

## **Developing Pathways for Increasing Retention and Facilitating Transition of Students from HSIs**

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P.K. Imbrie is the Head and Professor of the Department of Engineering Education and a Professor in the Department of Aerospace Engineering and Engineering Mechanics University of Cincinnati. He received his B.S., M.S. and Ph.D. degrees in Aerospace Engineering from Texas A&M University. He is an advocate for research-based approaches to engineering education, curricular reform, and student retention. Imbrie conducts both traditional, as well as educational research in experimental mechanics, piezospectroscopic techniques, epistemologies, assessment, and modeling of student learning, student success, student team effectiveness, and global competencies He helped establish the scholarly foundation for engineering education as an academic discipline through lead authorship of the landmark 2006 JEE special reports "The National Engineering Education Research Colloquies" and "The Research Agenda for the New Discipline of Engineering Education." He has a passion for designing state-of-the-art learning spaces. While at Purdue University, Imbrie co-led the creation of the First-Year Engineering Program's Ideas to Innovation (i2i) Learning Laboratory, a design-oriented facility that engages students in team-based, socially relevant projects. While at Texas A&M University Imbrie co-led the design of a 525,000 square foot state-of-the-art engineering education focused facility; the largest educational building in the state. His expertise in educational pedagogy, student learning, and teaching has impacted thousands of students at the universities for which he has been associated. Imbrie is nationally recognized for his work in active/collaborative learning pedagogies, teaming and student success modeling. His engineering education leadership has produced fundamental changes in the way students are educated around the world.

Imbrie has been a member of ASEE since 2000 and has been actively involved with the Society in various capacities. He has served in multiple leadership roles in the ERM and FPD divisions, including: ERM board of directors (2002-2004), program chair for ERM (2005 and 2009), ERM program chair for Frontiers in Education (FIE) (2004), FIE Steering Committee ERM representative (2003-2009), as well as program chair (2016) and division chair (2016-17) for FPD. He has also served on two ASEE advisory committees.

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“Because of the rich diversity of their student populations, America’s community colleges are slowly attracting attention as potential reservoirs of the kinds of diverse people and diverse thinking needed in a creative and competitive engineering workforce. ... [C]ommunity colleges are, indeed, a promising potential source of “overlooked engineers,” and recruiting and supporting these students could begin to help redress the racial/ethnic imbalance in engineering education.”

