUREs during and after the grant funding period. A significant number of participants expressed concern in view of the "*lack of institutional plans to sustain existing CUREs once external funding has been depleted*" (Anonymous participant, personal communication, November 18, 2022). There is a significant administrative resistance to normalizing or incorporating CUREs into existing curricula. Normalization requires integrating CUREs into courses and course maps, as well as pledging to support CUREs in material and nonmaterial ways.

Focus Area: Institutional Support for CUREs - Institutionalization	Recommendations from the Conference
• Cooperation between various departments in support of CUREs is needed in the form of sharing equipment, projects, and ideas for interdisciplinary experiential learning projects. A significant number of departments on the same campus are reluctant to share assets. This is particularly detrimental for faculty in community colleges, where there is no (or minimal) research infrastructure • There are no plans at the department level to engage faculty in CURE implementation. Instructors running CUREs are usually a minority. Some department chairs support CUREs, but it is not the general rule	• Interdepartmental cooperation is needed for CURE development and support and to promote interdisciplinarity at all levels. That cooperation may result in the establishment of interdisciplinary experiential learning (for instance Biology and Engineering, or Business and Finances), faculty immersion in interdisciplinary training and projects, and student interest in interdisciplinary careers • A cohesive plan at the departmental level is needed. That might include support for equipment or the development of CUREs that benefit students taking sequential courses
• For colleges/universities that offer CUREs in their courses, there is a need for administrative level management of CURE grants instead of departmental level management. CUREs require staff, purchases, collaborations, assessment, student travel, and budget management. Departments do not have the managerial capacity for that	• Centralized management of CUREs grants and programs

• CUREs become unsustainable once external funding, usually in the form of grants, is depleted. Institutions lack plans for CURE sustainability • Resistance to CURE normalization	• An institutionalized sustainability plan is needed • Integrate CUREs into courses and major course maps

Focus Area: Institutional Support for CURE - Design and Implementation

CURE implementation ultimately needs administrative and institutional buy-in and budget lines to finance both the material cost of CUREs (lab technicians, instrumentation, reagents) and the personal effort of faculty implementing CUREs. Currently, no institutional support for that exists or, if it does, it is at a minimal level.

Focus Area: Institutional Support for CUREs - Design and Implementation	Recommendations from the Conference
• Buy-in for undergraduate research and support for those facilitating CUREs in community colleges • Administrators do not actively lead efforts to implement a variety of forms of experiential learning, including but not limited to CUREs • Community college faculty carry a substantial teaching load that hardly allows time to carry on projects out of their teaching schedule and service assignments. Furthermore, there is no research infrastructure in community colleges, a fact that makes CURE implementation all the more challenging	• Academic administrators should actively lead the efforts for institutionalizing all types of experiential learning • College leadership should prioritize support and funding (budget lines) for CUREs • Hold conversations and discussions between faculty and administrators to stress STEM students' needs for success and good curricula • Leverage faculty that are already working on CUREs in colleges or universities to inspire departments and colleges • Broaden participation in STEM beyond STEM faculty so that CUREs are implemented across disciplines and for the benefit of all students
• Individuals making financial decisions are unaware of the value of CUREs	• Help individuals within the institutions become aware of CUREs and its benefits on student outcomes
• Community college faculty carry a substantial teaching load (an overload in some cases) that hardly allows time to carry on projects outside of their teaching schedule and service	• Administrative level support to build better partnerships between universities, colleges, and K-12. Such partnerships can facilitate collaborations for CURE design,

assignments. Furthermore, there is no research infrastructure in community colleges, a fact that makes CURE implementation all the more challenging	implementation, and, ultimately, institutionalization ● Provide faculty access to faculty training and reassigned time for adapting/adopting/building CUREs ● Promote intradepartmental CUREs that can be continued in a course sequence. That strategy may reduce costs and engage students in a multicourse project as well as support and enhance collaborations (many hands make light work) ● Greater support for student mentor and graduate TAs facilitating CUREs
● Although some institutional funding and support for CUREs is available in certain areas (mini-grants, summer projects), it is insufficient or not at all available in others, for instance: curriculum improvement, institutional research, grant officers and grant writers, faculty compensation, student mentors	The various ways of overcoming lack of institutional funding and support could be alleviated by: o Providing access to grant writers o Identifying grants that would fully fund all aspects of CUREs o Supporting faculty in applying for funds o Funding individuals who can support functions such as identifying and coordinating partnerships o Building funding and support within the institution o Supporting the development of interdisciplinary collaboration o Supporting experiential learning opportunities for students through CUREs o Establishing budget lines for programs that support training of student mentors and facilitate student immersion in undergraduate research

Focus Area: Institutional Support for CUREs - Support for Faculty Training

To implement CUREs, faculty training and support is needed, not only for faculty who are interested in CUREs, but also to help bring a broader awareness for all faculty of the benefits of CUREs for Hispanic and other historically underrepresented students in STEM. In addition, faculty support should include collaboration between faculty peers to develop CUREs, as well as time for developing CUREs. Most faculty *"express being at capacity and unable to add more to their plate,"* and see release time as a big incentive to broad CURE implementation: *"It is above and beyond work for faculty (no compensation, doesn't help with promotion and tenure) and it doesn't count for students, unless the course already happens to be a required course in the major"* (Anonymous participant, personal communication, November 18, 2022). Support and

resources are needed for faculty. Those who have the support and resources are able and enthusiastic about offering CUREs. Among faculty and administrators there is generally consensus about the value of CUREs *"but when it comes to finance and resources, that's where [consensus] often stalls"* (Anonymous participant, personal communication, November 18, 2022).

Focus Area: Institutional Support for CUREs - Support for Faculty Training	Recommendations from the Conference
• Faculty training. Significant work is required to develop CUREs. This includes the time that faculty need to spend training, collaborating, and supporting each other, in order to develop, implement, and sustain CUREs	• Use internal or external professional development resources to train and educate faculty on the benefits of CUREs for Hispanic and underserved populations • Provide faculty who have developed CUREs with the required support needed to share their experiences with those new to CUREs (in exploring, designing, and implementing CUREs) • Provide release time, support, and resources (research supplies, funding for curriculum development for faculty) to do what is needed to set up CUREs. Administration should recognize that faculty needs this time to work on such projects. Faculty who have the support and resources are able and enthusiastic about offering CUREs • Provide resources for the development of robust assessment
• There is a big need for grant writing training and resources within the community colleges	• Provide training and resources for grant writing

Theme: Industry and Community Partners Needed for CUREs

Focus Area: Establishing Partnerships with Industry and Community Partners

Industry and community partnerships are needed for successful CURE implementation, a need that is all the more urgent in community colleges. Community colleges lack research infrastructure and research faculty and need *"to collaborate with industry leaders to determine skills and experience that students need to be successful and to align research projects with industry standards"* (Anonymous participant, personal communication, November 18, 2022). Access to support, resources, and databases make it possible to design and implement CUREs that are relevant. Communities of practices provide wide support to CURE practitioners.

Focus Area: Establishing Partnerships with Industry and Community Partners	Recommendations from the Conference
• There is a need for creating industry partnerships, especially with community colleges. Partnerships with industry are not easy to establish in community colleges and are a must for successful CUREs	• Establish partnerships with industry, government, and community organizations
• CURE practitioners need to have a community of practice	• Build and support communities of practice with intramural and extramural faculty who have implemented CUREs

