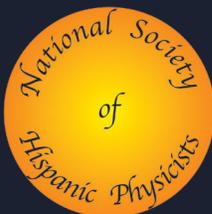




Report on the Conference for Enhancing Undergraduate Physics Programs at Hispanic-Serving Institutions



The Conference for Enhancing Undergraduate Physics Programs at Hispanic-Serving Institutions

January 5, 2018
San Diego, CA

**National Society of Hispanic Physicists
American Association of Physics Teachers**

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Executive Summary

On January 5, 2018, the National Society of Hispanic Physicists and the American Association of Physics Teachers hosted a small conference on Enhancing Physics Programs at Hispanic-Serving Institutions (HSIs). A pre-conference survey elicited the participants' opinions and experiences with physics programs at HSIs. Most reported that they found the range of ages, socio-economic status, physics and mathematics preparation, and experience in the culture of higher education was wider among Hispanic American students than among students from other groups under-represented in physics and certainly different from that of majority students. The participants were all committed to enhancing physics programs for Hispanic American students but many felt they lack the professional skills to work effectively with that audience, particularly as mentors.

As a result of conference discussion, the leaders and participants provide the following recommendations to enhance physics programs at HSIs.

For faculty:

- Recognize that the professional expectations of the faculty have grown increasingly complex and faculty need to continue developing professionally to meet these increased expectations.
- Pursue opportunities for professional development and incorporate a plan of ongoing professional development.
- Use professional societies to develop professionally and to become a member of the larger physics community.
- Study and utilize multiple effective pedagogies in order to be able to respond flexibly to the needs of a variety of students, particularly Hispanic students.
- Learn how to become an effective mentor for a diverse student population.
- Understand and employ assessment for curricular and extra-curricular programs.
- Use the resources of the college.

For physics departments:

- Recognize the value of the diverse contributions of faculty to the departmental program.
- Build community environments for faculty.
- Develop and implement a plan to recruit, retain, and acclimate a diverse student population.
- Provide opportunities for faculty professional development.
- Build vertical and horizontal bridges to extend the resources and community of the department.

For colleges and universities:

- Recognize the multiple facets of faculty contributions.
- Change perspective from “Are the students ready for college?” to “Are we ready for the students?”
- Provide services to assist a diverse student population to be successful.

For professional societies:

- Coordinate, inventory and promote existing and new opportunities for professional development.
- Enhance the availability of professional development resources, workshops and sessions strategically.
- Advocate for the professionalization of the professoriate.
- Improve access for new and early career faculty to the society's resources.
- Help departments make connections and build bridges to other institutions and to other disciplines.
- Provide programs to address a diverse faculty and student population.

For funding agencies:

- Recognize and promote the multiple facets of faculty contributions.
- Fund opportunities for faculty to pursue professional development.
- Encourage professional societies to develop new opportunities for professional development.
- Encourage and expect departments to develop bridges between institutions and among disciplines.
- Recognize the need for and fund initiatives that address diverse faculty, student, and institutional needs.

A detailed discussion of the pre-conference survey results, the conference discussions, and the suggested (recommended) practices are given in the conference report.

I. Introduction

In 2015 there were 472 Hispanic-Serving Institutions¹ (HSIs) in the United States, making up less than 14% of the non-commercial colleges and universities. Those HSIs enrolled more than 60% of the Hispanic American college and university students in the United States. But there were also 323 emerging HSIs that, if counted in the HSI total, would change the fraction to 23% of colleges and universities. Estimates of the U.S. Census Bureau place the Hispanic American population at 30% by 2040. That fact tells us that the HSI of today is a test bed for a significant fraction of the colleges and universities of tomorrow.

Though HSIs have large numbers of Hispanic American students, most HSIs also enroll large numbers of both majority and other minority students. We see today's HSIs as models of tomorrow's richly diverse, multicultural, multiracial colleges and universities.

To develop a clear understanding of the current situation confronting physics programs at HSIs, the American Association of Physics Teachers (www.aapt.org) and the National Society of Hispanic Physicists (www.hispanicphysicists.org) hosted a Conference on Enhancing Undergraduate Physics Programs at Hispanic-Serving Institutions (EUPP-HSI) at the Joint AAPT/NSHP meeting in San Diego, January 5, 2018. The conference was envisioned as a way to bring together physics faculty from representative HSIs to discuss the challenges and opportunities of physics education at HSIs, to explore what resources exist to enhance physics programming at HSIs, what resources and programs need to be developed, and the role of professional societies in faculty development at HSIs.

Though the outcomes of the conference were expected to be comprehensive, complex and multi-faceted, the principle value of the conference may well have been the opportunity for physics faculty from diverse HSIs to come together to discuss their experiences and needs. The primary activity of the conference was therefore built around small group discussions focused on key questions of physics programs at HSIs.

Prior to the EUPP-HSI conference, a pre-conference survey was distributed to the participants to provide insight into the current physics programming at HSIs.

The pre-conference survey results painted a picture of the present state of the challenges confronting many Hispanic-serving institutions. These include faculty and administrators who lack familiarity with many of the reports containing suggested practices for pedagogy and student programming, strained resources, a lack of awareness of the opportunities for professional development, and difficulty in fully understanding the meaning of a Hispanic-*servi*ng institution.

The conference brought together 32 participants for a day of discussions, and strategic re-envisioning of undergraduate physics education at HSIs. The attendees represented nine universities, eight two-year colleges, five liberal arts colleges, and four primarily undergraduate state schools.

This report on the EUPP-HSI conference provides a “state of the community” on physics programs and resources at HSIs; an articulation of the challenges confronting the teaching, learning and mentoring of physics at HSIs; suggested practices of physics teaching, learning and mentoring at HSIs; and a list of recommendations for program change initiatives for physics departments, professional societies, and funding agencies.

1. An HSI is defined as an accredited, degree-granting, public or private nonprofit institution of higher education with 25% or more total undergraduate Hispanic full-time equivalent student enrollment.

II. Physics Programs at Hispanic-Serving Institutions

In 2015, there were 60.2 million Hispanic Americans in the United States (including Puerto Rico) and they made up 17.6% of the U.S. population. The undergraduate population that year would seem to reflect this distribution with 2.9 million Hispanic Americans making up 18.1% of the total 16.1 million undergraduates (HACU, 2017b). But the situation is much more complex.

In 2015, 33.3% of Hispanic Americans, aged 25 and older, had not completed high school compared to 6.7% non-Hispanic whites (HACU, 2017a). This has a critical impact on the STEM workforce. Though Hispanic Americans made up 15% of the overall workforce in 2011, they were only 7% of the STEM labor pool (Landivar, 2013).

The United States will need to produce approximately one million more STEM professionals over the next ten years to fulfill the needs of business, industry, and basic research. In order to meet this demand, we will need to increase the number of students earning STEM degrees by nearly 35% per year over current rates (Crisp and Nora, 2012).

However, in 2002, STEM degrees accounted for 17% of all degrees awarded in the United States compared to an international average of 26% (Crisp and Nora, 2012). In 2012, China awarded 23% of its first university degrees in science and engineering, while the European Union awarded 12% and the United States awarded 9% (National Science Board, 2016).

As the fastest growing and youngest group in the United States, Hispanic Americans should play a key role in the future American workforce. In 2012 there were 1.8M people awarded a bachelor's degree (all fields), a 38% increase from 2002. However, only 16 percent of Hispanic American students who began college in 2004 as STEM majors completed a STEM degree by 2009, compared to 25 percent of White students (Crisp and Nora, 2012).

In physics the situation is complex. In 2012 Hispanic Americans made up 9.8% of all bachelor's degree recipients but only 5% of the graduate students in physics (AIP, 2014a). And, also in 2012, physicists from a Hispanic background made up only 3.2% of the physics faculty (AIP, 2014b). Nonetheless, there is some cause of optimism because the number of Hispanic Americans earning a bachelor degree increased by 85% in that same period (AIP, 2014).

These data indicate that providing appropriate curricular and programmatic opportunities in STEM education at HSIs is a critical element in educating and preparing tomorrow's workforce.

III. Conference Design

The organizing committee for the Conference on Enhancing Undergraduate Physics Programs at Hispanic Serving Institutions (EUPP-HSI) was made up of representatives from the American Association of Physics Teachers (AAPT), the National Society of Hispanic Physicists (NSHP) and faculty from HSIs.

The EUPP-HSI conference was designed to bring together physicists from a variety of HSI physics programs to have a representative profile of HSIs and their faculty. The organizing committee attempted to take into account the diversity of physics programs at HSIs by balancing the representation of schools, aiming at 1/3 two-year colleges, 1/3 large universities, 1/3 smaller schools (liberal arts colleges and primarily undergraduate state schools).

Prior to the EUPP-HSI conference, participants were asked to complete a survey intended to develop a detailed understanding of the "state of the community" in physics education at HSIs.

The survey included questions about programs targeting STEM student recruitment, retention and acclimation; professional development of faculty and mentors at HSIs; participation of HSI faculty in professional societies; educational practices in physics at HSIs; the role of undergraduate research and internships at HSIs; the familiarity of the departments with reports containing suggested practices for improving physics curricula and student support programming; and the participation of HSI students in meetings of the professional societies, particularly advocacy societies.

