2006-253: THE ADVANTAGES OF STARTING AN ENGINEERING EDUCATION AT A COMMUNITY COLLEGE

Dan Dimitriu, San Antonio College

DAN G. DIMITRIU has been practicing engineering since 1970 and taught engineering courses concurrently for over 20 years. He has been involved with several engineering societies and was elected vice-chair of the Two-Year College Division of ASEE in 2005. He has been the coordinator of the Engineering Program at San Antonio College since 2001. His research interests are: alternative fuels, fuel cells, plastics, and engineering education.

Jerry O'Connor, San Antonio College

JERRY O'CONNOR has been teaching physics (and a few engineering courses) at San Antonio College since 1987. He was the Campus Coordinator for the Texas Alliance for Minority Participation program from 1993 to 2002, and is currently the Department Chairperson for Physics, Engineering, & Architecture. He has been involved in numerous initiatives to integrate the findings of physics and engineering education research with education practice.

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Abstract

At a time when virtually every government agency and many private industry sources are predicting a significant shortage of qualified American scientists, engineers, and technicians, it is important to utilize every available resource to attract and retain students in these fields.

Community Colleges, sometimes called Junior Colleges, can play a vital role in addressing this shortage. They present some unique advantages over four year institutions to attract, prepare, and retain students, particularly in technical fields. At a time of increasing higher education costs they present a more affordable alternative to four year institutions. With their small size classes, community colleges provide an environment with a more personalized approach, at the foundation level of college education. They are more adaptable to the needs of students and generally more approachable to their communities. The availability of remedial courses makes community colleges a better option for students with underdeveloped abilities. Two-year colleges also often offer a less expensive way for the undecided students to explore a variety of courses where they can discover the field that best suits their interests.

This paper will present a variety of advantages for students who start an engineering education at a community college. It is intended to help engineering faculty, counselors, and administrators at community colleges with their recruiting and retention efforts.

Recent trends

It is well documented that United States produces far less engineers per capita than other developed countries, including Russia, India, and China. According to the group Business Roundtable, a Washington-based coalition of leading U.S. corporations, the number of students in the United States planning to pursue engineering degrees declined by one-third between 1992 and 2002. ("Business Coalition Focuses on Math, Science Careers," Aug. 10, 2005) The Business Roundtable report also estimates that half the doctoral students graduating from engineering colleges in the United States are foreign nationals and the National Science Board in 2004 reported "a troubling decline in the number of U.S. citizens who are training to become scientists and engineers…" [1]

At the same time the U.S. Department of Labor predicts that the number of jobs requiring science, engineering, and technical training will increase by 51 percent through 2008. This increase could lead to 6 million new job openings for scientists, engineers, and technicians, and a critical shortage of qualified Americans is predicted.

To address this major national concern the government, private industry, and institutions of higher education have joined forces. Numerous programs designed to attract and retain students in technical fields have been initiated [2-10] and their success is an indication that solutions are available. Various states and four-year institutions are increasingly reaching out to help two year colleges improve their engineering programs and then recruiting their students by creating "two + two" articulation agreements to assure a smooth student transition[11, 12]. As a result all

stakeholders can benefit from strong engineering programs at the community college level[13, 14].

A recent report from the National Academy of Engineering revealed the important role of community college education in creating engineering career pathways for the general population[15]. Of all the recipients of engineering bachelor and master's degrees in 1999 and 2000, 40% attended community colleges and 20% of engineering degree holders began their academic careers with at least 10 credits from community colleges. More students than ever before, particularly students from groups that are underrepresented in the engineering workforce come to community colleges as a starting point for their postsecondary education. Community colleges thus offer significant opportunities for increasing diversity in the engineering workforce.

Advantages

Despite the fact that community colleges do not always get the recognition they deserve[16], students who start their engineering education at a community college with a strong program have a large variety of benefits and advantages. They include affordability, flexible hours, proximity to home, and small class sizes.

- At a time of increasing higher education costs, community colleges present a more affordable alternative to four year institutions. Students will save money on tuition and fees by having the basic and introductory level education of the first two years of college at a lower cost. In most instances the savings are in the double and triple digit percentage range when compared with four year schools.

- Community colleges are a very attractive alternative for minorities and economically disadvantaged students pursuing a higher education that otherwise might have skipped it altogether as unattainable. With their usually smaller size and student centered services, two year institutions can make the transition to higher education less stressful.

- Successive levels of higher education would require students to make only two-year commitments at a time. This feature may help increase student retention in engineering and would be even more appealing in uncertain economic times. For students with financial limitations, it may offer an opportunity to obtain a professional job with an Associate's Degree in Engineering and continue studying for a higher degree with the employer's help and assistance.

- The closer proximity of a two year college can be another advantage in some instances. Most of the time the four year institutions are located in large urban areas that may require students' relocation into an unfamiliar environment. Community colleges are located in almost every large community, allowing for the students to start the transition to higher education from home with potentially important savings in lodging and food costs.