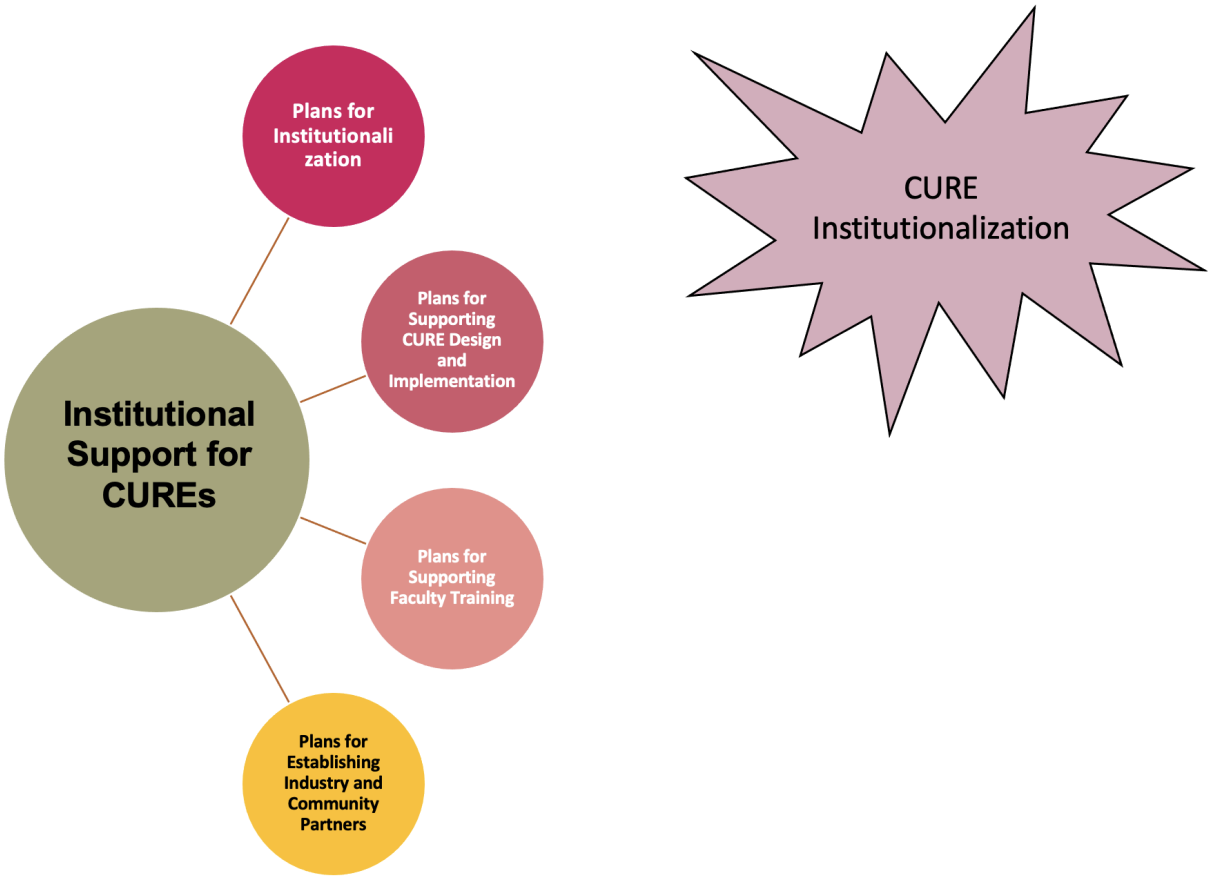

Figure 3. Elements of institutional support required for CURE institutionalization

Fig. 3 summarizes the conference participant consensus model and components of institutional support that are required for the successful implementation of CUREs in academic curricula. The need to have institutional plans for supporting faculty designing and implementing CUREs stands at the base. That support includes compensation in the form of reassigned time towards academic advancement, resources needed to implement CUREs, and training. This support is particularly necessary in community colleges, where there is no research faculty or infrastructure and the teaching load that faculty carry is considerably high. Establishing partnerships with industry and community organizations is particularly important for CURE practitioners in community colleges and crucial for those located in rural or remote areas (14). Such partnerships provide faculty training, help faculty to determine skills and experiences students need to be successful, help integrate such skills in their CUREs, and provide experiential learning opportunities (internships, shadowing, training, jobs) for students. Fundamentally, institutions have to intentionally commit programs, resources, and budget to institutionalize CUREs in their academic programs and curricula. With a decreasing trend in community college enrollment nationwide (15), colleges face financial challenges and budget adjustments that may delay, restrict, or altogether derail CURE institutionalization.

CATEGORY: DEVELOPING CULTURALLY INCLUSIVE CUREs

Theme: Institutional and Department Level Challenges with Developing Culturally Inclusive CUREs

Focus Area: Cultural Inclusiveness - Institutions and Departments

The challenges to developing culturally inclusive CUREs exist at both the institutional and departmental levels where the need for equity and culturally inclusive practices are still being questioned, and where there is a great deal of resistance to change.

Focus Area: Cultural Inclusiveness - Institutions and Departments	Recommendations from the Conference
• Big challenges to developing culturally inclusive CUREs exist at the institutional and departmental level. There is a lack of acceptance or resistance to the need for equity and inclusiveness, and a general unwillingness to change, which translates into a lack of support for both the implementation and institutionalization of CUREs	• Invest efforts to create an intramural and extramural culture of inclusiveness and relevance. Despite lack of support by some, there is work in progress directed to such efforts • Promote an all-encompassing cultural shift towards creating and establishing a culture of inclusion and relevance

Theme: Classroom Level Challenges with Developing Culturally Inclusive CUREs

Focus Area: Cultural Inclusiveness - Classroom, Faculty, and Students

Classroom level challenges with developing culturally inclusive CUREs reflect both the struggles of faculty who wish to serve their diverse student population and the lack of representation of people who look like the students. **Challenges that faculty face** with developing culturally inclusive CUREs include the difficulty, sometimes resistance, for them to recognize and identify their own biases. Developing culturally inclusive CUREs requires training in cultural inclusion and cultural relevance; faculty have limited time and access to this type of training or, frequently, they lack the incentive to develop culturally inclusive and relevant CUREs. Additionally, training of this type is often of not particularly high quality or useful for the typical instructor, as it is performed by those who are remote from the classroom and its realities. Furthermore, **not all students** are interested in research or CUREs, whether they are culturally inclusive and relevant or not.

Focus Area: Cultural Inclusiveness - Classroom, Faculty, and Students	Recommendations from the conference
Classroom level challenges to developing culturally inclusive CUREs	
• Reaching every student in a classroom, plus finding ways to be more inclusive so that all feel welcome and seen	• Promote an all-encompassing cultural shift directed to create and establish a culture of inclusion and relevance in the classroom
• Students are not just culturally diverse, but also come with different levels of academic preparedness	• Design student research groups according to student skill diversity. Create pre-research assignments to prepare ALL students for project execution
• Finding discipline specific activities and examples to create a culturally inclusive environment (e.g., creating a culturally inclusive environment in a math class)	• Promote an all-encompassing cultural shift directed to faculty (especially faculty with research background) and their preconceived notions of **WHO** can do research, **WHAT** constitutes a research project, and **WHAT** are student interests
• Finding a balance between academic rigor and student priorities	
• Identifying what students are left out *"The diversity of the student population calls for diversity in a culturally inclusive environment. Sometimes, attempts to create a Culturally Inclusive Academic Environment (CIAE) may alienate or fail to take into consideration some other ethnic/racial groups, e.g., how do you accommodate all the various groups in the design of a CIAE?"* (Anonymous	• Engage in discussion that include students, faculty, and administrators to accommodate student diversity

participant, personal communication, November 18, 2022) ● Teachers and administrators are not representative of our students in the classrooms	● Make diversity a must in the composition of hiring committees, departments, and students groups (for instance, student mentors and/or teaching assistants)
Faculty level challenges to developing culturally inclusive CUREs	**Recommendations from the conference**
● Understanding what diversity means broadly and identifying one's own biases *"While I can relate from a socioeconomic perspective, I can't relate from a cultural/ethnic perspective. I genuinely care, but do not want to act like/be perceived as a white savior"* (Anonymous participant, personal communication, November 18, 2022)	● Attending bias training for identifying one's own biases to create a more culturally inclusive academic environment is needed. *"My struggle begins in educating myself, fully understanding my own biases and identifying how I can better create a culturally inclusive academic environment"* (Anonymous participant, personal communication, November 18, 2022)
Student level challenges to developing culturally inclusive CUREs	**Recommendations from the conference**
● Some students are not interested in the learning process that participating in CUREs requires or in research altogether ● Students see CUREs as "just work"	● Stress the importance of staying away from the "right answer" attitude ● Ask students about their communities, the challenges they face, and what are their interest ● Help students see the benefits of CUREs

Creating a culturally inclusive and relevant/responsive educational environment requires being intentional about designing curriculum and class activities that support the needs of students from different cultures while valuing their unique contributions. Cultural inclusion goes hand in hand with the concept of cultural responsiveness or relevance in pedagogy. Ladson-Billings proposed, several decades ago, three main components of culturally responsive/relevant pedagogy: (a) a focus on student learning and academic success, (b) developing students' cultural competence in order to develop students' positive ethnic and social identities, and (c) supporting students' ability to recognize and critique societal inequalities (16). Ideally, all three components should be included in a culturally inclusive and responsive/relevant learning environment. In order to create culturally responsive/relevant and inclusive CUREs, the participation of all academic groups is needed (Fig. 4) (please also refer to conference participant recommendations under "What Successful Culturally Inclusive CUREs Look Like"). Faculty should reflect on their own biases and engage in discussions with faculty fellows, administrators, and students about diversity and how to accommodate it in their courses. **Faculty are the ones who have to ignite the shift**. Students are open to change but *"explanations are needed [as to] why there are changes so students understand the benefits [...]*

Students are supportive of [CUREs] mainly after seeing examples or being part of the course. Messaging is important at all levels to have students realize the impact to CUREs." (Anonymous participant, personal communication, November 18, 2022). The participant's comment stresses the role that students and faculty can play in the shift. Students have to see the benefits by engaging in discussions with faculty; if that exchange happens, it would be the driving force for establishing a culture of inclusion and relevance.

