

Extended Abstract- Supporting First Year Engineering Students in Community College Programs

Shelley L. Caraway and Jamie L. Turner

Lone Star College- Kingwood, TX, 77339, shelley.caraway@lonestar.edu, jamie.l.turner@lonestar.edu

Abstract - The U.S. faces a shortage of one million STEM professionals in the next decade putting U.S. global competitiveness at risk. Community college (CC) engineering programs are key to increasing both U.S. STEM graduation rates and the diversity of STEM students earning baccalaureate degrees. Five years ago, Texas CC and university faculties aligned curriculum to create statewide Voluntary Engineering Transfer Compacts to articulate 6 pathways for students transferring to most Texas universities. Community college programs soon realized a number of challenges. Few students begin mathematically prepared to study engineering, thus requiring leveling courses. Time to completion is extended since CC students frequently enroll less than full-time due to job and family responsibilities. Retention also becomes a challenge. Upon transferring, CC students face more scrutiny than university natives applying to engineering programs. CC students initially experiencing academic challenges, are not considered by engineering programs. Texas CC's are significantly more diverse than four-year schools. In fact, a majority of Texas students start at CC's, many working and enrolling only part-time. Trained on the job as technicians, drafters, mechanics, or in construction, these students bring valuable experience to classrooms however, few gain the academics needed for university engineering programs. CC's committed to engineering programs, use high touch strategies to ensure student access to academic supports. Orientations inform pre-engineering students of time commitments necessary. Ramping or strategically intensifying course loads in the first two semesters improves success and retention. Advisors/counselors working with faculty improve CC engineering student success using early alerts and identifying services and interventions needed.

Index Terms - (Community College, Engineering, High touch, Lone Star College, Student Success, Transfer).

EXTENDED ABSTRACT- SUPPORTING FIRST YEAR ENGINEERING STUDENTS IN COMMUNITY COLLEGE PROGRAMS

The demand for science, technology, engineering, and mathematics (STEM) degrees is rising. In 2008, 23% of awarded degrees worldwide were in STEM fields. China led in production of STEM graduates with 42% while U.S. college graduates lagged with only 15% earning degrees in STEM [1]. The President's Council of Advisors on Science and Technology estimates that the U.S. will need to produce approximately one million more science, technology, engineering, and mathematics professionals than are expected to graduate over the next ten years in order to ensure our global competitiveness [2]. The role community college engineering programs will play is crucial as we meet the challenges of increasing U.S. STEM graduation rates, and expand the diversity of students pursuing STEM programs, through collaborations with 4 year schools.

COMMUNITY COLLEGE STUDENTS

Ideally, students beginning their engineering studies at community colleges should resemble students enrolled at 4 year institutions but that is not the reality. Community college student demographics are much more diverse than those of selective admission 4 year schools. Community college students juggle multiple responsibilities and face financial hardships more commonly than students who study full-time on university campuses. In Texas, a higher percentage of students begin their college studies at community colleges than at 4 year institutions. Unfortunately, too few of these community college students transfer to university engineering programs and graduate [3].

A welcome but added challenge facing Texas community colleges is the growing diversity of community college students. The population of Texas is becoming more Hispanic with each year and this is being reflected on

campuses statewide [4]. A large number of these students lack cultural knowledge of college. Because of limited resources in the high schools they attended, many are woefully underprepared academically to begin a rigorous STEM curriculum in college. This effectively blocks their access to STEM fields such as engineering [5].

COLLEGE ACCESS

Five years ago, a group of Texas community college and university faculty, under the direction of the Texas Higher Education Coordinating Board and with a grant from the Lumina Foundation, assembled to address the pipeline challenges of community college students seeking entrance to selective admission university engineering programs. These meetings resulted in the creation of the statewide Voluntary Engineering Transfer Compacts. The 6 engineering compacts created agreed upon pathways and curriculum for students seeking to transfer from community college to university engineering programs. The majority of Texas universities partnered in this work [6].

The creation of the compacts paved the way for community colleges, with the assistance of universities in the state, to develop robust engineering curricula mirroring that previously available only to university students. Students from economically disadvantaged backgrounds could now pursue the dream of studying engineering on community college campuses for the first time.

THE CHALLENGES

One would think the hard work complete with the development and availability of the curriculum, however community college programs soon realized a number of challenges as they began enrollment and sequencing in the engineering courses. Community college students often enroll in less than full-time course loads. The rigor of the engineering curriculum poses numerous problems for community college students who juggle courses, jobs, and family responsibilities. In fact, retention is the number one problem facing community college students. Many are unaware of the demands engineering curriculum presents for students who need to work and go to school.

Academic preparation is another barrier community college students face when weighing whether to pursue engineering coursework. Few students beginning their studies at a community college meet the level of math required to study engineering. This creates the need to enroll in a number of leveling math courses.

The time commitment is another challenge. Engineering courses are often lecture/lab courses which add additional classroom hours to student schedules. For students who work, the added hours present hardships they seem unable to juggle.