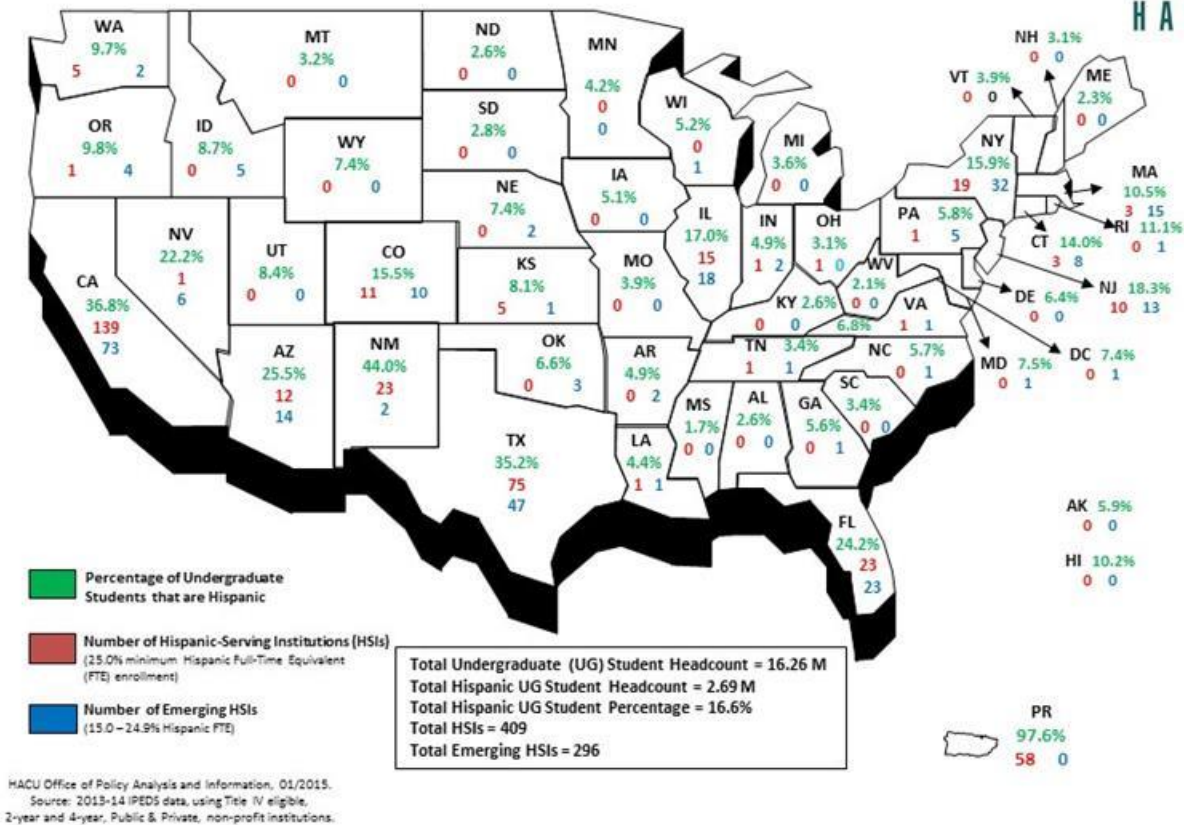
– America’s Overlooked Engineers, 2014

### **Introduction**

Developing strategic STEM pathways to increase the number of underrepresented students achieving STEM degrees is an essential ingredient for achieving goals of large numbers of STEM graduates entering the profession. Several studies have shown that two-year college students represent 42% of undergraduate enrollment and are historically over-represented in populations underrepresented in engineering (NSF, 2014; Ogilvie, 2014; Sullivan et al., 2012). In fact, recruiting and retaining 2-year college students has been discussed as an important avenue to help meet the challenge of increasing the number of STEM graduates. It has been noted that students who start in the community college system face many challenges (Kuh et al., 2006). In one particular study, the author found “over 90% of students enrolled in a 2-year college expect to earn a bachelor’s degree, yet less than 40% of students transfer to a 4-year institution within five years of their initial 2-year college enrollment” (Bradburn et al., 2001). In another study, the authors discovered with a “recent cohort of first-time beginning community college students who initially intended to transfer to a 4-year institution, only 15% had successfully transferred to a 4-year institution within three years of beginning college” (Horn, 2009). Even more, they revealed after six semesters of attending a community college, “just 9 percent [of Hispanic students] had reached a set of criteria (including academic course requirements) to be ready to transfer to a 4-year institution, and just one-third had met at least one of these criteria” (Hagedorn and Lester, 2006).

As shown in Figure 1 (HACU, 2015), 35.2% of all undergraduate students in Texas are Hispanic. In addition, there are 75 HSIs with an additional 47 emerging HSIs. Therefore, there is a definite need to better understand factors that lead to improved retention of students in STEM programs at 2-year HSIs, barriers and challenges that prevent the transfer of students at 2-year HSIs to 4-year universities, and strategies that enhance interest and motivation of students and improve persistence and graduation rates in undergraduate STEM programs at HSIs. The proposed HSI pre-conference will bring experts together to discuss recent research and education findings and expose attendees to promising programs, techniques, and efforts.

## 2013-14 Fall Enrollment Snapshot Hispanic Undergraduate Students



**Figure 1. 2013-2014 enrollment snapshot of Hispanic undergraduate students. (Hispanic Association of Colleges and Universities, 2015)**

The work in this grant looked at enhancing systemic support between 2-year colleges and 4-year institutions by providing an avenue for Hispanic Serving Institutions (HSIs) from across the state to address barriers and challenges for 2-year students transferring to 4-year engineering institutions. Additionally, attendees of the HSI Mid Years Engineering Experience (MYEE) Pre-conference had the opportunity to join the international MYEE Conference the two days following the HSI pre-conference. Participants collaborated and networked with attendees across the globe from both 2-year and 4-year institutions. Throughout the MYEE Conference, topic/papers on diversity and retention and the challenges faced by 2-year institutions were integrated to educate and share possible solutions.