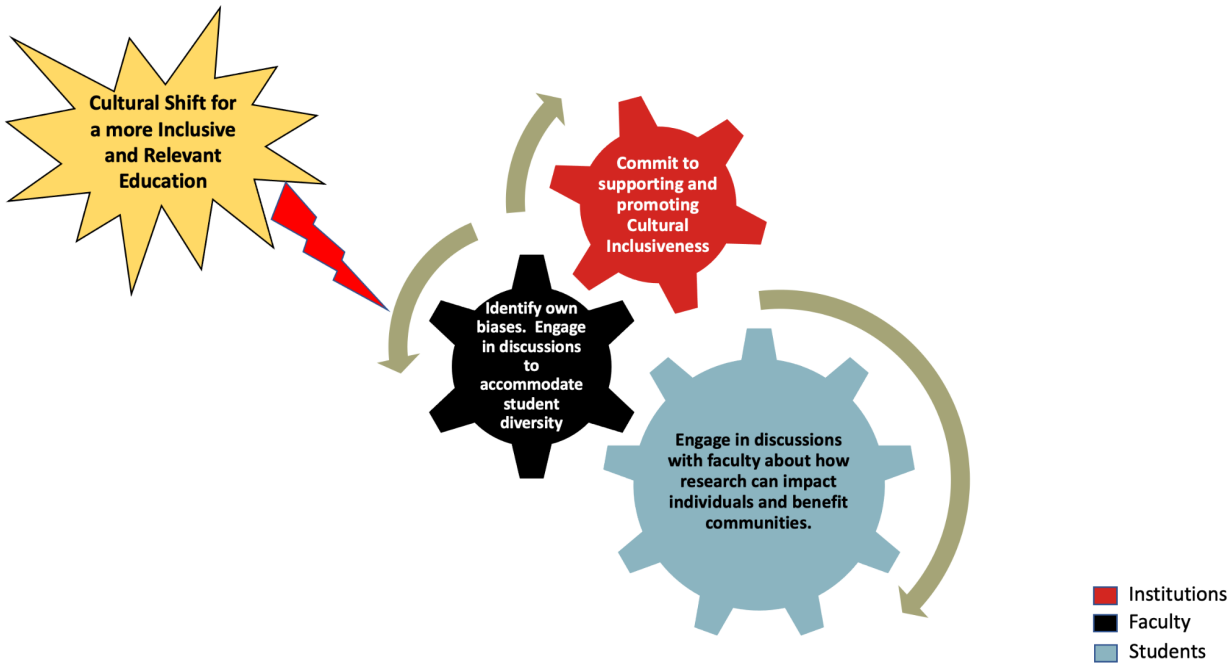

Figure 4. Milestones for creating inclusive and culturally responsive/relevant CUREs

Theme: What Successful Culturally Inclusive CUREs Look Like

Focus Area: Cultural Inclusiveness - What Successful Culturally Inclusive CUREs Look Like
Success in culturally inclusive CURE design and implementation requires having the appropriate resources, strategies, and commitment by faculty to implement such strategies in CURE courses (Fig. 5).

Focus Area: Cultural Inclusiveness - What Successful Culturally Inclusive CUREs Look Like	Recommendations from the conference
• Culturally inclusive and relevant CUREs need to be developed and implemented in ways to maximize student and community interest and participation	• Elements of successful culturally inclusive and responsive CUREs involve engaging students in a manner that is compelling and relevant to their personal and community lives, and help them understand why the research approach is beneficial • Strategies include: o Focus on students' strengths and assets o Focus research questions on community needs o Student generated research questions o Mentoring and supporting students to build their research interest and help them value the benefits of research
• One CURE does not fit all, CUREs can be offered to different populations at different levels	• There are different perspectives on when CUREs should be offered to students: o Start with first year students and offer CUREs in introduction to STEM courses. o Focus on required courses for first year students. o Focus on underserved or underprepared students. o Target transfer and non-traditional students. o Offer CURES to all levels of students.

In order to deliver culturally inclusive and responsive/relevant CUREs, it is imperative that faculty take the time to engage in a collaborative dialogue with students. The goal of this dialogue is to know students' strengths and assets, to become aware of their interests and to build a CURE accordingly, *"one in which students can relate to from their lives outside of school. If we can do this, they'll dive into the experience, and hopefully share with their families/communities."* Talking first with students helps to create a more relatable CURE experience that recognizes and appreciates students' cultural experiences, *"a space where all voices are heard and valued, cultural beliefs and concepts are incorporated into the learning and the research accommodates differing views"* (Anonymous participant, personal communication, November 18, 2022). This

process entails constant communication and mentoring. Faculty have to make the time to help students value the benefits of research by *"mentoring, working with students at whatever level they are, [providing] guidance [and] advice, discussing the importance of research, where to find opportunities"* (Anonymous participant, personal communication, November 18, 2022).

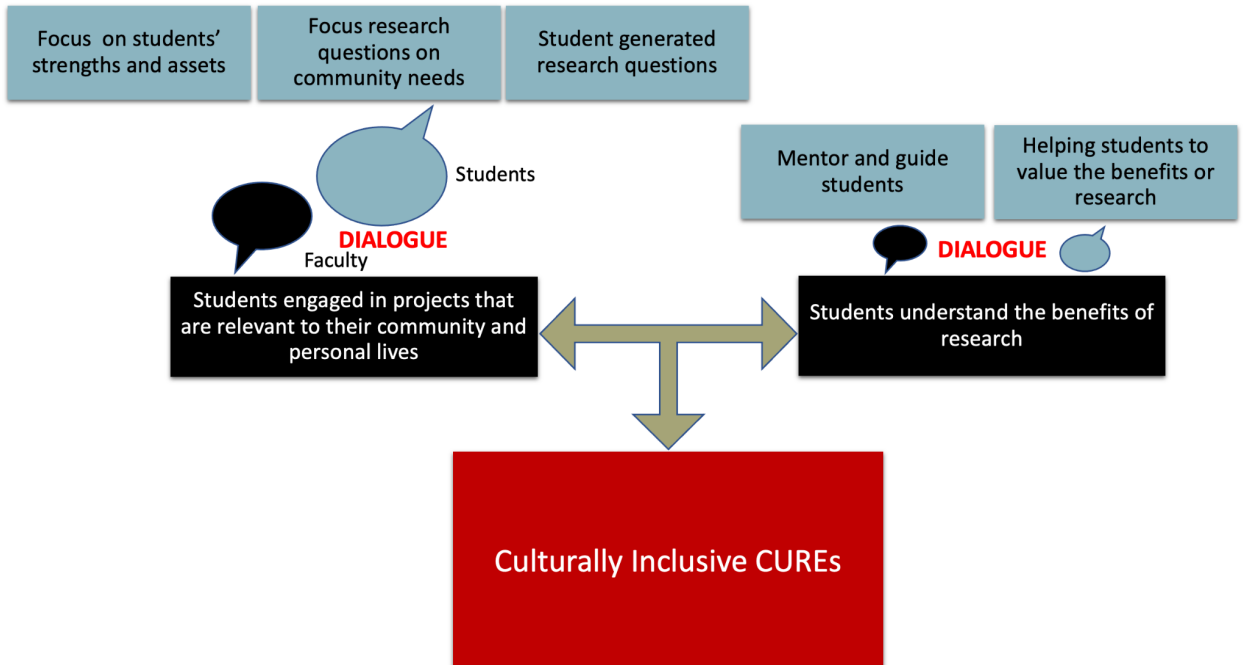

Figure 5. Strategies for creating inclusive and responsive/relevant CUREs

CATEGORY: EVIDENCE of CUREs IMPACT

Theme: Evidence of Impact Needed for CUREs Support

Focus Area: Evidence of CURE Impact on Student Success

Administrative support for CUREs requires evidence of impact on student success. There are many areas of assessment and evaluation that focus on different aspects of CURE impact. Significant time and energy are required not only to create appropriate evaluation and assessment tools but also to analyze and interpret results, which involves time and having the appropriate educational research background.

Focus Area: Evidence of CURE Impact on Student Success	Recommendations from the conference
• Administrative support for CUREs requires evidence of CURE impact on student academic performance or pathway	• Since evidence of impact is needed for administrative support, practitioners offer many insights on the types of **qualitative and quantitative assessment methods and data** that they would need to appropriately measure the impact of CUREs. These include: o Surveys o Tests o Presentations o Interviews o Institutional data o Rubrics o Papers o Lab reports • Practitioners also identify **areas of assessment and evaluation that focus on various aspects of CUREs impact**. These include o Evaluating Learning outcomes o Measuring sense of accomplishment o Measuring love for science o Measuring sense of belonging o Evaluating success in course o Evaluating persistence o Evaluating enrollment, retention, graduation/transfer rates o Measuring changes in STEM participation by Latinx and other underrepresented students o Evaluating changes in STEM/science identity o Measuring student confidence level o Identifying if students are able to apply what they have learned in the classroom in real life situations

	o Evaluating if students have learned the scientific process o Identifying any new skills that students have developed

Theme: How Success is Defined

Focus Area: Defining Success

The impact of educational interventions, such as CUREs, is generally measured by how they benefit student success. Evidence of impact and success are linked in some ways. How is success defined? The definition of success varies from an institutional, a CURE faculty practitioner, and a student perspective.