Being able to maintain a higher than average GPA is another requirement engineering transfers face. Community College transfer students are often required to maintain a

higher GPA in many cases than that required of university natives when seeking admission to university engineering programs. Students who face academic challenges early on at the community college often fail to persist as engineering students.

RETENTION PRACTICES

Community colleges committed to engineering programs need to ensure that students requiring academic supports are informed of their availability and afforded opportunities to receive those supports. Orientation sessions are necessary to make students aware of the time and study commitments necessary for success when pursuing engineering degrees. Constant monitoring and development of a team of advisors and counselors to address needs that arise is also essential when working with community college engineering students. Another strategy necessary to foster success is strategically ramping up the difficulty of coursework so that students are not overwhelmed in the first two semesters. Finally, monitoring the number of hours an engineering student spends working outside of school is necessary so that students don't overload.

Beginning with the Fall 2013 semester, Lone Star College- Kingwood, an Hispanic Serving Institution, enrolled its first cohort of engineering students. Eighty percent of the class was considered at-risk and underrepresented. Using the strategies outlined above, we attained a seventy three percent pass rate for the fall semester for the first engineering course, and a seventy one percent pass rate in the spring cohort for the second sequence course. The engineering course enrollments are reflective of the campus demographics except that females were under-represented in the courses. Women outnumber men on the campus yet only account for twelve percent of the engineering enrollment.

Recognizing that students from at-risk and underrepresented populations may start out academically behind, we found that they are often ahead in terms of the skills they bring from work experiences. Many of our students already work at engineering firms as technicians, drafters, mechanics, and in construction. On-the-job training, and skills gained from employment are not reflected in their academic transcripts, but are an asset in the classroom as they contribute real world wisdom that many of the traditional engineering students lack. Combining at-risk, yet experienced students, with academically proficient, yet inexperienced undergraduates can be mutually beneficial as both populations have the potential to teach and learn from one another.

To better support freshmen, each LSC-K engineering student is required to visit with the dean, a counselor, and remain in contact with an advisor throughout the semester to monitor progress in the courses. Each semester, engineering students track progress in their sequence and meet with one or more of these individuals to discuss work/life issues that may impede success. Using this high touch model, Lone

Star College- Kingwood is committed to increasing the number of associate degrees awarded, and university transfer of students seeking engineering degrees.

FUTURE CHALLENGES

Identified challenges facing Lone Star College- Kingwood currently include growing demand for courses, classroom availability, and lack of academic preparedness of students seeking admission to begin the engineering sequence. Three cohorts numbering more than 200 students are planned for Fall 2014. Demand and space issues are being addressed by the scheduling of additional courses at off-campus locations. Additionally, we will offer a themed first-year-experience/student success course targeted to 50 students interested in pursuing engineering coursework who may lack the academic preparation to begin the sequence, yet indicate interest in preparing to do so.

University transfer partnerships are also being developed as students prepare to graduate with associate degrees.

THE SCOPE

Lone Star College- Kingwood is one of 6 campuses in the second largest community college system in Texas. The service area its students reside in is composed of both rural and urban populations. The Lone Star College System encompasses the western and northern border of Houston, TX, a city of more than 2 million. Meeting the educational needs of this diverse population requires a commitment to support services. These supports are key to creation of student success for students with STEM goals who lack high school preparation for the rigors of college STEM studies.

REFERENCES

- [1] [1] Lund, S; Manyika, J; Nyquist, S; Mendonca, L; Ramaswamy, S, "Game changers: Five opportunities for US growth and renewal" McKinsey Global Institute, July 2013. See Exhibit 30, file:///C:/Users/Doug/Downloads/MGI_Game_changers_US_growth_and_renewal_Full_report.pdf
- [2] Holren, J, P.; Lander, E, "Report To The President, Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics" Executive Office of the President, President's Council of Advisors on Science and Technology, Feb 2012. http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-engage-to-excel-final_2-25-12.pdf
- [3] Ennis, S, R; Ríos-Vargas, M; and Albert, N, G. "The Hispanic Population: 2010", 2010 Census Briefs, U.S. Department of Commerce, Economics and Statistics Administration, U.S. CENSUS BUREAU C2010BR-04, May 2011, <http://www.census.gov/prod/cen2010/briefs/c2010br-04.pdf>
- [4] Kever, J, "Enrollment, diversity skyrocket at Texas colleges", Houston Chronicle, Sept 19, 2010.
- [5] American Speech Language Hearing Association. Minority Student Recruitment, Retention and Career Transition Practices: A Review of

the Literature". Accessed Jul 1, 2014

<http://www.asha.org/practice/multicultural/recruit/litreview.htm>

- [6] Texas Higher Education Coordinating Board, "Texas Tuning Project" Accessed June 13, 2014 <http://www.theccb.state.tx.us/index.cfm?objectid=8FFC700A-D9F8-57C3-CD178199FADC8CD4>

AUTHOR INFORMATION

Shelley Caraway Dean, Mathematics, Engineering, Education, and Student Success, Lone Star College- Kingwood, shelley.caraway@lonestar.edu

Jamie L. Turner Professor, Mathematics and Engineering, Lone Star College- Kingwood, jamie.l.turner@lonestar.edu