The EUPP-HSI Conference opened with a plenary presenting an overview of the challenges and opportunities of STEM education at HSIs. (See **Appendix A: Summary of Opening Plenary**)

The primary portion of the conference was designed as a series of small group discussions where the participants broke into groups of 12-15 to address five questions:

- What are the challenges to STEM education at an HSI?
- What are the opportunities for STEM education at an HSI?

- Why should majority institutions and industry form partnerships with HSIs?
- What are the institutional barriers to improving STEM education at HSIs?
- What can professional societies do to promote, sustain and expand STEM education at an HSI?

The sixth section, **Conference Breakout Questions and Discussions**, provides a summary of the discussions.

The conference concluded with a summary session on the resources and references used to design the conference.

IV. Framework of Suggested Practices

To prepare for the Conference on Enhancing Undergraduate Physics programs at Hispanic Serving Institutions (EUPP-HSI), the organizing committee surveyed the literature on improving physics programs and improving the recruitment, retention and acclimation of under-represented groups, particularly Hispanic American students.

Though each member of the organizing committee was familiar with curricular and program development in physics, this preliminary analysis of the literature was a useful reminder of the key lessons that had already been established and the effective programs that were already in operation.

The organizing committee selected six “Foundational Reports” to construct a cognitive/epistemological framework for physics program review and development. These reports were chosen for their comprehensive investigation into curricular and program development, for the extent and variety of their suggested practices, and the common, unifying themes of their conclusions. In this document, the set of six reports are collectively referred to as the Foundational Reports.

The framework based on the Foundational Reports became the source of the pre-conference survey questions. In addition, the framework, along with the responses to the survey, became the basis for the discussion questions that helped articulate the recommendations from the conference.

Here we list the Foundational Reports.

SPIN-UP Final Report

National Task Force for Undergraduate Physics

AAPT, 2003

<https://www.aapt.org/Programs/projects/spinup/upload/SPIN-UP-Final-Report.pdf>, referenced 8 June 2018

The SPIN-UP report summarized conclusions from analyzing thriving physics programs at 21 colleges and universities with an extended history of substantial numbers of physics majors, student engagement, undergraduate research participation, and recruitment/outreach programs. (See **Appendix B Table 1.**)

SPIN-UP TYC Final Report

SPIN-UP/TYC

AAPT, 2005

<https://www.aapt.org/Programs/projects/spinup/upload/SPIN-UP-TYC-Booklet-2.pdf>, referenced 8 June 2018

The TYC SPIN-UP report summarized conclusions from analyzing site visits to thriving physics programs at 10 two-year colleges (TYCs) based on a variety of criteria including recruiting and retaining physics and STEM majors, future STEM teachers, and students from under-represented groups. In addition, these schools were selected because of a history of implementing innovations and addressing the needs of special student populations. (See **Appendix B Tables 2a-c.**)

A National Symposium on Best Practices for Student Achievement in Science, Mathematics, Engineering, and Technology in Two-Year Hispanic-Serving Institutions (HSIs)

http://www2.estrellamountain.edu/nca/resources/criterion3/NSF_EMCC_Symposium_Best_Practices_%20Report.pdf, referenced 8 June 2018

This report contains a summary of a 2001 NSF-sponsored conference on “best practices” employed by community colleges serving Hispanic students. The conference generated two publications (no longer readily available) describing the best practices. However, the NSF report contains the comprehensive lists of practices that address preparation for college, retention, continuing on to additional education, or transitioning to the work force. (See **Appendix B Table 3.**)

Increasing the Number of Underrepresented Minorities in Astronomy at the Undergraduate, Graduate, and Postdoctoral Levels (Paper I)

AAS Committee on the Status of Minorities in Astronomy (CSMA)

AAS, 2009

<http://arxiv.org/pdf/0903.4506.pdf>, referenced 8 June 2018

In preparation for the decadal Astro 2010 State of the Profession report, the CSMA prepared two reports on the status of minorities in astronomy and made recommendations for practices that could improve the representation of minorities in astronomy. The first paper focuses on the educational experience of future astronomers and contains suggestions for Ph.D. granting institutions, funding agencies, national labs, and professional societies. (See **Appendix B Tables 4a-d.**)

Increasing the Number of Underrepresented Minorities in Astronomy Through K-12 Education and Public Outreach (Paper II)

AAS Committee on the Status of Minorities in Astronomy (CSMA)

AAS, 2009

<http://arxiv.org/abs/0903.4507>, referenced 8 June 2018

The second of two reports prepared by the CSMA for the decadal Astro 2010 State of the Profession report. This paper addresses outreach to pre-college students and to the general public with recommendations for institutions of higher education, funding agencies and professional societies. (See **Appendix B Tables 5a-c.**)

Finding Your Workforce: Latinos in Science, Technology, Engineering, and Math (STEM) Excelencia in Education

<https://www.edexcelencia.org/research/publications/finding-your-workforce-latinos-science-technology-engineering-and-math-stem>, referenced 8 June 2018

Excelencia in Education periodically publishes reports focusing on particular sectors of the labor force, such as STEM or health fields. The STEM issue focuses on best practices and best programs in STEM education. (See **Appendix B Table 6.**)

V. Design of the Pre-Conference Survey

Based on the cognitive/epistemological framework, described in **Section IV**, the conference organizers first identified a list of areas of interest for physics programs at HSIs. The areas of interest included STEM student recruitment, retention and acclimation; professional development of faculty and mentors at HSIs; participation of HSI faculty in professional societies; educational practices in physics at HSIs; the role of undergraduate research and internships at HSIs; participation of HSI students in meetings of the professional societies, particularly advocacy societies.

The conference organizers then selected a subset of these issues to address in a survey that could be completed in 30-40 minutes. The survey was sent electronically to the participants registered for the EUPP-HSI conference.

To establish a rough sense of the entire department's thinking and activities focusing on Hispanic American students, the survey participants were asked to answer many of the same questions a second time as a representative of an "average" member of the department. This process was evidently uncomfortable for many of the survey participants, or perhaps survey fatigue set in, since a third of the survey respondents did not answer the final set of questions.

VI. Survey Results

The pre-conferences survey yielded responses from 18 of the 30 participants. We summarize those responses and provide some commentary. The summary below is based on the responses of the conference attendees. But a caveat is needed since the organizers did not comprehensively survey each member of the participants' departments. Rather, the attendees were asked to respond for their departments, as mentioned previously, based on their perceptions of the thinking of other members of their departments.

Demographics

Participants from two-year colleges represented the largest number of those turning in the survey. The 18 survey respondents represented 8 two-year colleges, three state baccalaureate schools, four liberal arts colleges, and three universities.

How knowledgeable are physics departments with the Foundational Reports and how do they use the reports?

For the survey, the organizers chose six Foundational Reports, selected for the quality and comprehensiveness of their suggested practices. We expected that our conference participants are among the more knowledgeable of their departments' faculty about issues of diversity and inclusiveness and yet our participants' knowledge of these reports was limited.

Only the SPIN-UP report had achieved good penetration (~60% very familiar or somewhat familiar) into the mindset of the departments represented by the survey participants. Even the SPIN-UP TYC report did not rate as highly with only about 45% of the respondents describing themselves as very familiar or somewhat familiar with the report. Our respondents were not as familiar with the other reports, despite the quality and relevance of these reports for physics programs at HSIs.

Encouragingly, when a report is known, there seems to exist a good correlation with the use of the suggested practices when the department develops curricular or extra-curricular programming. In this context, extra-curricular encompasses those programs focused on skills and perspectives outside coursework, such as recruiting, career advising, mentoring, or developing social capital in the context of expectations of higher education or being away from home.

Like SPIN-UP, both SPIN-UP TYC and the Best Practices for Student Achievement in SMET in TY HSIs conference had comprehensive distribution plans: the reports were distributed widely throughout the higher education community.

But, in addition, SPIN-UP was in front of the physics community for 15 years. The SPIN-UP leaders gave many talks on the project, the departmental site visit program was very public, and the report was followed by many sessions at national meetings and workshops. This kind of extended and comprehensive push may be needed to make institutional changes.

In addition to the Foundational Reports, other resources from AAPT, the American Physical Society (APS), the American Institute of Physics (AIP) and other organizations are being used for physics program development. Some of the more frequently mentioned resources include AAPT recommendations (TYC, Labs, Computational Physics, ...), AIP Career Pathway Project and the **Careers Toolbox**, and **Phys21: Preparing Physics Students for Diverse Careers** report.

How common are vertical or horizontal bridges in physics departments?

Vertical bridges are those that connect schools with students at different levels of preparation. For instance, a college physics department might establish a connection with a local high school. This relationship allows the high school access to speakers and student visitors for outreach activities that promote higher education and career options in STEM. It also allows the college department to have a better understanding of the challenges of high school teachers, the physics education of high school students, and leadership and engagement opportunities for the department's students. Another vertical bridge may be between a four-year college (FYC) and a research university. This allows the FYC to benefit from a steady stream of speakers, opportunities to highlight research activities, and a way for the faculty at the FYC to remain current in contemporary research. The department at the university benefits from developing familiarity with students at the FYC for recruiting purposes, ready access to faculty who may be more knowledgeable about pedagogy and curricular innovation, and leadership and engagement opportunities for their own graduate students.