Focus Area: Defining Success	Contributions from the conference
• **From the institutional perspective**	• From an institutional perspective, success is defined in a number of ways. These include o Graduation with degree or certificate o Transfer to four-year program o Completing a course with C or better o Retention, persistence, and graduation rates o Enrollment o Recruitment o Alumni giving o Grades o Engagement o Fitting into job market o Success after college
• **From the practitioner perspective**	• From a practitioner's perspective, success is defined in a number of ways. These include, among others, course performance, knowledge gained, and readiness: o Course performance o Transfer readiness through research experience o Gaining knowledge o Being able to apply what they have learned o Being happy o Having a pro-science attitude o Thinking like a scientist o Knowing the scientific process o Finding their own passion in continuing their education o Being functional citizens in society and giving back to their communities

• **From the student perspective**	• According to practitioners, students define success in a number of ways, which includes: ○ completing their courses successfully ○ completing their degrees ○ being able to move on to their next steps in their educational journeys ○ applying what they have learned ○ making a living

Even though definitions of success are diverse and vary from academic groups (institution, faculty, and students), they all appear to converge on a common ground: student success involves successful course performance and progression, graduating, fitting in the job market, and being a good professional (Fig. 6). *"Each student defines success and what their goals are. One student's success may be passing one semester. Another student's success may be getting a one- year diploma. Yet another student's definition of success may be getting a doctorate"* (Anonymous participant, personal communication, November 18, 2022). Community college students face external challenges (family responsibilities, financial hardship) that might prevent them from finishing a course or a degree and, therefore, from being what the institution, faculty, and themselves consider "academic success." If they are enrolled in CURE courses, that would prevent them from participating and completing the research project and the course (17). Conversations among the three groups need to occur to adapt CUREs to the different academic goals of community college students, whether that is to complete an occupational program, a two year associate degree, or to transfer to a four year university.

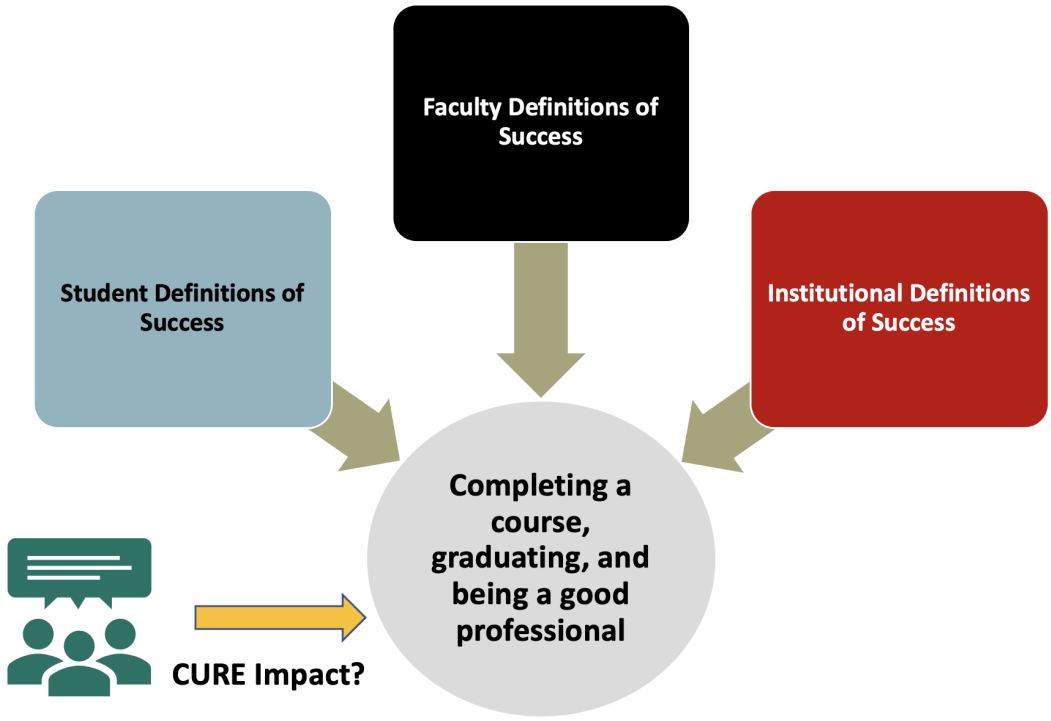

Figure 6. Convergence of student, faculty, and institutional definitions of success

Theme: Prioritizing High Impact Practices for Student Success

Focus Area: Prioritizing High Impact Practices

Currently CUREs are undertaken by a limited number of faculty who are motivated in providing course-based high-impact practices. Their focus is prioritizing student success. Other faculty are mostly focused on providing lectures to ensure they cover the course content adequately.

Focus Area: Prioritizing High Impact Practices	Recommendations from the conference
• Current focus is on providing sufficient course sections and technologies for students. But there is not much focus on instruction that would support student success • Some faculty are focused on providing high impact practices like CUREs, while others are focused on covering lecture content	• Implementation of existing college/university policy and strategic plans that prioritize student success • Updating instruction and faculty policies for best practices

CATEGORY: MOVING FORWARD

Theme: Next Steps in Development and Implementation of CUREs

Focus Area: Moving Forward

Many of the conference participants appeared inspired to develop, implement, effectively assess, and sustain CUREs. Some mentioned that they would also like to help teach and/or support faculty with their CUREs. Below are areas where faculty need support/help in making their plans become a reality:

Focus Area: Moving Forward	Recommendations from the conference
• Help is needed to support the design and development of CUREs	• Help needed with design and development of CUREs includes the following: o Help with finding partnerships o Repository for exchange and sharing of ideas o CURE specific grants o Funds from grants and help with writing grants o Funding for undergraduate assistants to help with CURE courses o Resources for Hispanic/Latinx/minorities specific engagement methods o Mentors to guide new faculty through the process

	○ Sharing examples of CUREs
● Help is needed to support the assessment of CUREs	● Help needed in the area of assessment of CUREs includes the following: ○ Evaluating if student learning outcomes are being met through courses that offer CUREs ○ Evaluating if CUREs impact students' sense of belonging within their field ○ Evaluating if CUREs impacts students' confidence and career choices ○ Evaluating if CUREs impact student engagement ○ Evaluating if students participating in CUREs can apply their learning to real life problems ○ Evaluating if students participating in CUREs are understanding and retaining content ○ Knowing how CUREs would allow students to publish or be co-authors in publications ○ Having access to different forms of evaluations ○ Knowing how to obtain student feedback on their CURE experience
● Faculty professional development is needed	● Faculty professional development include the following: ○ A teaching and learning center or a faculty development center within institutions ○ Collaboration with networks, colleagues, and communities of practice ○ Develop mentoring training ○ Access to CUREs specific professional development workshops ○ Grants to cover expenses for CUREs faculty development

Figure 7 reflects in graphic form the conference consensus of proposed strategies for CURE institutionalization in HSIs (particularly two-year HSIs). Institutionalization of CUREs requires a cultural shift to a different approach to STEM education with an absolute focus on cultural inclusiveness and relevance/responsiveness. Such an endeavor should engage all the academic groups (students, faculty, administrators) in discussions and collaboration. Discussions may involve revising curricula, assigning course credit for students participating in CURE courses, establishing partnerships with community organizations and local industry, and a college-wide awareness of student interests as they relate to their personal and professional lives, their families, and their communities.

Immersing in culturally inclusive and culturally relevant/responsive pedagogies requires, for most faculty, extensive training. Designing and implementing culturally inclusive and relevant

CUREs requires a big investment of time and training for faculty that ought to be supported by institutions. Institutions may be reluctant to invest in CURE training for faculty because there is no substantial evidence in the literature (18) of CURE impact on student success parameters in community colleges (HSI or non-HSI) nor standard success parameters seem to be applicable in such educational settings. Community colleges should engage in local and nationwide conversations to examine the validity of standard assessment tools when applied to underrepresented student populations and to promote assessment initiatives directed to better assess the impact of CUREs and other experiential learning interventions on the diverse and historically underrepresented student population attending HSI community colleges (19).

