Co-Designing an Engineering Education Research Agenda

IMPROVING UNDERGRADUATE STEM EDUCATION: HISPANIC SERVING INSTITUTIONS (HSIs)

This public report provides a brief overview of the project results, highlighting key research areas and findings for the academic community.

Meagan Kendall, Michele Williams, Alexandra Coso Strong, Ines Basalo, Derin Ural, Gemma Henderson.
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About the Project

In response to the NSF Dear Colleague Letter: Improving Undergraduate STEM Education in Hispanic Serving Institutions (HSIs), this collaborative project sought to uncover the non-obvious needs and existing successes at HSIs that can be addressed and amplified in future NSF initiatives to improve undergraduate engineering education.

Our Motivation

After decades of focus on increasing diversity in engineering, Latinx students continue to be underrepresented in undergraduate engineering education programs.

10.1% engineering bachelor degrees were awarded to Hispanic students in 2014. (Yoder, 2015)

59% Hispanic students pursue and obtain engineering degrees from HSIs. (Santiago & Soliz, 2012)
Our Approach

To increase the representation of Hispanic individuals in the engineering field, our team focused on identifying and amplifying the successful efforts already in place at HSIs and developing approaches to address areas still needing refinement in existing HSI engineering education programs.

We designed and executed a multi-site, multi-day workshop series, *Rethinking Engineering Education at HSIs*, to co-develop research needs with engineering educators from HSIs in the Southwest and Florida through an iterative and emergent analysis process. A follow-up workshop took place at the 2018 American Society for Engineering Education (ASEE) Annual Conference & Exposition to disseminate preliminary results from the first two workshops.
Our Team

This project is the result of a collaborative research grant with the University of Texas, El Paso (Lead), University of Miami, and Olin College of Engineering (the PI at Olin later transferred to Florida International University).

Dr. Meagan Kendall, PI, UTEP Site Lead, and Workshop Instructor
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Undergraduate Research Assistants enrolled at The University of Texas at El Paso College of Engineering. Key support in data analysis and reporting of the project.
Dr. Ines Basalo, UM PI, UM Site Lead, and Workshop Instructor
Assistant Professor in Practice in Mechanical and Aerospace Engineering at the University of Miami, and PI for the University of Miami.

Dr. Derin Ural, UM Workshop Instructor
Professor in Practice of Civil Engineering, Associate Dean of Student Affairs at the University of Miami, College of Engineering and workshop instructor.

Gemma Henderson, UM Workshop Instructor
Senior Instructional Designer within the Learning Innovation and Faculty Engagement team at the University of Miami, and workshop instructor.

Dr. Alexandra Coso Strong, Olin and FIU PI and Workshop Instructor
Assistant Professor in the School of Universal Computing, Construction, and Engineering Education at Florida International University. Previously Assistant Professor at Olin College of Engineering. PI for Olin and FIU.
Workshop Overview

The Rethinking Engineering Education Workshops exposed attendees to three innovative approaches to supporting student learning that are independent of specific pedagogies or tools: intrinsic motivation, students as empowered agents, and design thinking.

INSTRINSIC MOTIVATION

The first, intrinsic motivation, allowed participants to reflect on factors within their courses that contribute to students’ motivation and ultimately, their academic performance.

During the workshops, participants explored different approaches to supporting students’ sense of competency about the topics within the course, autonomy to control their own learning, and relatedness to others around them and the engineering topics within the course (Ryan and Deci, 2000).
STUDENTS AS EMPOWERED AGENTS

As agents of their own learning, students are self-directed and empowered learners who actively construct their understanding of concepts, reflect on learning experiences to develop strategies for approaching problems in the future, and seek out help as needed (Goller & Harteis, 2014; Newstetter, Behravesh, Nersessian, & Fasse, 2010; Newstetter, Kurz-Milcke, & Nersessian, 2004).

Within the workshops, participants engaged with agency both from the perspective of students as agents of their own learning and of educators as agents of change within their institution and field to explore internal and external factors impacting an individual’s sense of agency.