Horizontal bridges are those between institutions at equivalent levels of student preparation. Two colleges may partner to share SPS activities, travel to meetings, speaker engagements, and so forth. Both schools benefit from sharing their resources and expertise. Bridges to industrial partners are also useful. Faculty in a department can use long-term relationships with industrial partners or undergraduate research programs to better evaluate the preparation of their students for these opportunities and the kind of mentoring and oversight provided to their students.

However, though using vertical and horizontal bridges to extend the community and resources of departments is a highly recommended practice, only 18% of the departments frequently used horizontal bridges and less than 30% used vertical bridges.

How pervasive are the opportunities for professional development?

Approximately 40% of the participants stated there were opportunities for professional development at their schools for improving as a researcher and as a teacher. But only 25% had professional development opportunities to improve as mentors. An examination of the comments reveal that these opportunities tend to cover a variety of topics and lack the structure and coherence needed for comprehensive professional development.

Funding was readily available for conference travel to professional meetings for research (64%) and teaching (94%), but support dropped to 50% for mentoring professional development. The high response for support of teaching professional development may be a reflection of the high representation of TYC faculty among the survey respondents.

A commonly repeated comment was that, though funding is available, the amount of funding was minimal or access was restricted. Half of those faculty who regularly attend meetings for their research (~60%) are not aware of opportunities at these meetings for development in mentoring. A similar percentage of those faculty who regularly attend meetings for their teaching (~65%), are not aware of mentoring development opportunities at those meetings. There is a comparable uncertainty about opportunities to improve extra-curricular programs. A number of professional meetings are mentioned but the most prevalent are AAPT and APS meetings. The perception by the conference participants is that there are development opportunities for mentoring focused on the classroom and on engaging minority students but not as many opportunities for development in mentoring research students. Generally, the availability of professional development as a mentor seems to be an unfulfilled need.

What resources should professional societies develop to improve STEM education at HSIs?

The most frequently desired resources were “best practices” in pedagogy, mentoring and advising for a variety of institutions. However, many of these recommendations already exist in the Foundational Reports. Further work will be needed to determine if the departments are simply unaware of the existence of these suggested practices or if they are looking for wider endorsement of these practices.

In addition, frequently mentioned resources included papers and reports aimed at faculty that emphasize the need for flexible pedagogy and the needs of under-represented groups. In particular, resources on mentoring and advising minority students were repeatedly requested.

In addition, there was an appeal for assistance in forming partnerships with research institutions.

What suggested practices are already employed by the physics departments of the conference attendees?

- **Mentoring program** – Several of the Foundational Reports recommend an intentional comprehensive mentoring program where the student may be contacted even before the first day of classes (in cases where the student has expressed an interest in the major) or at least in the first semester. In addition, the idea of having several mentors, e.g., a career advisor, an academic mentor, a social mentor ..., is mentioned in some Foundational Reports.

The survey participants indicated that this kind of intentional mentoring program was rare with only 5-6% of the participants mentioning that this was usually the case at their institutions. An examination of the comments indicated that most mentoring programs occurred late in the student’s career and focused on already declared majors.

Frequent constraints seemed to be a lack of awareness of this approach, a lack of faculty time, and a high degree of uncertainty about how to mentor undeclared majors, particularly minority students. Many mentoring programs that were mentioned were informal and required students to take the initiative.

- **A challenging, supportive pedagogy** – Almost all of the Foundational Reports mentioned that the pedagogy should be challenging and supportive with flexible approaches that might include peer group work. A good practice would be to solicit students’ satisfaction for both the level of challenge and the extent of supportive resources and strategies in their classes.

Nearly 50% of the survey participants acknowledged the use of curricula based on Physics Education Research (PER). But most went on to state that this was an option adopted by individual faculty members, not something promoted or required by the department.

A common concern was the achievement gap between lower- and higher-performing students and many participants seemed to equate “lower-performing” with minority students.

Most of the supportive strategies mentioned seemed to focus on sorting underprepared or at-risk students into separate courses or programs rather than using the PER curricula in ways that support diverse learning strategies and provide pathways for review and comprehensive learning.

Although ~60% of the survey participants reported that they sought anonymous feedback for students’ satisfaction with the curricula, the comments revealed that most relied on course evaluations and few sought regular, anonymous, curriculum-wide feedback.

- **Multiple, vital student communities** – Many of the Foundational Reports mention that student community plays an important role in student retention and acclimation. Furthermore, the Foundational Reports suggest that faculty bear some responsibility for these communities by encouraging their formation and providing rooms and other resources. In addition, faculty ought to maintain some (non-intrusive) oversight of the level of engagement and civility among the communities of students by soliciting regular anonymous feedback.

Though the majority of the survey participants reported a high level of satisfaction among the student community, the comments indicate that this analysis is based on anecdotal and informal interactions. There is no regular mechanism for obtaining detailed anonymous feedback. And there seems to be no effort to solicit feedback from minority students separate from majority students.

The idea of multiple, distinct communities within a department seems to be a new paradigm for the survey participants but comments reveal that the participants recognized distinctions between men and women, among students with different cultural backgrounds (e.g., Chinese American and Hispanic American), between introductory students and upper-level students, and perhaps other distinctions that factor into defining communities.

Most participants reported no friction among these communities but again this understanding was based on informal feedback.

• **Multiple student spaces under student control** – Several of the Foundational Reports suggested that student community can be improved by having spaces for students under student control. This may not extend to the choice of décor but should at least be exempt from a regular faculty presence. However, some students seem to prefer informal spaces and other students seem to prefer more formal, quiet rooms. Therefore, the suggestion for multiple spaces.

Most departments do not provide dedicated space under student control. But, there is some evidence that there is a difference between public versus private institutions: private institutions are more likely to provide such spaces.

• **Leadership opportunities and development of an identity within the department** – Several Foundational Reports state that many students, particularly students from under-represented groups, seem to excel when allowed to function outside the classroom in leadership roles. This seems to be rooted in the idea of giving back to the community. In addition, a number of mainstream reports on critical professional skills list leadership as a high priority.

Though most of the survey participants describe opportunities for student leadership, a close examination of the comments reveals that these are mostly informal activities without mentoring, guidance or assessment. This situation is not surprising since the emphasis on developing leadership skills as an expected outcome of the physics baccalaureate degree program is relatively new.

In addition, the opportunities for students to develop an identity within the department (also strongly endorsed by the Foundational Reports) are not well established in the departments. And again, the survey responses indicate that there is no mentoring or assessment of students in these roles. In some departments, many of these roles are restricted to very strong majors.

There are also constraints from schools (usually TYCs) that do not have the opportunity to develop majors. If the institution does not have a degree-granting program in physics, it may be difficult for students to develop a physics identity. However, having a student physics club or a Society of Physics Students chapter can help the students feel that they are part of a larger physics community.

• **Access to advocacy societies and meetings** – Several of the Foundational Reports encourage early and frequent contact with advocacy societies (such as NSHP, the National Society of Black Physicist, NSBP and the Society for Advancement of Chicanos/Hispanics and Native Americans in Science, SACNAS) as a way of combating isolation and providing additional mentoring opportunities and role models.

Few schools (~11%) support travel to meetings of the advocacy societies as a routine matter. Some make funds available to students who are giving presentations at those societies' meetings instead of at a professional society meeting.

Responses as a Representation of the Department

Though not all of the survey respondents answered the questions designed to elicit their expected responses of an “average member of their department,” enough answered so that we were able to confirm our expectation that the conference participants represent the more knowledgeable and more engaged faculty, compared to their departmental colleagues, in terms of pedagogy and the needs of students from under-represented groups.

The data also indicate that many of the survey participants characterize their departments as having faculty who are still struggling with questions regarding the need for diversity and inclusion, with the role of the faculty in this effort, and with a lack of awareness of the suggested practices in pedagogy, mentoring, and community.

VII. Conference Breakout Questions and Discussions

Breakout I & II: *What are the Challenges and Opportunities for Physics Education at HSIs?*

Who do we teach?

One of the key points that arose in our discussions was the nature of diversity in the student body – not simply diversity in racial or cultural background but in all aspects of the student profile. There is a range in academic preparation, socio-economic background, age, financial resources, citizenship status, cultural capital, motivation, gender complexities, veteran status, and external influences (both positive and negative) that seem to surpass the range and extent of most majority students in majority institutions. Furthermore, not only is there a portion of the student body that is characterized by being “different” from majority students, but this group is growing in numbers.

Another point that arose in this breakout session was that this group of diverse students is enmeshed with traditional, majority students. However, this should be viewed as a benefit since by working with this diverse group of students we are beginning to recognize that majority students are themselves very diverse in ways we had not previously recognized or accommodated.

This increasingly diverse student population has impacted faculty in a number of ways. No longer can faculty simply teach in the classroom, they must also mentor students with very different backgrounds and expectations, act as a guide to the academic community, serve as a career counselor, and learn and implement alternative pedagogies. In reality, this has always been the case ... but the need to actually do these things is becoming more critical.