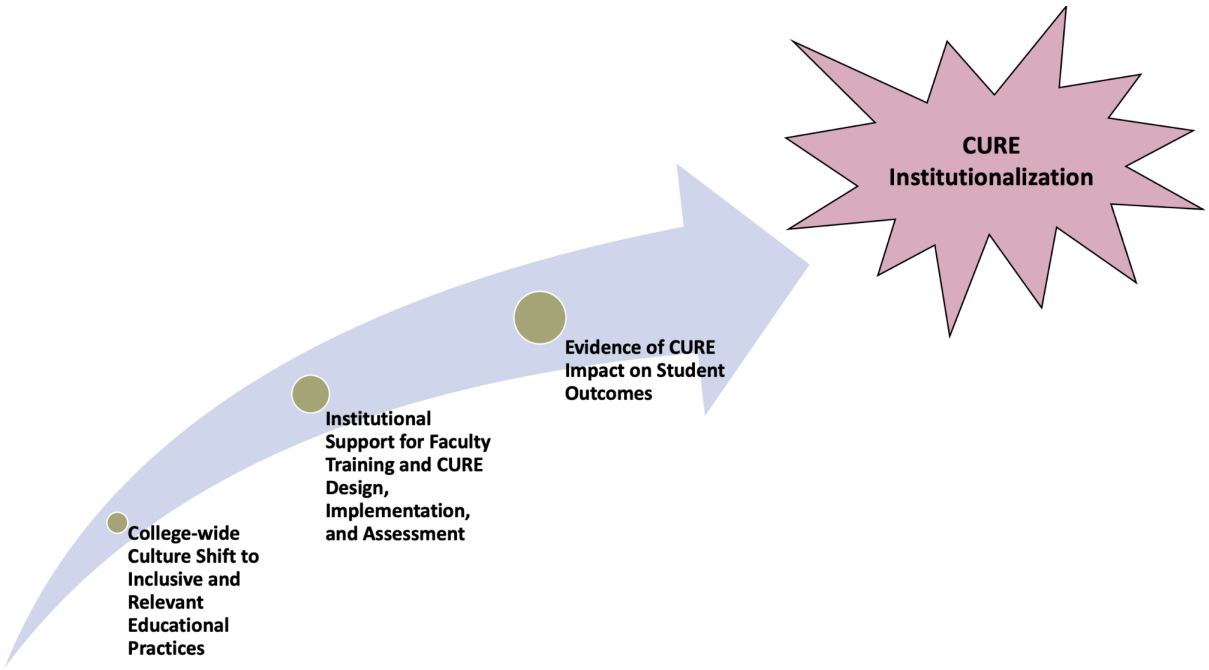

Figure 7. Elements required for CURE institutionalization in HSIs Community Colleges

REFERENCES

1. Committee of STEM Education (National Science & Technology Council) (2018). *Charting a Course for Success: America's Strategy for STEM Education.* Executive Office of the President: Washington, DC.

2. National Science Board: Science & Engineering Indicators (2022). *The U. S. Must Improve K-12 STEM Education for All.* National Science Foundation: Alexandria, VA.

3. Amaya LR, Betancourt T, Collins KH, Hinojosa O, Corona C. (2018). Undergraduate research experiences: mentoring, awareness, and perceptions – a case study at a Hispanic-serving institution. *International Journal of STEM Education, 5 (9)*: 1-13

4. Collins TW, Grineski SE, Shenberger J, Morales X, Morera OF, Echegoyen LE. (2018). Undergraduate Research Participation is associated with improved student outcomes at a Hispanic-Serving institution. *Journal of College Student Development, 58(4)*: 583-600

5. Eagan M, Hurtado S, Chang M, Garcia G, Herrera F, Garibay J. (2013). Making a difference in science education for underrepresented students: The impact of undergraduate research programs. *American Educational Research Journal, 50*: 683-713

6. Jones M, Barlow A, Villarejo M. (2010). Importance of undergraduate research for minority persistence and achievement in biology. *Journal of Higher Education, 81*: 82-115

7. Schultz P, Hernandez P, Woodcock A, Estrada M, Chance R, Aguilar M, Serpe R. (2011). Patching the pipeline: Reducing educational disparities in the sciences through minority training programs. *Educational Evaluation and Policy Analysis, 33*: 95-114

8. Villarejo M, Barlow A, Kogan D, Veazey B, Sweneey J. (2008). Encouraging minority undergraduates to choose science careers: Career paths survey results. *CBE-Life Sciences Education, 7*: 394-409

9. Linn MC, Palmer E, Baranger E, Gerard E, Stone E. (2015). Undergraduate research experiences: Impacts and opportunities. *Science, 347*: 6222

10. Bangera G, Brownell SE. (2014). Course-based-undergraduate research experiences can make scientific research more inclusive. *CBE- Life Sciences Education, 13*: 602-606

11. Dvorak AL, Hernandez-Ruiz E. (2019). Outcomes of a Course-based Undergraduate research Experience (CURE) for music therapy and music education students. *Music Therapy, 56(1)*: 30-60

12. Auchincloss LC, Laursen SL, Branchaw J, Eagan K, Graham M, Hanauer DI, Lawrie G, McLinn CM, Pelaez N, Rowland S, Towns M, Trautmann NM, Varma-Nelson P, Weston TJ, Dolan EL. (2014). Assessment of course-based undergraduate research experiences: A meeting report. *CBE- Life Sciences Education, 13 (1)*: 29-40

13. Dimino E. (2019). How outcomes metrics can better reflect community college performance. *Third Way*: 1-35

14. Bunkelman J, Noravian A, Gilliland MK, Grierson A, Lopez M, VanIngen-Dunn C, Franco M (2021). *The State of STEM Education in Rural Hispanic Serving Institutions: A Consensus Report*. Retrieved April 28, 2023, https://centralaz.edu/wp-content/uploads/2021/09/Consensus-Report-NSF-Rural-HSI-STEM-Conference.pdf

15. Conley B & Massa R (2022, February 28). The Great Interruption. *Inside Higher Ed*. Retrieved April 25, 2023, https://www.insidehighered.com/admissions/views/2022/02/28/enrollment-changes-colleges-are-feeling-are-much-more-covid-19

16. Ladson-Billings G (1995). Toward a Theory of Culturally Relevant Pedagogy. *American Educational Research Journal, 32(3)*: 465-491

17. Ashcroft J, Jaramillo V, Blatti J, Guan S-S A, Bui A, Villasenor V, Adamian A, Chavira G, Saetermoe C, Horowitz B, Palacios B, Williams PB, Brockman E, Moses J (2021). BUILDing equity in STEM: A collaborative undergraduate research program to increase achievement of underserved community college students. *Scholarship and Practice of Undergraduate Research, 4*(3): 47-58, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8863109/

18. Hanauer DI, Graham MJ, Jacobs-Sera D, Garlena RA, Russell DA, Sivanathan V, Asai DJ, Hartfull GF (2022). Broadening Access to STEM through the Community College: Investigating the Role of Course-Based Research Experiences (CREs). *CBE-Life Sciences Education, 21*(2):ar38

19. Leonetti C, Lindberg H, Schwake DO, Cotter RL (2023). A Call to Assess the Impacts of Course-Based Undergraduate Experiences for Career and Technical Education, Allied Health, and Underrepresented Students at Community Colleges. *CBE-Life Sciences Education, 22*:ar4

APPENDIX A

A1. Conference Structure

Fifty-eight (58) in-person participants and seventy-seven (77) online participants representing sixty-nine (69) institutions attended the conference that took place in two daily, seven hour segments from November 17-18, 2022. Of these sixty-nine institutions, forty-seven (47) were HSIs (twenty-eight (28) two-year HSIs; nineteen (19) four-year HSIs) (see Fig. 1 for a detailed distribution of participating institutions). Twenty-four (24) facilitators, speakers, conference coordinators, and six (6) students attended the conference. Phoenix College (Maricopa County Community College District, MCCCD) was the lead institution and hosted the conference. The University of Arizona (UA, a designated HSI located in Tucson, AZ) and Central Arizona College (CAC, a rural HSI community college located in Coolidge, AZ) contributed their 2017 and 2020 HSI conference planning, management, data analysis, and reporting and dissemination strategies experience (NSF DUE 1748526 and NSF DUE 1940949, respectively).

Conference topics were intended to address gaps, benefits, challenges and opportunities associated with CURE implementation in CCs and two-year HSIs. The conference was organized as a sequence of five sessions that mirror the process of CURE implementation:

1. Identifying your CURE
2. Designing your CURE
3. Implementing your CURE
4. Assessing your CURE
5. CURE Sustainability and Institutionalization

A1.1. Capturing Participants' Voices: Methodology

Participants attended sessions sequentially. In each session, participants were asked to answer questions, posed in advance or in real time during breakout rooms, that addressed 1) Gaps and Needs; 2) Barriers and Challenges; 3) Defining Success; 4) Opportunities and Priorities; and 5) Funding and Collaborative Opportunities (Tables 1, 2, 3, 4, 5). Not all the topics fitted all sessions' themes. Participant responses were captured in Google Forms and end-of-day satisfaction surveys. Following is a list of the questions used for each session:

Table 1. Questions for participants in Session 1: Identifying your CURE

Topic 1: Gaps and Needs
Q 1.1: Briefly describe the scope of the administrative unit you most want to influence. For instance, you may wish to change the culture of your entire institution, or you may prefer instead to focus on your school, college, department, or peer group. Choose the unit that is most meaningful to you. Q 1.2: Describe your institutional or departmental level of PLANNING for expanding CURE engagements. For instance, are you at the beginning stages of generating interest among colleagues and administrators? Are you at a stage where you have consensus, and are now articulating goals and objectives? Have you begun building/planning specific interventions or programs? Have you implemented new CUREs, and now need to focus on assessment? How comfortable are you with the intentionality of your plans?
Topic 2: Barriers and Challenges
Q 2.1: What have you struggled when creating a culturally inclusive academic environment? Q 2.2: How is it that we are HSIs and we are not fully serving our Hispanic/Latinx students simultaneously? Q 2.3: Describe the level of institutional SUPPORT for expanding student engagement in course-based undergraduate research experiences (CUREs). For instance, how supportive is your institutional or departmental leadership? Do you have financial support? To what extent do you have support from your colleagues? How supportive are students for this change?
Topic 3: Defining Success
Q 3.1: What does a culturally responsive URE (Undergraduate Research Experience, i.e. CUREs) look like to you? Q 3.2: Describe the level of institutional or departmental focus on WHERE to expand CURE engagements. For instance, is there a strong focus on engaging first-year students? Is there an emphasis on expanding participation in specific academic disciplines, or among specific underserved student populations? Are there specific courses or course categories that are most important? Are you interested in expanding CURE engagements for all students at all levels?
Topic 4: Opportunities and Priorities
Q 4.1: What are your learning objectives for this conference and what learning are you responsible for putting into practice?