DESIGN THINKING

Lastly, the principles of design thinking (e.g., understanding the problem, building empathy for all stakeholders, tolerating ambiguity, practicing iteration) were reframed to focus on the design of a course and/or the broader learning environment.

Participants engaged in a student-centered design process to design and reflect on activities that would positively impact their students’ sense of motivation and agency (Razzouk and Shute, 2012).

Ultimately, the workshops were designed to leverage these approaches to facilitate in-depth reflection and enable participants to prototype ideas in their own context. For example, these ideas provided a lens through which participants could examine their context, the educational experiences of their students, and their own beliefs and values.
Participants

Our regional-focused workshops facilitated a comparison of different Latinx populations and engaged educators from southern HSIs with an instructional role and more than 2 years of teaching experience in engineering at a HSI.

Institutional Representation

Thirty-six participants from thirteen institutions across the southern United States (from Arizona, New Mexico, Texas, and Florida) attended one of the two Rethinking Engineering Education Workshops. Each participant was provided with meals during the workshops and a stipend to offset their time and transportation costs.
Eight institutions were represented by the 18 participants at the Texas workshop and five institutions by the 18 participants at the Florida workshop. Of these institutions, all were considered Hispanic Serving Institutions based on having over 25% of their student body identifying as Latinx/Hispanic. The Florida workshop had a larger number of private, 4-year institutions as compared to the Texas workshop, where all but one of the 18 participants were instructors at a public, 4-year institution.
Role of Educators

The educators attending these workshops included a diverse set of engineering instructors. Across both workshops, 42% were tenured or tenure-track faculty, 44% were instructional faculty (professional and non-tenure track), and 17% were part-time lecturers, staff, or administrators with instructional responsibilities. Twenty-five percent of attendees identified as women and 39% identified as Hispanic (the same at both workshops).
ASEE Workshop

The follow-up workshop at ASEE, *Co-designing a Research Agenda to Amplify Engineering Education Efforts at HSIs*, also applied voluntary and convenience sampling methods to engage engineering educators from each workshop as well as attendees at ASEE. Five participants from each workshop were provided with stipends to attend ASEE. To be eligible for the stipends participants had to:

1. Agree to attend ASEE and the workshop.
2. Have completed a majority of workshop activities.
3. Have not attended ASEE previously.

Participants were also selected for diversity of institution and faculty type.
Five core research areas were co-developed from insights from participants who engaged with preliminary results at the ASEE workshop. Participants contextualised the research according to their institutional needs, and suggested research areas and questions for the wider academic community to pursue. We performed analysis on the research areas and discussion of questions, to form the five research areas.

01 ENGINEERING CURRICULA ENHANCEMENT

02 UNDERSTANDING OUR STUDENTS

03 FACULTY DEVELOPMENT RELEVANT TO HSIs

04 PERCEPTIONS OF INSTRUCTIONAL FACULTY

05 LONG-TERM IMPACTFUL APPROACHES

A description of these five research areas are shared in the following pages, with examples of potential research questions articulated by ASEE workshop participants related to each area and category.
ENGINEERING CURRICULA ENHANCEMENT

Within this research area, three categories emerged: curriculum development strategies, multiple pathways to an engineering degree, and the hidden curriculum.

Curriculum development strategies

According to coded responses related to curriculum development strategies, participants articulated an interest in investigating methods for students to apply course material, through project-based, hands-on, experimental or research-based learning activities within engineering curricula, specific and relevant to the context of HSIs.

“What active learning practices are effective for HSI students and affordable for our institution?”

“What existing theories and models can be used to design experiential learning within engineering HSIs?”

“What research has already been done regarding integration of disciplinary research at 2-year colleges?”

Multiple pathways to an engineering degree

Multiple participants proposed research into the role of two-year colleges, progress-based programs and academic factors that lead to completion of degrees at HSIs. The following are examples of potential research questions articulated by ASEE workshop participants related to this category.

“Does starting at a two-year college with clearly defined articulation to a 4-year School increase student completion of degrees?”

“Would it be possible to let go of the 4-year model with a view toward a progress-based (not time-based) model that has student achieve mastery over a longer period of time?”