And colleges and universities can no longer ask “Are the students ready for college?” but must ask themselves “Are we prepared for the students?”

Among the strengths of the Hispanic American students are that many (though not all) are respectful, value education as a key to upward mobility, and are self-reliant. Among the challenges facing the Hispanic American students are that many (though not all) are the first in their family to attend college and they do not have the cultural background to navigate the academic community of higher education (e.g., they do not know how to learn, when to ask for help, how to work in heterogeneous groups). Economic trends show that Hispanic households have lower median income² thus many Hispanic American students (though not all) are financially struggling and must take on jobs to a greater extent than majority students. And many come from secondary schools that did not provide them with a strong academic preparation.

In addition, though Hispanic American students frequently have strong family support, there are often challenges due to family obligations and problems. As an example, the need to provide financial support to the family and to help with the care of younger siblings are frequently expressed by Hispanic American students. We note that these strengths and challenges are not confined to Hispanic American students.

Where do we teach?

Diversity also describes the schools represented at the EUPP-HSI conference.

The institutions represented both public and private sectors and included two-year colleges, state baccalaureate schools, liberal arts colleges, and research universities. Many schools offered a bachelor’s degree in physics but others did not. Those that have physics major programs are usually able to provide significant resources such as student study spaces, room and support for student communities, easy access to faculty, opportunities for student engagement and leadership in the department, academic support programs in the department and from the school, and social support programming. But other programs were more constrained in terms of student study spaces, access to faculty, and opportunities for engaging students within the department. Many of the conference participants agreed that providing student spaces is essential.

By “student spaces” we mean formal study spaces (i.e., classrooms, library, tutoring rooms, lab rooms), informal study spaces (e.g., quiet room with access to computers, physics library), and informal community rooms (Society of Physics Students club room, hang-out space, rooms with considerable student responsibility and control).

These rooms are essential venues for conveying information about the department, the major, the school community, and career opportunities. In addition, these student spaces allowed easy access for students to observe models of both individual and group study. For many students, an important element of their academic success was to be introduced to these student spaces early in their academic

2. \$44,800 vs. \$57,230 in 2015. (From <http://www.pewhispanic.org/2017/09/18/facts-on-u-s-latinos-trend-data/>)

career. Possibly the most critical contribution of student spaces in the department was that it encouraged the development of student communities.

An active Society of Physics Students chapter or physics club provides students with opportunities for outreach, leadership, and alternative engagement with the discipline. In addition to being students of physics, students can participate in the department as models for younger students, organizers of outreach activities, tutors, departmental guide for visitors, and learning assistants, to mention just a few possibilities. Two-year colleges, whose student populations tend to be less rooted in the department, are particularly challenged in terms of fostering vital communities within the department.

A key first step to building vital student communities is for faculty to recognize that there is a community. More precisely, it is almost certain that there are multiple student communities. And a critical second step is to recognize that there is a role for faculty to play in providing guidance, support, role models and resources to promote vital and positive communities within the student population. However, the way to establish a community will vary with institution, faculty and situation.

A critical limiting factor in “being prepared for our students” is that few schools fully acknowledge the contributions made by faculty in engaging and mentoring students or allowed for the impact that these activities make on the professional careers of the faculty.

How do we teach?

Diversity also describes the pedagogies employed by the faculty. Though there was a preference for active learning strategies, even traditional lecture formats are used.

The faculty seemed to agree that there was a need to be flexible in approaching pedagogy, that it is necessary to employ multiple strategies to address more effectively the diverse backgrounds, preparations, and abilities that may be represented in a single classroom.

A second element that was frequently discussed was that students should be given the opportunity to fail while being supported to learn from their mistakes. That is, students must become aware that trying, failing, and learning from mistakes are all part of the learning process. Classrooms need to be a safe space for students to go beyond their comfort zone.

And a third critical factor was that faculty need to be accessible and need to be able to relate to their students. Many students benefit when faculty not only reveal the passion and pleasure we find in our discipline but also the frequent struggles we have had in our own experiences as students, teachers, and scholars.

Are we prepared?

Many schools are already incorporating programs to address more effectively the needs and challenges of Hispanic American students as well as those from other under-represented groups, and to provide a wider spectrum of opportunities for student engagement. However, there is much more work to be done.

Some of these programs are academically based such as first-year cohorts, freshman orientation classes or seminars, centers for teaching and learning, supplemental instruction, tutoring and bridge programs. Others are non-academic but critical social support programs such as a multi-cultural office, multi-cultural student organizations, career advising and counseling.

Unfortunately, there are only a few schools that have a complete set of such programs in place or excel with all such programs.

Key limiting factors for the faculty are the variability of faculty time, motivation, and preparation to undertake non-classroom activities. This is a particular challenge for community colleges, which frequently have a large number of part-time faculty who are not, and cannot be, fully invested in the department.

Professional development for both faculty and student support staff remains a critical issue.

Breakout III: Why should majority institutions/industry form partnerships with HSIs? Why should HSIs form partnerships with majority institutions/industry?

Though this is a critical set of issues, the Organizing Committee chose to skip this question during the conference in order to remain on schedule.

Bridge programs were frequently brought up during the discussions of other Breakout questions and some comments are described in **Section VI. Survey Results, Section IX. Synthesis of Suggested Practices**, and **Table 5 of Appendix B: Tables Summarizing the Foundational Reports**.

Breakout IV: *What are the institutional barriers to enhancing physics education at HSIs?*

Though the participants brought up a number of barriers to enhancing physics programs at HSIs, three dominated the discussions. Interestingly, one of the most fundamental barriers is a lack of clarity about what it means to be a Hispanic-*servicing* institution. For many schools and faculty this designation is simply a number about the demographics of the school. And there was considerable interest in the idea of what a Hispanic-*thriving* institution would look like.

Though many schools and programs have moved to a student-centered philosophy, there remains a considerable gap between intent and implementation. As a result, schools are still lagging in their student support programming, faculty and staff professional development, and recruitment and acclimation efforts. Often there is still a lack of coherence and communal consensus for the programs that are in place.

A second critical barrier is the lack of recognition or support by institutions of higher education for the faculty work in these areas. Faculty who are willing and able to serve as mentors, to work closely with students, to study and adopt new pedagogical techniques and to perform outreach should be supported and encouraged by recognizing these activities as valid scholarly engagement. Institutions need to provide time, support for professional development, and additional resources for these activities. There is a limit to depending on empathy or professional pride to motivate change.

A third dominant theme was the lack of professional development opportunities. Though there are now more opportunities to become better researchers or teachers, the new roles for the faculty that we have been discussing need additional support. Faculty need development in their roles as research mentors, advisors, outreach leaders, teachers outside the classroom, and their ability to work with students from a variety of backgrounds and preparations.

Though these three issues dominated the discussions there were other issues that should be mentioned.

- Many Hispanic students, many students from other under-represented groups, and many majority students as well, need additional support transitioning from secondary to higher education to be effective and productive in their higher education careers. Though many of these transition programs are heavily subscribed, the concept of a “remedial course” is frequently viewed with suspicion.

Additional work must be invested in looking at these programs outside the framework of remediation. And further exploration is needed to identify and promote exemplar programs and to make effective transitional programs available for all students who need them.

- For many schools, a lack of resources severely constrains the opportunities they can provide. A particularly problematic resource is space for student study and community. Additional work is needed to support the argument that these spaces for student study and informal interaction are an integral part of the learning environment of the department and of the school.
- Many schools, particularly community colleges, depend on a large number of part-time faculty who are frequently only minimally present outside their class times. Students are not the only ones who suffer from this lack of broad engagement. The departments themselves suffer when so many of their faculty are not present for meetings, faculty community, or engaging with other departments at the institution.
- Finally, an awareness of physics specific careers is frequently not present at the high school or college entry level. Having this kind of information available within the department, for both faculty and students, would be valuable.

Breakout V: *What can professional societies do to promote, sustain and expand physics education at an HSI?*

Though conference participants agreed that AAPT and NSHP had done a valuable service by holding the conference and starting the conversation, there is much more work to be done.

AAPT should find a way to develop an archive for the outcomes of this conference and relevant resources and references. In addition, a database of exemplar programs should be established, maintained, and widely promoted.

In addition, AAPT should find a way to make available in a more coherent way the talks presented at national meetings, particularly those focused on working with under-represented groups. Though this is being done already to some extent, more work is needed.

AAPT could also develop a series of case studies of thriving physics programs at Hispanic-serving institutions.

New professional development workshops need to be developed and implemented. Faculty need additional assistance in mentoring in the research environment, teaching outside the classroom, providing leadership opportunities and guidance, working with diverse

student populations (racial and cultural backgrounds, genders, socio-economic status, national origins, and so on), in effective assessment methods and implementation, etc. Existing workshops should be identified and promoted.

These new resources should be incorporated into the Physics and Astronomy New Faculty Workshops whenever appropriate.

In addition to workshops and sessions on these known difficulties, the PER community should be reminded of the work needed to identify culturally relevant assignments and pedagogy within physics, barriers to change, and the challenges in establishing a learning environment for a multi-racial, multi-cultural, multi-generational, multi-class, and mixed-gender student body.