At the time of the grant proposal (Summer 2015), there were 49 HSI designated institutions in the state of Texas were Hispanic Association of College and University members (HACU, 2015). Of those, 22 were represented at the workshop in March of 2016. A motivation for the proposal as well as a focus of the workshop itself was on the

participants of the Texas A&M Engineering Academies (Perez et al., 2016; Cortez et al., 2015) in that each of these sites are a designated HSI in the state of Texas; HCC, El Centro, Texas Southmost, and Alamo Colleges. This program was the impetus for the grant and these conversations held during the HSI Pre-Conference.

### **Texas A&M Chevron Engineering Academies**

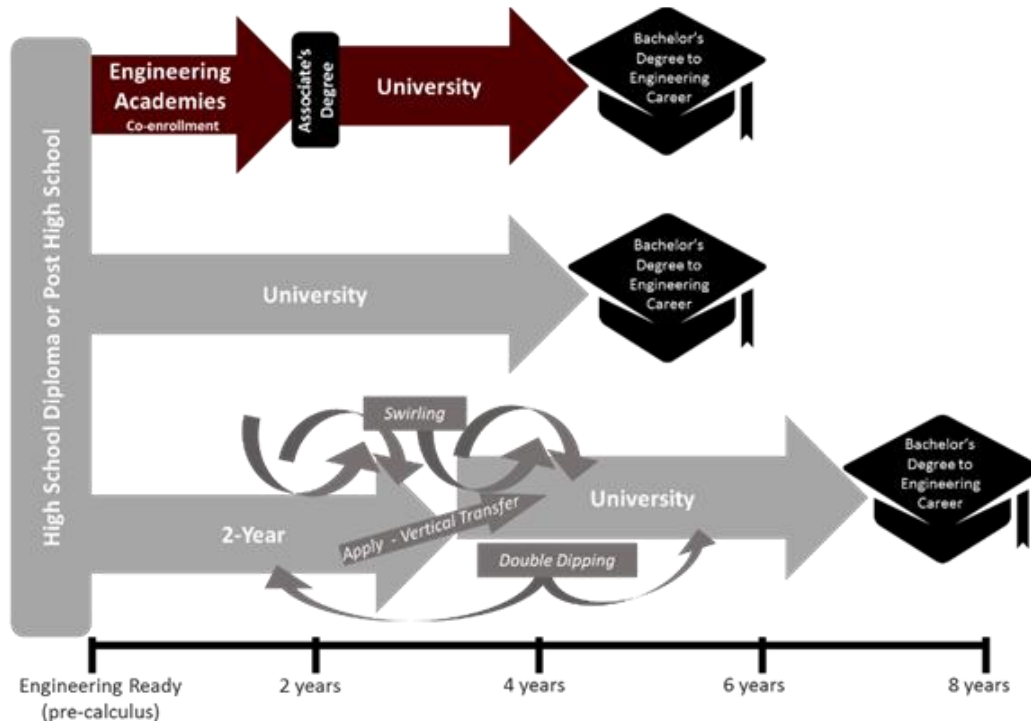
In 2013, over 17.5 million students were enrolled in US public or private academic institutions with over 6 million in 2-year (2Y) institutions. Texas ranked 2<sup>nd</sup> nationally below California in both 2Y and 4-year (4Y) enrollment categories with approximately an equal split (Digest of Education Statistics, 2015). In addition, Texas leads the nation with over 78% (45% national average) of 4Y graduates having been enrolled at 2Y institutions (NSCRC, 2012). Despite the prevalence of these multi-institution attendance patterns, this is not a popular phenomenon among faculty, administrators, and policy makers, as it challenges the assumptions about curricula, planning, and academic support programs (Borden, 2004). This back-and-forth enrollment is referred to as “student swirl”, a term first coined by de los Santos and Wright in 1990 (Borden, 2004). de los Santos and Wright also coined “double-dipping” to refer to concurrent enrollment at two institutions, but in this case, concurrent enrollment is not supported by institutional efforts and policies. In addition to this inter-institutional variety, travel abroad, co-op education, and exchange programs are considered student swirl (Borden, 2004). Finally, vertical transfer (moving from a 2Y to a 4Y institution) and lateral transfer (moving from 4Y to 4Y institution) can result in loss of credit and increased time to degree completion (Shealy, Brawner, Mobley, & Layton, 2013).