“What level of faculty support and maintenance of articulation agreements are needed to maintain success?”
Hidden curriculum

Several participant responses related to the concept of the hidden curriculum and its impact on Latinx students. Educators expressed interest in exploring ‘hidden’ elements within engineering curricula important to student outcomes at HSIs, including the role of faculty-student relationships and students’ understanding of educational challenges in comparison to high-school experience.

“How do we level the playing field for students at HSI versus students at other universities? (mainly due to work/job issues; hidden curriculum)”

“How would students develop close continuum relations with faculty members in this sort of [non-semester] model?”

Meeting the needs of students with diverse abilities

In meeting the diverse academic and personal needs of the student population at HSIs, educators indicated researching approaches to assess and respond to student preparation of prerequisites and the value of supplemental teaching.

“Can co-curriculum and supplemental teaching help in mitigating student deficiencies in lower division courses?”

“Why is SVA [spatial visualization abilities] a precursor of all disciplines in engineering? How can the gap in SVA between female and male engineering students be decrease with explicit syllabi projects?”

“How can we improve language (especially writing) skills for all (incl. Native speakers of English) students?”

“How prepared are the students in mathematics?”

UNDERSTANDING OUR STUDENTS

Throughout the data, participants focused on research areas that involved understanding, identifying and meeting the diverse academic and personal needs of the student population at HSIs. Within this research area, two categories emerged: meeting the needs of students with diverse abilities and faculty perceptions of students.
Faculty perceptions of students

Participant responses that fell into this category involved exploring the characteristics of students to better inform HSIs in their support of resources for students, including the leveraging of existing behaviour, family values and work of LatinX students. Educators described students as hardworking, who often worked while studying in higher education. Multiple participants also expressed concerns about their limited knowledge about minority students and role of student family dynamics.

“What are faculty expectations of family support and family demands vs. reality of Latinx students?”

“What were the greatest assets/strengths HSI students began with and ended with (are they different for HSI vs. non-HSI students?)”

FACULTY DEVELOPMENT RELEVANT TO HSIS

Participant responses discussing faculty development focused on researching the design of faculty development programs or resources specifically for HSIs, in the context of their institutional needs, in collaboration with other HSIs and evidence-based pedagogical innovations.

“What type of support for teaching faculty (seminars, TAs, etc) provide the best so that they can develop more integrative courses for better student outcomes.”

“What opportunities exist for faculty to teach experientially? What type of project/ experiences are unique/relevant to HSIs?”

“How can the constraints working against faculty development be overcome to improve teaching and learning outcomes?”

 “[Could] significant interactions with faculty at other HSIs change faculty perceptions?”
PERCEPTIONS OF INSTRUCTIONAL FACULTY
This research theme surfaced from multiple participant responses that referred to the perceptions of instructional faculty. In particular, one educator expressed researching concerns about limited engineering education leadership for non-tenure faculty within institutions, and how curriculum development and teaching-focused positions are perceived as inferior by peers.

“Is choosing a non-tenure faculty position over a tenure-track render a PhD holding engineer as inferior to engineering-related abilities?”

“Why does the majority think teaching engineering is less than discipline-specific research?”

LONG-TERM IMPACTFUL APPROACHES
This research theme reflects somewhat uncertain reflections about the concept of ‘change’ within HSIs, where multiple participants demonstrated broader apprehension about addressing specific research areas, in favour of investigating operational, practical and sustainable approaches to areas like curricula development, institutional challenges and student success.

“What specific practices have increase[d] student recruitment and retention in engineering at other institutions (or within my Institution)?”

“What department operational practices are effective in enabling HSI student success?”