Though the need for these professional development opportunities are important, possibly an even more critical step would be for the professional societies (AAPT, APS and AIP) and the advocacy societies (NSHP and NSBP) to collaborate and add their weight to a statement urging institutions of higher education to recognize the value of professional development for faculty in the classroom, in the research area, and in the community. Faculty should be given the recognition, time and financial resources to become more effective mentors and scholars. This includes recognizing the value of, and time commitments required by activities such as mentoring and/or outreach, providing travel funds for professional development at national meetings and other venues, and giving appropriate consideration for these activities in career promotion and evaluation.

Professional societies should also study the needs of their members at their meetings. A way for faculty from financially constrained schools should be explored to allow easier (less costly) access to the meetings as AAPT has done with its travel grants program

VIII. Further Work

In this section, we pull together recommendations for enhancing physics programs at HSIs, with an emphasis on what professional societies can do to help this effort.

A. Immediate Action

1. Develop a community-wide vision of the specific resource needs for enhancing educational practices and professional development for physics programs at Hispanic-Serving Institutions.

AAPT will ensure widespread circulation of this conference report to both HSIs and majority schools. But in addition, AAPT should work to ensure that the report has a high visibility within the AAPT community and that appropriate committees (Undergraduate Education, Diversity in Physics, Two-Year Colleges, Professional Concerns, ...) that structure workshop and session programming at national meetings will be encouraged to incorporate the recommendations of the report into their strategic planning.

In addition, a report to the AAPT community at the Winter 2019 and Summer 2019 meetings will occur through sessions and papers. A report to the NSHP community will occur at the SACNAS 2019 meeting.

NSHP and AAPT will work to establish a long-range plan to develop and maintain a focus on the needs of physics programs at HSIs.

2. Circulate widely a list of recommended practices in pedagogy, mentoring and advising for HSIs.

The Foundational Reports discussed in **Section IV** already have an extensive list of suggested practices to improve both curricular and extra-curricular programming. (See **Appendix B: Tables 1-6** and **Section IX: Synthesis of Suggested Practices**.) One of the purposes of this report is to help make these insightful documents more widely known.

In addition to the Foundational Reports mentioned in **Section IV**, *Excelencia* in Education maintains a website with a focus on identifying “Best Practice Programs” at HSIs. The **Growing What Works** database (<https://www.edexcelencia.org/programs-initiatives/growing-what-works-database>, referenced 8 June 2018) contains hundreds (as of June 2018) of programs that address a variety of needs of Hispanic and Latino students.

3. Identify and promote existing workshops and resources for professional development.

The professional societies already offer a number of workshops and sessions on improving teaching, implementing new pedagogies, mentoring both majority and minority students, developing leadership skills, and other aspects of professional development. In addition, the professional societies have substantial resources that can be used by faculty and by departments to improve the effectiveness of physics programs at HSIs.

The appropriate committees of AAPT and NSHP should develop a catalog of the workshops and sessions that are currently being offered and to promote these and other resources. This may include both AAPT resources and those of other societies as well, e.g., APS, *Excelencia* in Education, NSHP, and SACNAS.

In addition, the current process of archiving sessions and workshops presented at national meetings should be studied in order to develop these presentations into a viable resource.

B. Long Term Action

1. Develop a vision of faculty professional development in service to Hispanic American and students from other under-represented groups, as an integral component of the professorial career.

The professional societies should help define and promote a strategic vision of the professional education of physics faculty. Faculty have roles outside of research and teaching in the classroom. But almost all of their professional development in mentoring, developing community, designing learning environments, developing and maintaining research or scholarly groups, being an active contributor and leader in the department, and many other areas occur only after graduate school and “on the job.”

The professional societies should prepare and issue a statement urging institutions of higher education to recognize the value of professional development for faculty in the classroom, in research, and in the community. In addition, the statement should urge that departments recognize and value the contributions of faculty as mentors and community members. Part of this recognition should be in the form of time and financial resources to become more effective mentors and scholars and an appropriate consideration for these scholarly activities in career promotion and evaluation.

2. Explore the needs of adjunct faculty in order to effectively engage the services of part time faculty.

Though schools should be strongly encouraged to provide enough long-term and full-time faculty lines to meet the needs of their students, many schools will need to resort to temporary or part-time appointments due to budget restrictions. It is important to note that this approach has a significant negative impact on the learning environment of the students and on the work of the department.

How can the professional societies help both the schools and the community of adjunct faculty? What resources would help departments better prepare these (unfortunately) itinerate faculty for the classroom and for engaging students? How can professional societies reach these part-time faculty more effectively and bring them into the community of professional faculty?

3. Encourage the development of needed HSI faculty professional development resources that do not yet exist or are not widely available.

As mentioned previously, we recommend developing and implementing new professional development workshops to provide faculty with additional assistance in mentoring in the research environment, teaching outside the classroom, providing leadership opportunities and guidance, working with diverse student populations (racial and cultural backgrounds, genders, socio-economic status, national origins, and so on), in effective assessment methods and implementation, etc. Existing workshops should be identified and promoted.

Conversations between the PER community and faculty from HSIs should be organized to articulate more effectively the work needed to identify culturally relevant assignments and pedagogy within physics, barriers to change, and the challenges in establishing a learning environment for a multi-racial, multi-cultural, multi-generational, multi-class, and mixed-gender student body.

4. Explore and develop a means to form vertical and horizontal partnerships between institutions.

The challenges of forming, implementing, and sustaining vertical and horizontal bridge programs require additional study by both higher education institutions and by professional societies.

5. Improve access to the resources and community of professional societies, for both faculty and students at HSIs.

Professional societies should study the needs of their Hispanic American members at their meetings. The societies should find ways to support faculty from financially constrained schools to allow easier (less costly) access to the meetings

IX. Synthesis of Suggested Practices

Why do we use the term “Suggested Practices”?

Too often the focus on *best practices* is on the program or practice and too little on the people whose work has made that technique effective. However, it is not programs that work but people.

A second concern is that *best practice* has the aura of being rigorously vetted. But frequently there is no scientific testing or evaluation. Rather these ideas and programs have been effective with the right people and under certain conditions.

Though we heartily endorse adopting the practices that best meet the needs and conditions of the particular institutional environment, the efficacy of any program or practice depends on the people implementing these ideas and their constant assessment and evaluation of that implementation.

Suggested Practices for Faculty

- **Recognize that the professional expectations** of the faculty have grown increasingly complex and faculty need to continue developing professionally to meet these increased expectations.

No longer is it sufficient for a faculty member to be able to pursue research and lecture well. Rather faculty, in addition to pursuing research or scholarly activities appropriate to their school, are expected to be effective in the classroom; to mentor students who have diverse backgrounds, expectations, and preparation; to help build a departmental community; create and maintain groups for research or learning purposes; and to function both as a community member of the department and as a leader within the department. Though the balance of expectations will vary from institution to institution and from faculty to faculty, the first step for any faculty member is to recognize the numerous expectations confronting them and to understand that most physics programs have prepared them for only a fraction of these expectations.

- **Pursue opportunities** for professional development and incorporate a plan of ongoing professional development.

To meet the challenges confronting them, most faculty should seek out opportunities to develop professionally in research, in the classroom, as mentors, and as members of their departments and members of the physics community at large. Many schools have centers for teaching and learning that offer workshops on effective teaching practice, current pedagogy, and working with students. Professional societies (APS and AAPT) frequently offer workshops and sessions on teaching, mentoring, and developing outreach activities. In addition, the advocacy societies (NSBP, SACNAS, NSHP, the Association of Women in Science, and so on) also frequently have meetings that offer other opportunities for professional development. However, faculty must carefully balance the time devoted to professional development to that needed to build a research program or other scholarly work.

- **Use professional societies** to develop professionally and to become a member of the larger physics community.

Simply being a member of a professional society is insufficient. Faculty should explore the resources and communities of professional societies and become familiar with the resources and opportunities for professional development. In addition, faculty should learn how to initiate and develop new programming within the umbrella of a professional society.

- **Study and utilize** multiple effective pedagogies in order to be able to respond flexibly to the needs of a variety of students.

Though a lecture is well designed to convey content material, and developing a well-organized lecture is an effective way for speakers to review and organize their own understanding, discipline-based educational research (DBER) has verified time and again that the lecture method of instruction is not very effective in promoting student learning. However, there are PER-based pedagogies that can be much more effective engaging students and enhancing their learning. In addition, many of these PER-based curricula allow faculty to monitor student learning closely and in “real time.” Thereby, faculty can pinpoint specific areas where students need additional academic support. But faculty typically need to be introduced to these methods and given a chance to practice them before effectively using them in the classroom. It is worthwhile for faculty to explore several pedagogies to find one or several that best match the faculty member’s own teaching style and can also address the needs of their students. Evidence suggests that having a variety of teaching strategies and a flexibility in employing these to match student needs is a characteristic of effective faculty members in classrooms with diverse students.