Table 2. Questions for participants in Session 2: Designing your CURE

Topic 1: Gaps and Needs
Q 1: Why do you want to teach a CURE?

Table 3. Questions for participants in Session 3: Implementing your CURE

Topic 1: Gaps and Needs
Q 1: (These questions relate to Phase 1 – Preparation for Implementation). You have decided to include your CURE in your course, you are preparing your syllabus, which now includes a CURE, and you are about to start the course. With that scenario in mind, please answer the questions below: Q 1.1: Are you prepared to deliver your CURE? What resources are needed at your institution? Q 1.2: Do you have a partnership, internal or external, to facilitate your CURE? Do you need one? Have you thought of viable alternatives to partnerships? Q 1.3: Are your students prepared for your CURE? How do you get students CURE-ready? Please consider diverse student backgrounds, self-efficacy, preparedness, math skills, lab skills, scientific literacy. How will you introduce students to research literature without overwhelming them? Q 1.4: How does your CURE fit into your class schedule? How do you balance content with research?
Topic 2: Barriers and Challenges
Q 2: (These questions relate to Phase 2 – During Implementation). Class has started; you have interacted with your students and have a better idea as to what the project will require of you and your students. With that scenario in mind, please answer the questions below: Q 2.1: How do you form student research groups and divide up tasks for your CURE? Q 2.2: How do students collect, report, and analyze data in your CURE? Q 2.3: How do you address issues with student commitment, skill-level, and group conflict in your CURE?
Topics 3 & 4: Defining Success & Opportunities and Priorities
Q 3: (These questions relate to Phase 3 – The End of Implementation) Your CURE is coming to an end; your students collected and analyzed their data; some things went well and some did not! With this in mind, please answer the questions below: Q 3.1: How will you handle situations when things do not go as planned? Q 3.2: Where and how will students demonstrate or share knowledge and understanding gained through your CURE? Q 3.3: How can you learn from the experience to inform the next iteration of your CURE?
Topic 5: Funding and Collaborative Opportunities
Q 4: How can we help you implement your CURE? What do you need?

Table 4. Questions for participants in Session 4: Assessing your CURE

Topic 1: Gaps and Needs
Q 1.1: What would you like to assess/evaluate in your CURE course (ie. learning outcomes, sense of belonging, science identity, etc.)? Q 1.2: What type of data would you need to measure those outcomes (test scores, video/audio recordings, observations etc.)? Q 1.3: How would you measure those outcomes (i.e, using a survey, conducting interviews, etc.)?

Topic 2: Barriers and Challenges
Q 2.1: What challenges do you anticipate with CURE assessment at your HSI? Q 2.2: What resources (software, funding, partnerships, etc) or training do you need to help with assessment of CUREs at your institution?
Topic 3: Defining Success Opportunities and Priorities
Q 3.1: What does your institution define as student success? Q 3.2: What do YOU define as success for your students? Q 3.3: What might your students define as their own success?
Topic 4: Opportunities and Priorities
Q 4.1: What do you want to learn by assessing CUREs at your HSI? How will the assessment help you make or maintain positive changes at your institution?

Table 5. Questions for participants in Session 5: CURE Sustainability and Institutionalization

Topic 1: Gaps and Needs
Q 1.1: What resources, training, and partnerships need to be available to you for sustainability of your CURE? Q 1.2: What changes in the curriculum need to be made to institutionalize your CURE? Q 1.3. Which single gap or need, once addressed, would have the largest impact on CURE sustainability?

Topic 2: Barriers and Challenges
Q 2.1: Which barriers are most critical to you, your students, your department, and your institution for institutionalizing the CURE structures? Q 2.2: What do you believe is the largest barrier to continued success in sustaining a CURE at your institution? Q 2.3: What do you believe is the single most important thing for continued success in sustaining a CURE at your institution?
Topic 3: Defining Success
Q 3.1: How would you know whether your CURE is sustainable /institutionalized?
Topic 4: Opportunities and Priorities
Q 4.1: What existing internal funding opportunities are available at your institution for successful CURE sustainability? Q 4.2: What opportunities for faculty professional growth currently exist at your institution? How could stakeholders at your institution collaborate to establish more opportunities for faculty professional growth? Q 4.3 (Priorities): Of all the topics discussed, which one will be the most effective for engaging faculty in CURE sustainability/institutionalization if implemented at your institution? Would this be unique to your institution or common to other HSIs? Are there initiatives already in place at your institution directed to that purpose?
Topic 5: Funding and Collaborative Opportunities
Q 5.1: Are there support structures at your institution for seeking funding resources or external resources for sustainability? What needs to improve? Q. 5.2: Are there support structures at your institution for collaborative work directed to CURE sustainability? What improvements can be made?

Data captured in Google Forms and over the duration of the conference were coded. Codes were summarized across topics; themes that emerged were analyzed, further discussed, and refined.

A2. Conference Satisfaction Survey

The 2022 CUREs in HSI Community College Conference was held November 17-18, 2022, in both virtual and in-person format at Phoenix College in Phoenix, Arizona. The two-day conference had five sessions, which included identification, design, implementation, assessment, and sustainability and institutionalization of CUREs within two-year HSI community colleges.

Approximately two-thirds of attendees were from two-year institutions and the remainder were from four-year institutions. Attendance consisted of 85% faculty, and 15% administrators or others. Approximately 64% of attendees were in person and 36% virtually.

A2.1. Purpose of the Survey

The evaluation satisfaction study sought to answer the following questions:

- Has the conference changed the perception of participants as to what CURE should look like in a two-year institution?
- Has the conference increased participants' understanding of CURE's impact on student engagement in community colleges? Has it increased their preparedness to design CUREs in their own institution?
- Has the conference increased participants' understanding of the impact of CUREs on student engagement in community colleges? Has it increased their preparedness to implement CUREs in their own institution?
- Has this conference had the intended short-term impact?

A2.2. Methodology

Survey data were collected by conference organizers. The survey had three levels of questions:

- Likert only
- Likert-explanation
- Questions that only required written answers

The Likert questions provided more quantitative feedback and were required. The explanation portions of the Likert questions were intended for additional details by respondents but were optional. The answers to the questions that required written answers only provided qualitative feedback and were optional.

The Likert scale used five points (strongly disagree, disagree, neither agree nor disagree, agree, strongly agree or extremely unlikely, unlikely, neutral, likely, extremely likely). When participants chose *neither agree nor disagree* or *neutral*, these selections were considered as not having an opinion one way or another. Data were compiled and analyzed using SPSS software.

A2.3. Summary of Participant Responses

Responses from participants were collected via survey at the end of each day.
Data indicate that the conference message was successfully communicated to and well received by a large majority of participants. In all sessions, high positive responses appeared for all evaluation questions, which included identification, design, and implementation of CUREs within their own institutions. More notably, response to the questions about the conference impact were highly positive. However, a stronger connection could have been made to specifically connect the design and implementation of CUREs to meet the needs of Hispanic students.

Participants found that the most valuable sessions were CURE Design (Session 2), CURE Implementation (Session 3), and CURE Sustainability and Institutionalization (Session 5). Sessions 1 (Identifying Your CURE) and Session 4 (Assessing Your CURE) were identified as the least valuable due to the difficulty to translate the information that was presented into practice.

Although the short-term impact is highly positive, the mid-term and long-term impact of the conference could be evaluated by surveying attendees in Fall 2023 to see whether they have identified, designed, or implemented CUREs in their two- or four-year HSI institutions. At that time, data could also be collected about challenges faced by attendees within their own institutions and incorporated into future CUREs conferences.