Through sharing conference information and preliminary results with other institutions that were awarded funds through the same NSF Dear Colleague Letter, alignment of our research areas emerged across awardees. Areas included faculty development, curriculum redesign or enhancement, addressing student support needs and establishing longitudinal designs to measure success. These thematic groupings echo within the new HSI program, Improving Undergraduate STEM Education: Hispanic-Serving Institutions (HSI Program), in particular, within the ‘Building Capacity’ category under the “Teaching and Learning in STEM” priority, promoting research that addresses curricular enhancement and faculty development.
To evaluate the effectiveness of the workshop design and the impact of the workshops on faculty perspectives of engineering education at HSIs, participants were asked to complete a series of assessment activities. Each participant completed a pre and post-workshop survey, handouts during the workshop, and a follow-up survey in the fall semester of 2018. Based on the analysis of the data, we have highlighted the following findings.

**Impact of the Workshops**

This conference sought to co-develop research needs with engineering educators at HSIs through an iterative and emergent analysis process. At the same time, the workshops were designed to also expose attendees to three innovative approaches to supporting student learning that are independent of specific pedagogies or tools: (1) intrinsic motivation, (2) students as empowered agents, and (3) design thinking. The specific activities in the workshops aimed to support:

- Participants’ self-efficacy and identified value of participating to explore engineering education research and engage in reform opportunities,
- Participants’ beliefs about teaching and learning and their willingness to test an educational prototype in their own context, and
- Participants’ readiness to take action in the classroom and more broadly.

The analysis of the pre-and follow-up surveys as they relate to these three workshop aims and the overall experiences of the workshop attendees resulted in three key impacts:

1. Community Development
2. Exposure to National Engineering Education Practice and Research
3. Increased Use of Student-Centered Education Design Strategies and Approaches
Community development

Workshop attendees discussed their experiences at the spring Texas and Florida workshops as well as the ASEE workshop as providing an opportunity to network, to meet collaborators, to develop a local support system, to learn from one another and to meet individuals who have had similar experiences.

“The workshop provided pointers and, dare I say, most importantly, the much needed networking with colleagues of similar mindset.”

“It was pleasant to meet colleagues from other institutions who are interested in improving education at Hispanic Serving Institutions.”

Some attendees described how they realized that they were not alone in their struggles and successes as instructors at HSIs, while others discussed potential future collaborations with workshop participants.

“That I am not alone as a faculty in having the same plethora of problems and having been thinking about solutions. I will be in contact with the presenters and fellow attendees, and explore more into my abilities to develop further in engineering education and serve/lead my HSI to become much better.”

“Networking with faculty from our geographic area that can help students make the jump from two-year to four-year engineering programs”

Exposure to national engineering education practice and research

Participants also saw value in the opportunity to attend ASEE. Individuals who received travel grants to ASEE had not previously attended. One participant, for instance, explained:

“I learned a lot and had a chance to see better/best practices and measure my then current standing as an instructor of engineering education. I was motivated to do research in engineering education and also act as an agent of change in my own program/department...to promote inductive teaching techniques.”

While another participant viewed attending ASEE as an opportunity to: “[make] me aware of the groups/divisions active in engineering education research especially in my interest areas of static, and mechanical engineering in general. I also learned about the challenges being faced and the efforts in order to solve the challenges such as math and physics preparation as well as motivation to continue in STEM fields. I also learned about the funding opportunities for new researchers in the area of engineering education.”

The ASEE conference became an additional opportunity for a subset of workshop attendees, who had previously not had the opportunity to attend, to explore engineering education research and engage in reform opportunities.
Increased use of student centered education design strategies and approaches

Another emerging theme from the follow-up survey was the exposure to new techniques, ideas, and research to inform the redesign of courses at the participants’ institutions. Three instructional faculty described how the workshop content raised their awareness of new course design approaches. Interactions among participants also allowed for participants’ ideas to be shared within and across institutions. As one participant explained:

“The workshop provided us opportunity to work in group and have greater discussions on the similar challenges and opportunities at HSIs. I also like the tools that were provided and we had hands-on activities that opened up my horizon.”

Attendees were asked in the post-workshop surveys about their current use and their predicted future use of the techniques and concepts presented at the workshop. Multiple workshop attendees described how they adopted strategies, teaching approaches and activities after the workshop:

“I learned about active learning techniques from the workshop and have started to implement them in my classes. These include 1 minute paper, exam wrappers, and systematic way of solving numerical problems in class. I have also started research into the weaknesses in statics in our current students and thinking/exploring the ways the ways to help them.”