- **Learn to become an effective mentor.**

Though faculty can be effective as academic advisers, the role of mentor is much more challenging and complex. First, it is critical to recognize that everyone is a mentor. Whether or not students are assigned to you, they will pick up feedback from you (intended or not) about their suitability for studying physics and how to conduct oneself as a physicist and as an educator.

- ***Understand and employ assessment for curricular and extra-curricular programs.***

The central focus of assessment is to identify what is or is not working, and to inform the faculty about which programs or practices need further improvement. Assessment is therefore a critical component of both personal professional development and programmatic development.

- ***Use the resources of the college to improve the departmental program.***

A common and critical failure on the part of many faculty is to be unfamiliar with the resources and programs of their college or university. Faculty should learn about the opportunities offered by their institution for professional development. In addition, faculty should explore those programs resources to help recruit, acclimate, and retain students in higher education and those elements that prepare students for their future careers in and outside of STEM. In addition, faculty should engage with those programs enough to offer feedback to their institution about their effectiveness.

Suggested Practices for Departments

- ***Recognize the value of the faculty.***

The department is the nexus between the individual faculty member (as a researcher, scholar, teacher, mentor, outreach host, academic advisor, community member and leader) and the institution. Though both the department and institution should view faculty members as resources that require investment, development, and cultivation; it is within the department that the contributions of a faculty member can best be identified, nurtured, and rewarded.

- ***Build community environments for faculty.***

Recognizing the value of the faculty is the first step in developing a departmental community environment. The vision of the environment is one that challenges and supports the faculty, one in which each member can contribute as a scholar, teacher, mentor, community member and leader. As with all key elements of a program, this community environment should be assessed regularly and anonymously. It is also important to recognize that diversity is a measure of the health and vitality of the department.

- ***Provide opportunities for professional development.***

The multi-faceted contributions of a faculty member as a researcher, scholar, teacher, mentor, outreach host, academic advisor, community member and leader should be recognized, their value and time commitment noted. The institution should provide opportunities for the strategic development of these skills and practices

- ***Build welcoming environments for students.***

In a very real sense, the department is providing a professional home for the students. Developing and maintaining an environment that is challenging and supportive of a variety of students is difficult. There are many elements that make up the departmental environment: (a) Student space for study and social interactions, activities (e.g., SPS, tutoring, and outreach) that allow students to collaborate and develop the ability to work in teams, (b) pedagogy and curricula that fit the needs of the students and faculty, (c) access to faculty and mentors, and (d) an inclusive openness and acceptance of diverse students. These elements are difficult to develop and maintain but regular and anonymous assessment could provide the department with feedback about these programs.

- ***Build vertical and horizontal bridges to extend the resources and community of the department.***

As mentioned previously, vertical bridge programs are those that connect schools with students at different levels of preparation. For instance, a college physics department might establish a connection with a local high school. Another vertical bridge program may be between a four-year college and a research university. Horizontal bridge programs are those between institutions at equivalent levels of student preparation. Two colleges may partner to share SPS activities, travel to meetings, speaker engagements, and so.

- ***Incorporate advocacy societies in departmental resources.***

Information about student and advocacy organizations (e.g., SPS, NSHP, NSBP, SACNAS, AWIS, and the Conference for Undergraduate Women in Physics {CUWiP}) should be readily visible in student spaces. If possible, financial resources to attend advocacy society meetings should be made available to students. Many of these meetings are very student-focused. Faculty might visit these meetings to determine the resources and programming available to both minority and majority students.

Suggested Practices for Colleges/Universities

- ***Recognize the multiple facets of faculty contributions.***

Incorporate the full range of faculty activities (e.g., mentoring, outreach, and engaging student communities) into the promotion and review process. Acknowledge and incorporate the impact of these activities on faculty time and energy. Provide appropriate financial resources for professional development both locally and at meetings of professional societies.

- ***Be ready for the students.***

Move away from the perspective of “Are the students ready for college?” to “Are we ready for the students?”. This will help frame the discussions about student recruitment, support and professional preparation.

Suggested Practices for Professional Societies

- **Coordinate, inventory and promote existing and new opportunities for faculty professional development.**

The professional societies offer a number of valuable resources and professional development opportunities but frequently these are not readily found or offered in a regular, predictable manner. Societies should work to develop the number, variety and depth of these opportunities.

- **Archive faculty professional development resources, workshops and sessions strategically.**

Though professional societies are working hard to archive the workshops and sessions more work needs to be done, particularly on those that focus on working with under-represented groups. Fortunately, there are a number of trial programs in other areas (e.g., Living Physics Portal and PhysPort) that may allow a significant improvement in the design and implementation of archiving resources.

- **Advocate for the professionalization of the professoriate.**

Professional societies should be at the forefront of helping articulate and recognize the varied contributions of faculty and the need for continued, ongoing professional development.

- **Improve access for new and early career faculty.**

Professional societies should continue to develop ways to reach out to early career faculty and to non-members to allow better access to the opportunities for professional development.

- **Help departments make connections and build bridges.**

Professional societies should help recognize exemplar vertical and horizontal bridge programs and explore ways for departments to identify potential partners (e.g., K-12 schools, research universities, and industrial organizations)

Suggested Practices for Funding Agencies

- **Recognize** and promote the multiple facets of faculty contributions.

In guidelines, ask faculty of the extent of their roles (e.g., mentoring or outreach) in programs that might be funded. Ask faculty to describe their professional preparation for these activities.

- **Fund** opportunities for faculty to pursue professional development.
- **Encourage** professional societies to develop new opportunities for faculty professional development.
- **Encourage** and expect departments to develop vertical and horizontal bridge programs.

Ask faculty about the extent these bridge programs will be used to broaden the impact of programs that might be funded.

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Appendix A: Summary of Opening Plenary

Reframing at-Risk to High Potential: Increasing Achievement & Success for Hispanic/Latin@ College Students in STEM

Thomas Brown
Thomas Brown and Associates, LLC
(<http://www.tbrownassociates.com/>)
San Diego, CA 2018

NARRATIVE SUMMARY

In his opening remarks for the **Conference on Enhancing Undergraduate Physics at Hispanic-Serving Institutions**, Thomas Brown, former Dean of Advising Students/Special Programs at Saint Mary's College of California, comprehensively discussed the challenges and barriers confronting many Hispanic students studying STEM fields and some of the effective practices and theories used that have increased student engagement and success both at the institutional and individual level.

Dean Brown began by reminding the participants that the purpose of the conference was

“To create a forum for an exchange of ideas, promising practices, and proven strategies to address the low representation of Hispanic/Latin@ students in Physics.”

He then listed the top 10 strategies to improve retention at four-year colleges (with high Hispanic enrolling numbers) and the top 10 strategies for community colleges (with similar enrollment of Hispanic students). Dean Brown then went on to point out that this was not new knowledge or new discoveries. Indeed, some programs similar to these have been used since the 60s and 70s. But we still have not become more effective in increasing student success. Why?

He quickly focused on the need for faculty professional development.

“[Educators] must be aware of and apply the skills, attitudes, and behaviors required to respond effectively to the needs of increasingly diverse students...”

He argued that professional development was not simply a matter of increasing the knowledge of the issues or developing a new repertoire of techniques to address these challenges; professional development also entailed changing the beliefs of the faculty about student potential and student success.

Therefore, Dean Brown concluded that professional development ought to be

- **Conceptual:** What should educators understand, value and appreciate?
- **Informational:** What should educators know?
- **Relational:** What should educators do and be?

This professional development is critically important since

What happens to students after they enroll frequently has a more powerful impact on whether they stay and achieve their goals or leave. – **Leaving College**, Vincent Tinto, 1987, 1993

Dean Brown thus shifted the discussion from “Are the students ready for college?” to “Are colleges ready for the students?” The answer to the latter question is simply that we are not.

“It is largely about us, uninformed about what it takes to help students succeed and unwilling to allocate the resources necessary to put it into practice.” – “The Myth of the College-Ready Student,” **Inside Higher Education**, Byron White, March 21, 2016

Dean Brown then focused on specific challenges students encounter as they navigate the paths through higher education, the context for some of the challenges, and efforts that can address these challenges. The key issues he discussed are

- **Isolation** – an inability to connect to significant members of the campus community.
- **Multiple Issues** for individual students – rarely are students being stressed in college simply because they are Hispanic. Rather each student is a nexus of identities (first-generation, immigrant, older, ...) any of which can add to the difficulties they encounter.
- **Lack of Cultural Capital** – those that are first-generation or immigrants will frequently lack the cultural capital to navigate higher education successfully (how to learn on your own, how to learn in a group, when to ask for help, how to ask for help, ...).
- **Stereotype threat** – regrettably, many students are infused with the idea that their race, gender, or culture may limit their ability in college or while studying STEM disciplines.
- **Low expectations** – too many students do not expect that they will do well. And too many faculty also have low expectations of these students.

- **Belief in fixed ability** – too many students and faculty tend to the false belief that the ability to learn, and the ability to master a discipline, is inherent and cannot change.

While these challenges are formidable, Dean Brown also discussed programs and perspectives that could help address these issues.

To address isolation, he reminded us that

“Latin@ students don’t have interactions with colleges, universities, or programs; they have encounters and interactions with individuals...”