The Texas A&M-Chevron Engineering Academies (Academies) are a transition partnership with Texas 2Y minority serving institutions (MSIs), all of which also carry Hispanic Serving Institution (HSI) designation. This innovative partnership is built on an *intentional co-enrollment* program designed for students to pursue an engineering, engineering technology, or computer science (e/et/cs) degree at Texas A&M University – College Station (TAMU), thus recognizing, embracing, and supporting student swirl, vertical transfer, and double-dipping. In addition, the Academies focus on concurrent enrollment that enables students to take courses directly aligned with engineering majors at TAMU to increase persistence, retention, and graduation in STEM fields (ABET, 2013, Bradburn, Hurst, & Peng, 2001, Johnson & Muse, 2012, Kuh et al., 2006). While at the 2Y partner, each cohort takes TAMU College of Engineering (CoE) courses taught by CoE faculty resulting in a TAMU transcript while simultaneously taking core curriculum courses at the 2Y partner in block schedules based on math readiness. This unique co-enrollment allows students to remain close to home without loss of time when completing a degree from the CoE. Figure 2 depicts the transition partnership and institutionally supported co-enrollment can result in a reduced time-to-degree for students beginning at a 2Y partner institution.

### **HSI Pre-conference Workshop Summary**

In all, fifty-four faculty, staff, and administrators from 26 total institutions (2 were not yet designated as HSI at the time of the conference, the hosts and one local 2-year institution), instructors, staff, and administrators from both 2-year and 4-year HSIs worked together to meet the goals of the workshop which were to gain a better understanding of factors contributing to student success and retention to help facilitate the transition from a 2-year to a 4-year institution.

The conference also provided opportunities to learn about successful strategies for retaining HSI students, hear from Hispanic/Latino students who have made the transition from 2-year to 4-year institutions, and meet individuals from other HSI 2-year and 4-year institutions.



**Figure 2. Time-to-degree of Academies compared to transfer and direct to university**

Attendees of the NSF-sponsored HSI Pre-Conference also had the opportunity to compete for three "HSI Excellence in Retention and Transition" awards. Each \$1,500 institution award recognized promising practices for unique retention and/or transition programs at the 2-year institution. Award winners were selected from a 2-3 page white paper submitted detailing their retention and/or transition program. In addition to being recognized during the HSI pre-conference, each of the recipients provided a brief presentation on their program during the MYEE Conference the following two days, which allowed all MYEE Conference participants to also engage in the conversation of focusing on HSI student success. The awardees with a brief description of their proposals were the following;

1. Mountain View College – Dallas County Community College District for their STEM SUCCESS program.

Mountain View College began designing the STEM SUCCESS program in 2008 to attract underrepresented students to STEM courses and improve student success in the courses. To increase retention and successfully transfer students to four-year institutions, Dr. Stephen L. Jones and the project development team recognized the need for project-based learning experiences centered around high-quality, well-designed exploration and engagement activities. Today, STEM SUCCESS features a 3-D visualization content system and a STEM Learning Community.

Mountain View College identified learner engagement as a key component to attracting and retaining Hispanic students, and as a result, implemented a 3-D, computer-based visualization content system. With the system, students observe objects and review complex processes in a 3-D environment. And, in 2013, Mountain View College installed the EON Reality iCube—a PC-based, multi-sided immersive environment where students are surrounded by virtual imagery and sound where the objects floating in space can be manipulated in real time.