“I already implemented some concepts I learned by attending the workshop into my classes. I’m applying the concept of having the student to help in the education process as educators not just learners. They are doing more presentations and projects, they work in teams, and more.”

The results, illustrated in ‘Use of educational design approaches and participation in research and collaborations,’ narrate a story of adoption of a variety of educational design tools by the workshop attendees.
One particular example is the increase in the use of activities focused around understanding one’s students, including but not limited to gathering student feedback, assessing student prior knowledge, and learning about students’ backgrounds or interests. While three attendees mentioned wanting to try experiments to better understand their students, four different attendees began implementing activities in their classes to better understand their students’ backgrounds and experiences.

“The Workshop made it abundantly clear that it is important to incorporate different teaching strategies that address that are effective with different sorts of learners. I also, learned and have implemented strategies to attempt to break down barriers between myself and my students.”

“I have worked towards providing autonomy to my students for their final projects. The scope of the project remained same but they can opt to select their team members or to work individually. I have gathered some informal feedback and it seems that they felt more engaged and responsible after making their choices.”
Engineering Educators at HSIs are working to shift their perspective of their students towards an asset-based approach.

When asked: “What do students bring to your classroom each week?” and “What challenges do your students face in the classroom and outside the classroom?” - participants at both workshops identified 28 assets and 33 challenges. Eight of these characteristics were defined as both assets and challenges by the workshop participants (in no particular order).

- CULTURAL DIVERSITY
- BILINGUAL
- COMFORT WORKING IN GROUPS/TEAMS
- COMMUTER
- FAMILY RESPONSIBILITIES
- TIME MANAGEMENT
- WORK EXPERIENCE
- MOTIVATION

The following diagrams illustrate comparisons of engineering educators’ description of challenges or assets their students face from the two geographical regions of the workshops.
CHARACTERISTICS DESCRIBED AS ASSETS

★ Student descriptors that were also perceived as challenges

Florida
- 1st generation college student
- Bilingual ★
- Comfortable working in groups/teams ☆
- Commuter ☆

Both
- Cultural diversity ☆
- Desire to learn
- Desire to succeed
- Diverse experiences
- Diverse perspectives
- Family responsibilities ☆
- Friend/peer network
- Hands on skills
- Hard working
- Inquisitive mind
- Interest
- Knowledge from other courses

Texas
- Military experience
- Motivated ☆
- Naivety
- Problem-solving skills
- Responsible
- Smart/intelligent
- Study habits
- Technology
- Time management ☆
- Trusting
- Work experience ☆
- Works independently

CHARACTERISTICS DESCRIBED AS CHALLENGES

★ Student descriptors that were also perceived as assets

Florida
- Commuter ★
- Cultural differences ★
- Extracurricular activities
- Family responsibilities ★
- Connecting coursework to real world
- Attendance/Being on time
- Comfort approaching professor
- Being “different”
- Financial constraints
- Graduating on time
- Lack of community in engineering

Both
- Lack of family support
- Language barriers ★
- Lack of self-awareness/self confidence
- Poor attitude
- Motivation ★
- Poor prior-preparation
- Lack of maturity
- Resistance to independent learning
- Lack of role model
- Learning disabilities
- No plan
- Poor communication skills
- Sleep deprivation

Texas
- Teamworking skills ★
- Tension between succeeding and learning
- Social responsibilities
- Work load/responsibilities ★
- Study habits
- Time management ★
- Stress management
- Transportation issues
Engineering Educators at HSIs are passionate about educational change efforts, but they recognize that there are resources they still need to implement their efforts.

When prototyping innovative interventions to implement at their institutions, educators identified the resources they already had or would need to acquire. These resources fell in categories such as:

CAMPUS STAKEHOLDERS AND POTENTIAL PARTNERS
CURRENT ACADEMIC CURRICULUM
INTEGRATION OF RESEARCH AND EDUCATION
PHYSICAL INFRASTRUCTURE AND OTHER RESOURCES.