What students want to know is

- I matter.
- Somebody cares about me.
- I am a capable learner.
- I can be a valuable member of this college community.
- What I bring to the college classroom is as valuable as what others think and know (student voice).
- The curriculum reflects who I am (inclusive curriculum).
- What it takes to get into and complete college—a clear pathway toward achieving their goals “
– “Community College Puente: A Validating Model of Education,” Educational Policy, Laura Rendon, September 2002

He also pointed out that students have many strengths and that we should use those strengths while working with the students.

Dean Brown also emphasized that the needs of students will change as they navigate through the higher education environment. They may need more time and information early on but later will need less time for their normal academic journey.

A critical element in mentoring is validation.

“Many non-traditional students want their doubts [dudas] erased about their being capable of learning....

This is especially true for first generation students, Hispanic and African American students....”

*“Validating Culturally Diverse Students: Toward a New Model of Learning and Student Development”
Innovative Higher Education, Laura Rendon, Fall 1994*

To combat stereotype threat, Dean Brown pointed to the work of Claude Steele, who wrote that we should

- Establish trust through demanding and supportive relationships built on students’ personal and cultural assets.
- Set high expectations along with hopeful narratives that inspire feelings of belonging.
- Focus on background and preparation vs. ability and present skills as learnable.
- High-quality teaching by a diverse and engaged faculty.
- Provide ongoing professional development for both faculty and students.

Whistling Vivaldi, Claude Steele, 2012

Men of Color and Community Colleges, 2014

A final critical element in mentoring is to shift the focus for students and faculty from attributing academic potential to just background and preparation and to develop a growth mindset.

As a way of developing this perspective, Dean Brown introduced the 0-100% Competence Learning Model developed by Dr. Mario Rivas.

As an example, rather than ask students to compare how they are doing compared to other students, develop task-oriented criteria, and ask how far do they need to go to meet those criteria.

That is, rather than let the students say and think, “I can’t do calculus”, instead change the conversation to “I got a 50 on the last HW set, I would like to get an 85.” Then break up that task of reducing the achievement gap into steps that the students can identify, pursue and accomplish.

Dean Brown then concluded the presentation.

Appendix B: Tables Summarizing the Foundational Reports

Table 1. Characteristics of a Thriving Undergraduate Physics Program SPIN-UP Final Report

National Task Force for Undergraduate Physics

AAPT, 2003

<https://www.aapt.org/Programs/projects/spinup/upload/SPIN-UP-Final-Report.pdf>, referenced 8 June 2018

Leadership

1. Sustained leadership with a focus on undergraduate physics within the department. Most faculty members in the department place a high value on undergraduate education.
2. A clearly articulated undergraduate mission and a vision of how that mission supports the mission of the institution. The vision is shared among the faculty and communicated to the students.
3. A large fraction of the departmental faculty actively engaged in the undergraduate program.
4. Administrative support from the dean/provost for the department's undergraduate efforts.

Supportive, Encouraging and Challenging Environment

1. Recruitment program either with high school students or with first-year students at the institution.
2. A strong academic advising program for physics majors that actively reaches out to the students.
3. Career mentoring: an active effort to make students (particularly beginning students) aware of the wide range of careers possible with a physics degree. For upper-level students the mentoring includes advice on how to apply for jobs, graduate schools, etc.
4. Flexible majors' program: Several options or tracks leading to the bachelor's degree are available (and promoted).
5. 3/2 dual-degree engineering programs, particularly at four-year colleges without engineering departments.
6. Mentoring of new faculty, particularly for teaching.
7. Active physics club or Society of Physics Students chapter.
8. Student commons room or lounge.
9. Opportunities for informal student/faculty interactions.
10. Alumni relations. The department keeps in contact with alumni, keeps data on careers of alumni, and so on.

Experimentation and Evaluation

1. Special attention paid to the introductory physics courses. The "best" teachers among the faculty are assigned to those courses.
2. Undergraduate research either during the summer or during the academic year.
3. Physics education research and external funding. Most of the faculty are aware of the findings of physics education research and pedagogical innovations based on physics education research. Some departments had one or two faculty actively engaged in physics education research. Some faculty members have received external funding for education projects.

Table 2a. Best Practices for a Two-Year Program – Focus on Faculty

SPIN-UP TYC: Best Practices of Physics Programs

SPIN-UP/TYC

AAPT, 2005

<https://www.aapt.org/Programs/projects/spinup/upload/SPIN-UP-TYC-Booklet-2.pdf>, referenced 8 June 2018

Collegiality

All two-year college physics programs visited during the SPIN-UP/TYC project cited the importance of interactions with colleagues, administration, and students as necessary components for developing and sustaining a vibrant physics program.

Sustained Faculty Leadership

The leadership for many successful physics programs is provided by one faculty member with significant experience.

Reform at the Local Level

A strength of the two-year college is the flexibility two-year college faculty have to implement program innovations and changes without multiple layers of an approval process.

Attention to Pedagogy

One of the characteristics that contributes to the success of a two-year college physics program is the ability of the faculty to devote attention to pedagogy.

Recruitment and Retention

In addition to institutional recruitment activities, most of the visited two-year colleges have a recruiting program that seeks to attract students to STEM fields and emphasizes the recruitment of underrepresented groups.

Opportunities for Professional Development

Faculty in exemplary programs take advantage of institutional support for professional development activities both on and off campus.

Scholarship and Networking

Scholarship in the context of a two-year college is a process of instituting, evaluating, and reporting curricular or pedagogical change made in a physics program.

Table 2b. Best Practices for a Two-Year Program – Focus on Students SPIN-UP TYC: Best Practices of Physics Programs

SPIN-UP/TYC

AAPT, 2005

<https://www.aapt.org/Programs/projects/spinup/upload/SPIN-UP-TYC-Booklet-2.pdf>, referenced 8 June 2018

Focus on Students

A Nurturing Classroom Environment

The classroom environments typified by exemplary physics programs that foster effective student learning tend to be small in size, have lectures integrated with lab activities, and use active engagement strategies tailored to student needs.

A Welcoming Social Environment

An environment such as a student club or study lounge that encourages student interactions with their peers and faculty members shows a commitment by two-year institutions to students and their needs.

Co-Curricular Activities that Support the Academic Program

Physics programs that have emerged as exemplary programs offer their students a wide range of learning opportunities and experiences, including internships, cooperative programs, research experiences, and special projects.

A Support System Including Faculty and Peer Mentors/Tutors

Exemplary TYC physics programs recognize that student success depends on students adopting a community of learners model where faculty, tutors, and students all work together.

A Plan to Assess Student Learning and Program Improvements

Exemplary physics programs use various assessment techniques to continuously monitor student outcomes and improve courses and programs of study with the overall goal of improving student learning and their future academic and career success.

A Plan for Student Advisement that Includes Career and Transfer Advising

Many successful TYC physics programs recognize the importance of regular student advising for STEM students.

Table 2c. Best Practices for a Two-Year Program – Focus on Faculty and Administration

SPIN-UP TYC: Best Practices of Physics Programs

SPIN-UP/TYC

AAPT, 2005

<https://www.aapt.org/Programs/projects/spinup/upload/SPIN-UP-TYC-Booklet-2.pdf>, referenced 8 June 2018

Fostering a Positive Working Relationship Between Faculty and Administration

In the case of the SPIN-UP/TYC site visits, visiting teams reported that the successful physics programs were the result of cooperation and collaboration between committed physics faculty and college administrators who are receptive to and encourage academic change.

The Role of Faculty in Building and Maintaining the Working Relationship

The implementation of change in physics curriculum and programs is most often due to the dedication and energy of a single faculty member.

1. Physics activities are in alignment with the institutional mission/strategic plan.
2. The physics courses realize a stable or growing student enrollment.
3. Physics faculty regularly visit with the college administration, describing the activities occurring within the program and how these activities impact student learning and the changing needs of the institutional student body.
4. The sphere of influence of the TYC physics program extends to other disciplines and instructional programs on the TYC campus or at the transfer university.

The Role of Administration in Building and Maintaining the Working Relationship

1. The college encourages and supports professional development.
2. College administration is receptive to and supports academic change.
3. The college commits its physical resources to its programs, thereby encouraging quality instruction.
4. College administration provides services enhancing the student pipeline from K-12 schools to the community college and from the community college to the university and the workplace.
5. College administration supports interactions among STEM faculty and the establishment of science learning communities among students and faculty.

Table 3 Best Practices for Student Achievement in Science, Mathematics, Engineering, and Technology in Two-Year Hispanic-Serving Institutions (HSIs)

Estrella Mountain Community College

http://www2.estrellamountain.edu/nca/resources/criterion3/NSF_EMCC_Symposium_Best_Practices_%20Report.pdf,

referenced 8 June 2018

Stage 1: Helping Hispanic students matriculate from the high school to the community college – practices and programs which recruit and prepare high school students for success in SMET³

- Developing strong links to elementary, middle school and feeder high schools
- Involving the parents and family in the educational process
- Professional development programs for high school teachers in SMET
- Ensuring availability of appropriate instructional technology
- Cultural Awareness Programs
- Involving policy makers in educational process
- Awareness of demographic change

Stage 2: Retaining Hispanic students in the community college – programs and services which help Hispanic youth to succeed in lower division courses

- Establishing student confidence by providing networks with peers, faculty and staff
- Improving counseling and advising
- Providing role models/mentors to interact with students
- Insuring that students have the basic skills to succeed in college math and science courses
- Offering appropriate SMET pedagogies for student success

3. When those reports were written, the acronym SMET was used instead of today's STEM.

- Providing professional development for SMET faculty
- Ongoing analysis and evaluation insuring availability of appropriate instructional technology Cultural Awareness Programs
- Involving policy makers in educational process.
- Build student awareness of demographic change.