In addition to the virtual environment, STEM SUCCESS created a STEM Learning Community, complete with a highly qualified director who manages an on-site team of STEM advisors, tutors, and Peer Assisted Learning Supporters (PALS). The team members work closely with STEM students, especially during critical transition times: advisors keep students informed about field research experiences, transfer opportunities and industry connections while tutors and PALS provide academic support at the four STEM Learning Community stations across the campus.

As a result of STEM SUCCESS, more students are enrolling, persisting and succeeding in Mountain View College STEM courses. Since the program's inception, Mountain View College has seen a 64 percent increase in STEM student enrollment. Meanwhile, the transfer rate for STEM students has increased by 35 percent, and Mountain View College faculty and staff are actively engaging with STEM-related education and industry representatives. As the name suggests, STEM SUCCESS is experiencing great success.

2. San Jacinto College – South, Houston, TX for their Associate of Science in Engineering Science degree program.

In the fall of 2014, San Jacinto College – South introduced the Associate of Science in Engineering Science degree program with 29 students. In just one year, the program flourished to nearly 300 students. Without a doubt, San Jacinto College – South is successfully recruiting students and instilling in them the confidence necessary to succeed. Fall 2015 data demonstrate that retention rates for incoming students and students in second-year courses are above 90 percent.

San Jacinto College – South's approach to ensuring student success in engineering programs is three-fold: confidence in the engineering program, confidence in student support services, and confidence in completion and matriculation.

To instill confidence in the engineering program, the college hosts informational sessions on their campus and at neighboring high schools in the Houston, Clear Creek, Pasadena, and Pearland school districts. During registration periods, the program invites students to the campus computer labs where counselors are available to provide enrollment assistance. San Jacinto College – South celebrates National Engineers Week and invites professional engineers and former students who have transferred into four-year engineering programs to participate in panel discussions. The college also ensures the engineering program meets the same rigorous standards as four-year programs by conducting mock ABET reviews has been fervent in developing direct pathways with four-year engineering programs at the University of Houston, Texas Tech University, and the University of Texas at Tyler.

To promote confidence in student support services, the program's department chair, the South Campus engineering program coordinator, and the faculty of the engineering program all maintain open-door policies. Additionally, staff and faculty meet with

students regularly—collectively and one-on-one—to discuss career goals and ensure necessary course sequences. This is especially important for students who may be the first in their families to attend college. Faculty members also mentor pre-engineering students in the Clear Horizons Early College High School, which is located on the South Campus. And, recognizing that healthy minds need healthy food choices, the college has a food and resource bank for any student in need.

Finally, to generate confidence in program completion and matriculation, the college offers an open laboratory every Friday where students utilize equipment, make up work, and formulate study groups. During the Introduction to Engineering course, faculty introduce students to the Project Graduation program where counselors and students work together to map their educational experience—from the first engineering course at San Jacinto College to the final class in completing a four-year engineering degree.

3. South Texas College, McAllen, TX for their Dual Enrollment Engineering Academy.

South Texas College is awarding STEM-related associate degrees to high school students—even before they graduate from high school—through its Dual Enrollment Academies. South Texas College launched the Dual Enrollment Medical Science Academy (DEMSA) in 2005 and co-enrolled 17 high school juniors interested in the medical sciences. In 2006, the Dual Enrollment Engineering Academy (DEEA) began with 46 students. Since the program’s inception, 1325 students have enrolled in four Dual Enrollment Academies—DEMSA, DEEA, Dual Enrollment Computer Science Academy (DECSA), and Dual Enrollment Criminal Justice Academy (DECJA)—and, collectively, the students are earning more than \$1 million in scholarships each year. In the Rio Grand Valley where 33 percent of the population experiences life at or below the poverty line and only 20 percent of the adults have a college degree, South Texas College is not only helping many students become the first in their families to earn a degree but also helping them get the financial assistance they need.

South Texas College ensures the success of students attending high school and college simultaneously by offering special programs and support services. These services—from seminar series to mentorships with local professionals and field trips to individually specialized Senior College Calendars that remind students when to take or retake ACT/SAT exams, when to begin investigating scholarship opportunities and when parents should file tax returns so students can meet FAFSA deadlines to qualify for financial aid—enhance students’ dual enrollment experiences and helps students successfully transfer into four-year universities and the workforce. To date, 100 percent of the dual enrollment students who intend to transfer to four-year universities have done so, and the program has produced 10 Bill and Melinda Gates Millennial Scholars.