- Community colleges with their small size classes allow for a more personalized interaction between students and faculty in the beginning years, when it is most important. The importance of the class size in student's involvement and in understanding and retention of the course material was repeatedly demonstrated in the pedagogic literature[17]. This aspect is

even more relevant for difficult courses such as the math and science courses encountered in early engineering education, where students may need more support and more encouragement from the faculty.

- Classes at community colleges are usually scheduled at a wider variety of times that can accommodate extracurricular activities and work programs. This is particularly important for nontraditional students that have families and need to work to support them.

- The community college, with its flexible hours and emphasis on teaching instead of research, can attract a larger variety of practicing professionals from the engineering field that have a wealth of industry related experience and willingness to share it with students. This provides students with the chance to interact with practicing professionals from the industry and learn about real engineering problems.

- The availability of remedial courses makes community colleges a better option for attracting and retaining students with underdeveloped abilities. It is well known that a large number of students are leaving high schools without the proper amount of knowledge to enable them to tackle the higher level courses offered in engineering education[18]. One ready solution is to provide them with the required remedial courses in basic areas. Community colleges are better prepared and have more affordable means to address this problem successfully.

- Two-year colleges also offer more affordable place for undecided students to explore and discover the field that best suits their interests and personality. They have the opportunity to investigate inexpensively a wide variety of different fields before discovering what their call in life is and start preparing for their future careers. This exploration may avert costly mistakes, both in time and money, by avoiding potential changes of heart in the future.

- Lastly, an "Associate's of Science in Engineering" Degree adds another milestone to a student's list of credentials. It demonstrates the student's ability to succeed in an academic program and may bolster their confidence to continue towards a Bachelor of Science in engineering and beyond.

Students starting their education at a community college differ from those starting at four-year institutions in many ways such as age, educational background, enrollment patterns and socioeconomic status, grade point average, and dropout rate. In addition, many community college students are first-generation students. All these factors, more personal in nature, make starting engineering education at a community college an excellent choice.

Conclusions

The engineering faculty and administrators at community colleges should become more aware of the engineering programs in other community colleges and communicate with colleges with similar demographics and general conditions. Articulation agreements with ABET accredited engineering programs[19] at four-year institutions can be viewed as a good indication of the quality

of a community college program. The number of students attending the engineering program at the college, their graduation rates, and rate of transfers to four-year institutions can also be monitored as good indicators of the program's quality.

Hopefully best practices will be shared and disseminated between colleges providing enough information to help more community colleges develop competitive programs that will help students pursue successful engineering careers.

References:

1. Science and Engineering Indicators 2004, NSB- 04-1 and NSB 04-1A, Arlington, VA.
2. PREP – PreEngineering Program, URL: < www.texprep.org >
3. < www.msoe.edu/admiss/summer/index.shtml >
4. < http://studentservices.engr.wisc.edu/diversity/esp/ >
5. < www.engr.ncsu.edu/summerprograms/index2.html >
6. < www.seas.virginia.edu/minority/ite.htm >
7. < www.engineering.cornell.edu/diversity/office-diversity-programs/summer-programs/index.cfm >
8. Bringing "Engineering Forward" To The High Schools: One University's Experience In Starting An Engineering Summer Camp Program, by Bryen E. Lorenz, Frontiers in Education Conference, Savannah, GA, October 2004.
9. MESA – Mathematics, Engineering, Science Achievement, URL: < http://mesa.ucop.edu/home.html >
10. Getting an EDGE in Engineering Education, by Jerry O'Connor and Dan G. Dimitriu, ASEE Conference, Salt Lake City, UT, June 2004
11. Improving Articulation Policy to Increase Transfer, by Tronie Rifkin, Education Commission of the States Policy Paper, September 1998, Denver, CO.
12. Evaluating State-Level Articulation Agreements According to Good Practice, by Jan M. Ignash and Barbara K. Townsend, Community College Review 28(3):1-21, 2000.
13. Forging Stronger Ties Between Community Colleges and Four Year Universities by Dan Dimitriu and Jerry O'Connor, Proceedings of the 2004 ASEE Annual Conference & Exposition
14. Engineering a Community College Program, – Panel, Chair Dan G. Dimitriu, Frontiers in Education Conference, Boston, MA, November 2002
15. Enhancing the Community College Pathway to Engineering Careers, The National Academies Press, 2005, Washington D.C.
16. 2-Year Colleges Face an Identity Crisis, by Jamilah Evelyn, The Chronicle of Higher Education, 2004, Volume 51, Issue 10, Page B1
17. The Effects Of Class Size On Student Achievement: New Evidence From Population Variation, by Carolyne M. Hoxby, MIT Press, 2000 < http://ideas.repec.org/a/tpr/qjecon/v115y2000i4p1239-1285.html >
18. The ABCs of Engineering, by Linda Creighton, ASEE Prism on Line, Vol. 12, Number 2, Nov. 2002
19. Engineering Criteria 2000, - Accreditation Board for Engineering and Technology, URL: < www.abet.org >