Stage 3: Helping Hispanic students matriculate from the community college to four-year schools or to the workforce – programs and services which enable Hispanic students to transfer to and succeed at employment or upper-division institutions

- Developing strong transfer links to universities and employers recruitment/outreach campaigns
- Developing instructional linkages with universities
- Cultural Awareness Programs
- Involving policy makers in educational process

Table 4a. Recommendations for PhD granting institutions Increasing the Number of Underrepresented Minorities in Astronomy at the Undergraduate, Graduate, and Postdoctoral Levels – Paper I

AAS Committee on the Status of Minorities in Astronomy

AAS, 2009

<http://arxiv.org/pdf/0903.4506.pdf>, referenced 8 June 2018

1. **Form “horizontal” partnerships** with MSIs in which MSI students and faculty are equal stakeholders in mission critical research, funding, and development opportunities. Institutional match-ups should reflect authentic synergies of intellectual contribution. In addition, the strong geographic concentration of MSIs may make regionally based partnerships both feasible and more attractive to “location bound” students.
2. **Develop “vertical” partnership** programs that ease the transition of minorities across critical junctures in the pipeline (college freshman transition programs, post- baccalaureate programs, Masters-to-PhD bridging programs). The Masters degree is emerging as a critically important, and previously poorly understood, transition point.

Table 4b. Recommendations for funding agencies Increasing the Number of Underrepresented Minorities in Astronomy at the Undergraduate, Graduate, and Postdoctoral Levels – Paper I

AAS Committee on the Status of Minorities in Astronomy

AAS, 2009

<http://arxiv.org/pdf/0903.4506.pdf>, referenced 8 June 2018

1. Substantially expand funding for undergraduate research internships. Extend REU support to students in the summer between the senior year of college and the first year of graduate school. Alternatively, develop opportunities for funding of “post-baccalaureate” students in research training programs.
2. Establish and maintain a suitable number of REU site programs at MSIs. These programs can bring in students from both minority and majority institutions to advance development of horizontal partnerships.
3. Provide new, focused support for programs and research portfolios that serve as on-ramps to astronomy from physics, engineering, and computer science. For example, the development of next generation instrumentation for large telescopes and space-based missions, and the increasing importance of large-scale computation for simulation and data-mining, both represent promising avenues for engagement.
4. Substantially expand funding for programs that specifically forge linkages between minority-serving institutions and research universities (e.g., NSF PAARE, NSF PREM, NASA MUCERPI).
5. Provide funding incentives for broadening participation of underrepresented minorities in federally funded programs by including this in funding criteria (e.g., NSF’s “broader impacts” criterion).
6. Provide opportunities for continuity of funding: Federal funding for minority engagement can achieve continuity of the most successful programs by establishing funding cycles in the same way that research is funded. The current practice of awarding seed funding with restrictions against innovative renewals is deleterious to the success and long-term viability of these programs.
7. Collect and maintain reliable statistics on minority representation and participation. There have been recent calls to limit collection of certain statistics because of the small numbers involved. However, these small numbers appear in demographics that are in areas crucial for tracking progress.

Table 4c. Recommendations for National Centers, Labs, Observatories Increasing the Number of Underrepresented Minorities in Astronomy at the Undergraduate, Graduate, and Postdoctoral Levels – Paper I

AAS Committee on the Status of Minorities in Astronomy

AAS, 2009

<http://arxiv.org/pdf/0903.4506.pdf>, referenced 8 June 2018

1. **Develop internship programs** that connect minority students to mentored research engagement with scientific and/or engineering staff.
2. **Develop pipeline programs** in partnership with universities. Especially needed are pipelines to post-doctoral opportunities.

Table 4d. Recommendations for professional societies Increasing the Number of Underrepresented Minorities in Astronomy at the Undergraduate, Graduate, and Postdoctoral Levels – Paper I

AAS Committee on the Status of Minorities in Astronomy

AAS, 2009

<http://arxiv.org/pdf/0903.4506.pdf>, referenced 8 June 2018

1. **Create a professional network** to better link potential candidates (at all levels) with potential employers/programs. The American Mathematical Society has recently created such a network that could be used as a model.
2. **Enhance connectivity and networking** between the traditional professional societies (e.g. AAS) and those that principally serve and represent minority students and professionals (e.g., National Society of Black Physicists, National Society of Hispanic Physicists, Society for the Advancement of Chicanos and Native Americans in Science, Society of Hispanic Professional Engineers).

Table 5a. Recommendations for colleges, universities, & national centers Increasing the Number of Underrepresented Minorities in Astronomy Through K-12 Education and Public Outreach (Paper II)

AAS Committee on the Status of Minorities in Astronomy

AAS, 2009

<http://arxiv.org/abs/0903.4507>, referenced 8 June 2018

1. Commit resources (money, interested staff, time) to support engagement in local underserved communities, to encourage citizen interest and understanding of scientific results and the field of astronomy.
2. Form ‘horizontal’ two-way partnerships with teacher’s professional organizations and local teachers to determine effective ways to engage minority K-12 students and/or their teachers.
3. Form partnerships with minority-serving institutions —both academic and community based— to identify the best ways to interact with these communities
4. Provide support and aid for students, postdocs and faculty to participate in outreach activities, perhaps even sponsoring TA positions for interested students.
5. Start or support, by involvement in, local academic and mentoring programs for minority students that bridge the transition from high school to college.

Table 5b. Recommendations for funding agencies Increasing the Number of Underrepresented Minorities in Astronomy Through K-12 Education and Public Outreach (Paper II)

AAS Committee on the Status of Minorities in Astronomy

AAS, 2009

<http://arxiv.org/abs/0903.4507>, referenced 8 June 2018

1. Provide opportunities for continuity of funding for astronomy education programs. The most successful programs that engage minority students and teachers in underserved areas can achieve continuity by establishing Federal funding cycles in the same way that research is funded. The current practice of awarding seed funding with restrictions against coming back for more is deleterious to the success of such programs.
2. Continue to fund and expand astronomy education programs that focus both on student enrichment and teacher professional development in underserved communities.
3. Fund efforts to expand informal learning in underserved communities.

Table 5c. Recommendations for professional societies Increasing the Number of Underrepresented Minorities in Astronomy Through K-12 Education and Public Outreach (Paper II)

AAS Committee on the Status of Minorities in Astronomy

AAS, 2009

<http://arxiv.org/abs/0903.4507>, referenced 8 June 2018

1. Create and maintain current networks and databases for teachers/students with information on available astronomical programs and workshops.
2. Play a lead role in identifying exceptionally effective K-12 outreach and education programs and work to see that they are adopted widely, particularly in underserved communities.
3. Endorse efforts to institute inquiry methods of teaching astronomy wherever possible, in classroom & informal teaching, as well as in citizen science forums.

Table 6. What Works for Latino Students in STEM Programs Finding Your Workforce

Excelencia in Education

<https://www.edexcelencia.org/research/publications/finding-your-workforce-latinos-science-technology-engineering-and-math-stem>, referenced 8 June 2018

College Readiness

Supporting policies that enhance K-12 STEM competency works to attract new talent to the fields and is crucial to academic and workforce preparation.

Outreach

Targeted outreach to students throughout the educational pipeline allows students to learn about the many career options within STEM and stimulate interest in pursuing a post-secondary education.

Institutional Commitment

Commitment from leadership is needed to ensure sustainability of collaborative programs and efforts to increase student success.

Institutional Partnerships

Partnerships between community colleges and surrounding universities allow students to transfer and continue their education. Through these partnerships, academic advising to transfer students assists with matriculation and enrolling in courses.

Advising

Academic advisors make sure students stay on track to graduate through creating academic plans and informing students of available financial aid. Advising and support from faculty also play a crucial role in students' retention.

Mentorship

Peer-mentorship programs allow students to build networks of support and can help improve retention, especially for transfer students.

Faculty

Avenues for faculty development provide opportunities to keep courses exciting and current through the use of new pedagogies that use technology and problem-based learning.

Academic Support

Supplemental instruction and on-campus centers dedicated to increasing success in math and science provide students additional academic support in STEM disciplines.

Research & Fellowships

Undergraduate research opportunities are absolutely crucial to establishing a professional identity early. Fellowships allow students to earn on-the-job experience and technical skills needed for the workforce after graduation. These opportunities can empower individuals to move along educational levels and careers paths.

Industry Cooperation

Industry cooperation is needed to ensure students receive relevant training that can transition well into the workplace. Efforts to align training to specific skills demanded by employers can hold value for both employee and employer.

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