Overall, buy-in from internal and external partners, time to implement these interventions, financial resources, and physical space were repeated resources that the educators needed. Student motivation, existing educational research, research infrastructure, and centers for teaching and learning were repeatedly seen as existing assets on the HSI campuses represented.

The following tables illustrate resources engineering educators at HSIs identified as necessary for educational innovation at their institution, according to assets and challenges.

<table>
<thead>
<tr>
<th>ENGINEERING CURRICULA ENHANCEMENT</th>
<th>Number Identified as Assets</th>
<th>Number Identified as Challenge/Need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extracurricular activities (e.g., stakeholder’s provide internships and field trips)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Invited guest lecturers</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Project based learning (e.g., stakeholders provide projects)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Existing engineering content</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Expanding engineering experiences</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Leverage interdisciplinary collaborations to introduce additional non-engineering content</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Need to build capacity (e.g., time and incentives)</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Need to expand engineering educational experiences (e.g., labs and intro-courses)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Reduce number of classes so class is manageable and students know that is being paid attention to</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Requires little to no resources other than time</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Challenge/Need</td>
<td>Number Identified as Assets</td>
<td>Number Identified as Challenge/Need</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------</td>
<td>-----------------------------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td>STUDENT AND FACULTY SUPPORT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buy-in from other faculty and administrators</td>
<td>9</td>
<td>22</td>
</tr>
<tr>
<td>Limited time and availability due to workload and heavy emphasis on non-teaching related responsibilities</td>
<td>2</td>
<td>31</td>
</tr>
<tr>
<td>Campus resources, such as Academic technologies and Professional Development Workshops to support faculty</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Incentives for faculty to innovate in class</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>TA support for faculty and students</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Advising (i.e., load and needs are different across student body)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Class size (i.e., faculty to student ratio)</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>More internship for students</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Need a formalized process for faculty interaction</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>External academic support (e.g., centers for teaching and learning)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>A culture of faculty individualism clashing with pockets of collaboration</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Lack of peer support</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Number of competent faculty members</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Fostering faculty-student interactions</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3D printing labs open to students</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Designation of campus resources</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>IT/web/software development support</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Funding</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Writing and editing support</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>On-campus student services, such as counseling, tutoring, academic technologies, career services, etc.</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Students are ready for this change, they are waiting for it to be realized</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>General campus student resources</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Lack of family support for students</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Students work hard/engaged</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Establishing a community where student feel that they belong</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Students do not have time to spend on their assignments, e.g., commuters, family responsibilities</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Undergraduate peer leaders</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
### Partnerships with Industry or Other Academic Institutions

<table>
<thead>
<tr>
<th>Type of Partnerships</th>
<th>Number Identified as Assets</th>
<th>Number Identified as Challenge/Need</th>
</tr>
</thead>
<tbody>
<tr>
<td>External academic partnerships</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Governmental partnerships</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Industry partnerships</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Internal academic partnerships</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>

### Physical Infrastructure and Other Resources

<table>
<thead>
<tr>
<th>Resource Description</th>
<th>Number Identified as Assets</th>
<th>Number Identified as Challenge/Need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical lab space (e.g., computer and lab space)</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Financial support is limited</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Space to support student/faculty common area/collaboration/meeting space</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Limited resources in general</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Maintaining/sustaining innovative systems</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Educational/Research technology: some missing/outdated others readily available</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>No further support needed</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Limited funding for personnel, equipment, etc.</td>
<td>3</td>
<td>7</td>
</tr>
</tbody>
</table>
Resources

Find more about the resources, publications and presentations we have contributed to the wider academic community within the information shared below.

**Website**

Rethinking Engineering Education at Hispanic Serving Institutions

eel.utep.edu/HSI

**Handouts and Slide Decks**

The handouts used during the workshops are available to the public under a creative commons license on the conference website.

eel.utep.edu/HSI
Publications


Learn more about the books, papers and reports referred to within this public report. A more extensive reference list related to this project is also available upon request.


Co-Designing an Engineering Education Research Agenda

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