A3. Conference Website

A conference website was created as a repository of all the pre- and post-conference files, data, and participant contact information. The conference website can be accessed here or by scanning the QR code below:

2022 CUREs in HSIs CC Conference QR Code

APPENDIX B

B1. Conference Leadership

- ★ Anna Martí-Subirana, PhD (**PI**), Professor of Biology, Phoenix College, AZ
- ★ Devin Fraley (**Co-PI**), Professor of Biology, District and Academic Chair, Science and Engineering Division, Central Arizona College, AZ
- ★ Ken Sweat, PhD (**Co-PI**), Teaching Professor, School of Mathematical and Natural Sciences, New College of Interdisciplinary Arts and Sciences, Arizona State University's West Campus, AZ

B2. Organizing Committee

- ★ Anna Martí-Subirana, PhD Phoenix College, AZ
- ★ Devin Fraley, Central Arizona College, AZ
- ★ Cori Leonetti, Pima Community College, AZ
- ★ Ken Sweat, PhD, Arizona State University West, AZ
- ★ Carlos Anguiano, PhD, RMC Research Corporation, CO
- ★ Robin Cotter, PhD, Phoenix College, AZ
- ★ Rosalind Cook, Phoenix College, AZ
- ★ Marla Franco, PhD, University of Arizona, AZ
- ★ Jennifer Katcher, PhD, Pima Community College, AZ

★ Pamela Marshall, PhD, Arizona State University West, AZ
★ Jill Massey, Phoenix College, AZ

B3. Conference Facilitators

Session 1: Identifying your CURE. Robin Cotter (Bioscience Faculty, Phoenix College) , **Cori Leonetti** (Bioscience Faculty, Pima Community College).

Session 2: Designing your CURE. Jennifer Foltz-Sweat, PhD (Bioscience Faculty, GateWay Community College), **Jennifer Katcher** (Bioscience Faculty, Pima Community College), **Ken Sweat** (Principal Lecturer, School of Mathematical and Natural Sciences, Arizona State University West).

Session 3: Implementing your CURE. Devin Fraley (Biology Faculty, Central Arizona College), **Cori Leonetti** (Bioscience Faculty, Pima Community College), **Anna Martí-Subirana** (Biosciences Faculty, Phoenix College).

Session 4: Assessing your CURE. Robin Cotter (Biosciences Faculty, Phoenix College), **Devin Fraley** (Biology Faculty, Central Arizona College), **Jennifer Katcher** (Bioscience Faculty, Pima Community College).

Session 5: CURE Sustainability and Institutionalization. Pamela Marshall, PhD (Professor, School of Mathematical and Natural Sciences,ArizonaStateUniversityWest)**, Ken Sweat** (Principal Lecturer, School of Mathematical and Natural Sciences, Arizona State University West).

B4. Conference Speakers

Opening Remarks Session Day 1 (Nov 17, 2022). Anna Martí-Subirana, PhD (Host, Professor of Biology, Phoenix College), **Kimberly Britt, PhD** (President, Phoenix College), **CJ Wurster, PhD** (Vice President of Academic Affairs, Phoenix College), **Adrianna Coronel (**Dean of Healthcare, Industry, Public Service and Technology, Phoenix College), **Marla Franco, PhD** (Vice President for Hispanic Serving Institution (HSI) Initiatives, University of Arizona), **Robin Cotter, PhD** (Professor of Biology, Phoenix College).

Session 1: Identifying your CURE. Mara Lopez, PhD (Senior Research Program Manager, Center for Broadening Participation in STEM, Arizona State University), **Anndee Rickey, PhD** (Psychology Faculty, Phoenix College), **Tim Schroeder, PhD** (Director, URAD & ECURE, University of New Mexico Albuquerque).

Session 2: Designing your CURE. Jennifer Foltz-Sweat, (Bioscience Faculty, GateWay Community College), **Sarah Miller** (Executive Director, Tiny Earth, University of Wisconsin-Madison).

Opening Remarks Session Day 2 (Nov 18, 2022). Sonja Montas-Hunter, PhD (Program Director, Hispanic Serving Institutions (HSIs) Programs, National Science Foundation).

Session 3: Implementing your CURE. Steve Burrell, PhD (Vice President for IT and CIO, Northern Arizona University, NSF Sun Corridor Network Expansion Principal Investigator**), Matt Haberkorn** (Phoenix College Bioscience Faculty and Data Scientist, CVS)**, Frank Marfai, PhD**

(Mathematics Faculty, Phoenix College)**, Tim Schroeder** (Director, URAD & ECURE, University of New Mexico Albuquerque).

Session 4: Assessing your CURE. Irfanul Alam (Ph D Candidate, University of Colorado Boulder), **Carlos Anguiano, PhD** (Research Associate at RMC Research), **Jeffrey Olimpo, PhD** (Associate Professor of Biology, University of Texas El Paso).

Session 5: CURE Sustainability and Institutionalization. Elena Ortíz, PhD (Bioscience Faculty, Phoenix College)**, Kasi Kielhbaugh, PhD** (Director, Health Science Design), **Kimberly Sierra-Cajas** (Director, Undergraduate Research & Inquiry, University of Arizona).

B5. Conference Data Analysis & Consensus Report Contributors (in alphabetical order by last name)

- ★ Rosalind Cook, Phoenix College
- ★ Robin Cotter, PhD, Phoenix College
- ★ Devin Fraley, Central Arizona College
- ★ Armineh Noravian, PhD, Central Arizona College
- ★ Anna Martí-Subirana, PhD, Phoenix College
- ★ Pamela Marshall, PhD, Arizona State University West
- ★ Ken Sweat, PhD, Arizona State University West

APPENDIX C

C1. Conference Participants (in alphabetical order by last name, including institution)

The conference included students, faculty, administrators and other stakeholders from organizations and institutions from seventeen US states (AL, AR, AZ, CA, CO, District of Columbia, MD, NC, NJ, NM, NY, FL, OH, OR, TX, VA, WA). Representatives from 70 different institutions from around the country participated. Of these, 64 were academic institutions (HSIs and non- HSIs).

First Name	Last Name ***A, B, C, D***	Organization/Institution
Ali	Ahmad	Doña Anna Community College, NM
Irfanul	Alam	University of Colorado, Boulder, CO
Rafael	Alvarez	San Diego City College, CA
Carlos	Anguiano	RMC Research Corporation, CO
Sudip	Bajpeyi	University of Texas El Paso, TX
Paula	Baker	Arizona State University, AZ
Michelle	Baland	San Antonio College, TX
Brian	Biederman	Howard Hughes Medical Inst, D. C
Sudipta	Biswas	South mountain Community Coll, AZ
Sandra	Brightwell	Central Arizona College, AZ
JoAna	Brooks	California State Univ Chino, CA
Alaina	Buchanan	University of Northern Colorado, CO

Jason	Burke	California St Univ S Bernardino, CA
Steven	Burrell	Northern Arizona University, AZ
Elizabeth	Carranza	Pima Community College, AZ
Melissa	Carpenter	Mesa Community College, AZ
Rajeev	Chandra	Nova Southeastern University, FL
Michelle	Clark	Arizona State University, AZ
Jordan	Clarke	Pima Community College, AZ
Rosalind	Cook	Phoenix College, AZ
Mayrismir	Cordero	Alamo Colleges, Palo Alto, TX
Robin	Cotter	Phoenix College, AZ
Chantal	Damas	Queensborough Community Coll, NY
Santanu	De	Nova Southeastern University, FL
Alejandra	DeLaTorre	Colton Joint Unif Sch. D, Colton, CA
Laura	de Lorenzo	Univ New Mexico Albuquerque, NM
Francesca	De Martini	Mesa Community College, AZ
Erin	Dodson	Pima Community College, AZ
Kari	Durham	Cochise Community College, AZ

E, F, G, H

Isi	Ero-Tolliver	Hampton University, VA
Lourdes	Echegoyen	University of Texas El Paso, TX
Katherine	Espinosa	Dutchess Community College, NY
Marla	Franco	University of Arizona, AZ
Maria	Fernandez	Georgia Gwinnett College, GA
Megan	Filbin	Metropolitan State Univ Denver, CO
Devin	Fraley	Central Arizona College, AZ
Jennifer	Foltz-Sweat	Gateway Community College, AZ
Leah	Gaines-Sewell	Arizona State University, AZ
Megan	Garvy	Mesa Community College, AZ
Marcus	Garcia	Phoenix College, AZ
Rufus	Glasper	The League for Innovation in CC
Gil	Gonzales	Northern Arizona University, AZ
Erron	Gonzalez	Palo Alto College, CA
Roberto	González, Jr.	USDA
Anya	Goodman	California PolytechState Univ, CA
Dania	Graham	Phoenix College, AZ
Michael	Groves	California State Univ Fullerton, CA
Matt	Haberkorn	Phoenix College, AZ
Jennifer	Hackney-Price	Arizona State University, AZ
Sharmin	Hasan	Sam Houston State University, TX
Shelley	Haydel	Arizona State University, AZ
Chris	Higgins	Arizona State University, AZ
Mariah	Hopkins	University of Texas San Antonio, TX
Alicia	Howard	University of the Incarnate Word, TX
Sandra	Howard	Arizona State University, AZ