The conference was kicked-off with a keynote address from Regent Elaine Mendoza, President and CEO of Conceptual MindWorks, Inc. and current Board of Regent of the Texas A&M University System. Regent Mendoza is a longtime supporter of education in the state of Texas and has worked to further access and success of many students at all levels of the education continuum in the state of Texas and San Antonio in particular. A mini-workshop was also presented during the day by consultant Dr. Sally Andrade, President of Andrade & Associates, Inc. Her past research and work with the University of Texas – El Paso informed her workshop. The day was also highlighted with an undergraduate engineering student panel with students who had successfully transitioned from 2-year institutions as well as a panel from the four Texas A&M

System schools with HSI designations; Texas A&M University – International, Texas A&M University – Corpus Christi, Texas A&M University – Kingsville, and Texas A&M University – San Antonio.

Finally, the workshop concluded with a panel from the Texas A&M Chevron Engineering Academies with representatives from the Director from the College Station campus along with representatives from Houston Community College – Northwest College, El Centro College – Dallas County Community College District, Texas Southmost College – Brownsville, TX, Alamo Colleges – San Antonio, TX, and Blinn College – Brenham Campus.

All attendees were then invited to attend the Networking reception between the HSI Pre-conference attendees and the Mid Years Engineering Experience Conference (MYEEC) participants.

### **Outcomes**

Results from the post-conference survey where 34% of the participants participated were as follows;

The opportunity to present a paper in the MYEE Conference was influential in my decision to apply for the HSI MYEE Pre-Conference Promising Practices Excellence Award – 67% agreed or strongly agreed, 33% neutral

The opportunity to earn a monetary award was influential in my decision to apply for the HSI Pre-Conference Promising Practices Excellence Award – 33% agreed, 67% were neutral or disagreed

What specific topic or information has been most helpful to you from last year's HSI MYEE Pre-Conference, if any (top comments)

- Hearing from transfer students about challenges faced at 4-year institution
- Comments and perspectives shared by attendees from 2-year and 4-year institutions
- Performance review of transfer students vs. native students
- Opportunity to network

I felt the student panel was informative – 100% agreed or strong agreed

I felt the workshop on diversity and retention was useful – 86% agreed or strongly agreed, 14% neutral

I felt the panel session hearing from 4-year HSI institutions was informative – 100% agreed or strongly agreed

I felt the panel session hearing from 2-year HSI institutions was informative – 93% agreed or strongly agreed, 7% neutral

I felt networking with others from 2-year and 4-year HSI institutions was valuable – 79% agreed or strongly agreed, 21% neutral



What specific topic(s) or information would you have liked to have seen at last year's HSI MYEE Pre-Conference (top comments)

- A digital copy of engineering student successes, native vs. transfer, and time of transfer would be helpful
- Well planned; nothing to add at this moment
- Transfer from 2-year to 4-year programs

Other comments received: outstanding conference; very informative; excellent networking opportunity; nice to meet so many people in the same boat as me

Fifty-four faculty, staff, and administrators from 26 total institutions (2 were not yet designated as HSI at the time of the conference, the hosts and one local 2-year institution), instructors, staff, and administrators from both 2-year and 4-year HSIs worked together to meet the goals of the workshop which were to gain a better understanding of factors contributing to student success and retention to help facilitate the transition from a 2-year to a 4-year institution. Forty-three individuals attended both events, the HSI pre-conference and the MYEE Conference. The MYEEC had a total of 90 individuals attend with 102 unique individuals attending one or the other event.

The pre-conference and MYEE Conference attendance was supported by a National Science Foundation grant (EEC - 15-50046). Childcare options were available to all attendees. The website can be found at this link; <http://myeec.org/HSI/HSIBody.htm>. Special thanks to Amy Klinkovsky for publication and marketing assistance and KrisAnn Everett for organizational support.

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