I, J, K, L

Joan	Jaimes	San Antonio College, TX

Kevin	Jagnandan	San Diego City College, CA
Sanjiv	Jha	Gateway Community College, AZ
Celia	Jenkins	Cochise Community College, AZ
Casey	Jones	Pima Community College, AZ
Jesus	Iñiguez	Los Angeles Mission College, CA
Jennifer	Katcher	Pima Community College, AZ
Sosse	Kendoyan	Madera Community College, CA
Swati	Khare	Gateway Community College, AZ
Bethuel	Khamala	Doña Anna Community College, NM
Meenna	Kharatmal	Homi Bhabha Ctr for Sci Ed, India
Kasi	Kiehlbaugh	University of Arizona, AZ
Robert	Klinger	Phoenix College, AZ
Tatiana	Kona	Phoenix College, AZ
Zuli	Kurji	St. Mary's College of California, CA
Jean	Larson	Arizona State University, AZ
Joann	Latorre	Doña Anna Community College, NM
Cori	Leonetti	Pima Community College, AZ
Mara	López	Arizona State University, AZ
Jessie	Lundin	Northern Arizona University, AZ

M, N, O, P

Shannon	Mallison	Wake Forest University, NC
Anita	Mandal	Edward Waters University, FL
Prabir	Mandal	Edward Waters University, FL
Frank	Marfai	Phoenix College, AZ
Anna	Martí-Subirana	Phoenix College, AZ
Pamela	Marshall	Arizona State University, AZ
Heber	Martínez	El Paso Community College, TX
Sienna	Martínez	Arizona State University, AZ
Heather	McGray	San Diego City College, CA
Crystal	McKenna	Central Arizona College, AZ
Steve	Merkley	Cochise Community College, AZ
Alejandro	Mendez	California State Univ, Fresno, CA
Concepción	Miller	Doña Anna Community College, NM
Sarah	Miller	Univ of Wisconsin, Madison, WA
Neil	McGurty	Arizona State University, AZ
Par	Mohammadian	Los Angeles Mission College, CA
Marie	Montes	Union College of Union County, NJ
Aaron	Montoya	Adams State University, CO
Erin	Mulholland	Pima Community College, AZ
Lorena	Navarro	Woodland Community College, CA
Armineh	Noravian	Central Arizona College, AZ
Emmanuel	Ojameruaye	Paradise Valley Community Coll, AZ
Jeffrey	Olimpo	University of Texas El Paso, TX
Jacque	Orr	Gateway Community College, AZ
Elena	Ortíz	Phoenix College, AZ
Maura	Palacios	Mt San Antonio College, CA
Sunjung	Park	Central Arizona College, AZ

Jonathan	Parrot	Arizona State University, AZ
Matthew	Partim	Bowling Green State University, OH
Brittney	Paulk	Arizona innovation Alliance, AZ
Amanda	Pepin	Alamo Colleges, San Antonio, TX
Stevan	Pecic	California State Univ Fullerton, CA
Kathleen	Perales	Mesa Community College, AZ
Cynthia	Pickering	Arizona State University, AZ
Filippo	Posta	Estrella Mountain Com. College, AZ
Benjamin	Pundit	Phoenix College, AZ

Q, R, S, T

Pushpa	Ramakrishna	Maricopa County CC District, AZ
Christopher	Ray	San Antonio College, TX
Michelle	Reese	Rio Salado Community College, AZ
Anndee	Rickey	Phoenix College, AZ
Rogelio	Robles	University of Arizona, AZ
Amelia	Rodríguez	Mesa Community College, AZ
Joel	Rodríguez	CUNY Hostos Com. College, NY
Maria del Carmen	Rodríguez	San Bernardino Valley College, CA
Deanne	Roopnarine	Nova Southeastern University, FL
Ann	Roselle	Phoenix College, AZ
Joseph	Ross	California State Univ Fresno, CA
Melissa	Salazar	Escala Educational Services, Inc.,NM
Christopher	Saldívar	San Antonio College, TX
Diznar	Satubaldiyeva	Arizona State University, AZ
Joanna	Scheffler	Mesa Community College, AZ
Lavinia	Sebastian	Mesa Community College, AZ
Jeffrey	Shaver	Univ of Arkansas, Fort Smith, AR
Shelly	Sheppard	San Antonio College, TX
Tim	Schroeder	Univ New Mexico Albuquerque, NM
Kimberly	Sierra-Cajas	University of Arizona, AZ
Arthur	Sikora	Nova Southeastern University, FL
Viknesh	Sivanathan	Howard Hughes Medical Inst, D.C.
Andrea	Schnitz	Southwestern Community Coll, CA
Nancy	Staus	Oregon State University, OR
Deepak	Subedi	Doña Anna Community College, NM
Bharathi	Subramaniasiva	Howard Community College, MD
Ken	Sweat	Arizona State University, AZ
Anna	Tanguma	Arizona State University, AZ
Jennifer	Teske	Arizona State University, AZ
Michael	Tobin	University of Houston, TX

U, V, W, XYZ

Caroline	Vaningen-Dunn	Arizona State University, AZ
Cora	Varas-Nelson	Pima Community College, AZ
Danny	Vingochea	Gateway Community College, AZ
Adriana	Visbal	University of Houston, TX
Dehlia	Wallis	San Antonio College, TX

Emily	Walter	California State Univ Fresno, CA
Chun-Hung	Wang	Northland Pioneer College, AZ
Lisa	Werner	Pima Community College, AZ
Megaan	Workman	Pima Community College, AZ
Tina	Zecher	Northern Arizona University, AZ
Min	Zhong	Auburn University, AL

C2. Participating non-Academic Organizations (6)

- ★ Arizona Innovation Alliance, AZ
- ★ Escala Educational Services, Inc., NM
- ★ Howard Hughes Medical Institute, Washington D. C.
- ★ The League for Innovation in the Community College
- ★ RMC Research Corporation, Denver, CO
- ★ United States Department of Agriculture (USDA)

C3. Participating Two-year HSIs (28)

- ★ Alamo Colleges, Palo Alto, TX
- ★ Alamo Colleges, San Antonio, TX
- ★ Central Arizona College, AZ
- ★ City University of New York, Hostos Community College, NY
- ★ Cochise Community College, AZ
- ★ District Office, Maricopa County Community Colleges, AZ
- ★ Doña Anna Community College, NM
- ★ Dutchess Community College, NY
- ★ El Paso Community College, TX
- ★ Estrella Mountain Community College, AZ
- ★ GateWay Community College, AZ
- ★ Howard College, TX
- ★ Los Angeles Mission College, CA
- ★ Madera Community College, CA
- ★ Mesa Community College, AZ
- ★ Mt San Antonio College, CA
- ★ Palo Alto College, CA
- ★ Paradise Valley Community College, AZ
- ★ Phoenix College, AZ
- ★ Pima Community College, AZ
- ★ Rio Salado College, AZ
- ★ San Antonio College, TX
- ★ San Bernardino Valley College, CA
- ★ San Diego City College, CA
- ★ South Mountain Community College, AZ
- ★ Southwestern Community College, CA
- ★ Union College of Union County, NJ
- ★ Woodland Community College, CA

C4. Participating Four-year HSIs (21)

- ★ Adams State University, CO
- ★ Arizona State University, AZ
- ★ California Polytechnic State University, CA
- ★ California State University, Chino, CA
- ★ California State University, Fresno, CA
- ★ California State University, Fullerton, CA
- ★ California State University, San Bernardino, CA
- ★ Edward Waters University, FL
- ★ Georgia Gwinnett College, GA
- ★ Metropolitan State University of Denver, CO
- ★ Northern Arizona University, AZ
- ★ Nova Southeastern University, FL
- ★ Sam Houston State University, TX
- ★ St. Mary's College of California, CA
- ★ University of Arizona, AZ
- ★ University of Northern Colorado, CO
- ★ University of Houston, TX
- ★ University of New Mexico Albuquerque, NM
- ★ University of the Incarnate Word, TX
- ★ University of Texas El Paso, TX
- ★ University of Texas San Antonio, TX

C5. Other Participating Academic & Research Institutions (15)

- ★ Auburn University, AL
- ★ Bowling Green State University, OH
- ★ Center for Bio-Mediated and Bio-inspired Geotechnics (CBBG), Arizona State University, AZ
- ★ Colton Joint Unified School District, Colton, CA
- ★ Center for Broadening Participation in STEM, Arizona State University, AZ
- ★ Hampton University, VA
- ★ Howard Community College, MD
- ★ Maricopa County Community Colleges District Office, Tempe, AZ
- ★ Northland Pioneer College, AZ
- ★ Oregon State University, OR
- ★ Queensborough Community College, NY
- ★ University of Arkansas, Fort Smith, AR
- ★ University of Colorado, Boulder, CO
- ★ University of Wisconsin, Madison, WA
- ★ Wake Forest University, NC