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Board 303: High Tech and High Touch: Inclusive Ecosystems for Community College Engineering and Engineering Technology Student Success

Prof. eugene leo draine mahmoud, Mt. San Antonio Community College

eugene is a Professor of Physics and Engineering and educational researcher at Mt. San Antonio College (Mt. SAC). He received a B.S. in Aerospace Engineering with a minor in Ethnic Studies from the University of California, San Diego; and a M.S. and Engineers' Degree in Mechanical Engineering from the California Institute of Technology. Currently, he serves as the chair for the California Engineering Liaison Council and a Principal Investigator on a National Science Foundation Advanced Technological Education project. His grant-funded activities are focused on serving Engineering Technicians in Undergraduate Programs, and broadening access to careers in STEM.

High Tech and High Touch: Inclusive Ecosystems for Community College Engineering and Engineering Technology Student Success

Introduction

The economic demand for engineering and engineering technology professionals in the United States continues expand with the support of national government policy. Through the efforts of previous and current White House administrations [1]–[3], and recent legislation on cybersecurity and semiconductors [4], [5], the economic prosperity and national security of the United States are dependent on the growth of our engineering workforce. Between 2016 and 2026, the Bureau of Labor Statistics projects an 8.3% growth in engineering employment. In California, employment in Aerospace and Manufacturing engineering is expected to increase by more than 11% in the next decade [6]. This economic demand is mirrored by national policy that will develop incentives for new domestic students to pursue post-secondary higher education in engineering and engineering technology [4], [5], [7]. Community colleges, in particular, stand apart for their role in cultivating a diverse, talented pool of low-income engineering and technology scholars for this growing workforce [8], [9]. Given that students from low income and demographically minoritized communities in engineering (women, African-Americans, Indigenous, and Latinx students) are more likely to begin their higher education outside of universities, and the numbers of white and male students receiving engineering bachelor degrees have stalled [1], it is imperative to turn our national resources to engineering education systems that are inclusive of community colleges.

Mt. SAC is the largest community college in California, serving more than 66,000 students annually in Los Angeles County, Orange County, and Riverside County. As both a federally designated Hispanic-Serving Institution and an Asian American and Native American Pacific Islander-Serving Institution, Hispanic students (56.5%) and Asian students (17.2%) make up the two largest ethnic groups on campus. Among students who report ethnicity, 90.6% are from historically marginalized communities. At Mt. SAC, about three-quarters of credit students receive some form of financial aid, and about half are first-generation college students. Additionally, Mt. SAC also has a strong history of serving disabled students, foster youth, unhoused students, veterans, student-athletes, and transfer students.

This paper will review changes in the learning and teaching of engineering technology at Mt. SAC. It will share the development of a holistic, student-centered framework for improving students' learning opportunities. The institutional practices and innovative approaches discussed will evidence the work in progress towards an improved, integrated learning experience for engineering technology students. Finally, current results will support prior findings and provide new evidence for engineering education practices in community colleges.

Stackable Certificates and Degrees

In the Fall of 2022, Mt. SAC began offering 12 new certificates of achievement and 6 new associate of science degrees in the discipline of Engineering Technology. These certificates include Technical Sales, Engineering Fundamentals, Engineering with Emphasis in Chemical and Materials Engineering Applications Level 1, Engineering with Emphasis in Chemical and Materials Engineering Applications Level 2, Engineering with Emphasis in Software Engineering Applications Level 1, Engineering with Emphasis in Software Engineering Applications Level 2, Engineering with Emphasis in Mechanical

Engineering Applications Level 1, Engineering with Emphasis in Mechanical Engineering Applications Level 2, Engineering with Emphasis in Civil Engineering Applications Level 1, Engineering with Emphasis in Civil Engineering Applications Level 2, Engineering with Emphasis in Electrical Engineering Applications Level 1, and Engineering with Emphasis in Electrical Engineering Applications Level 2. The Associate of Science degrees include Engineering with Emphasis in Chemical and Materials Engineering Applications, Engineering with Emphasis in Software Engineering Applications, Engineering with Emphasis in Mechanical Engineering Applications, Engineering with Emphasis in Civil Engineering, Engineering with Emphasis in Electrical Engineering Applications, and Sales Engineering. Each program was approved with a career technical education designation, and with the exception of Sales Engineering and Technical Sales, all of the programs were recognized as transfer preparation for university degree programs. We are currently in discussion with our transfer partners as to how these degrees can form a basis for transfer admission incentives and program articulation, as opposed to course articulation. We also continue to explore ABET accreditation for our new associate degree programs. In addition, we have received local and regional approval for a new certificate program in Surveying Engineering Technology.

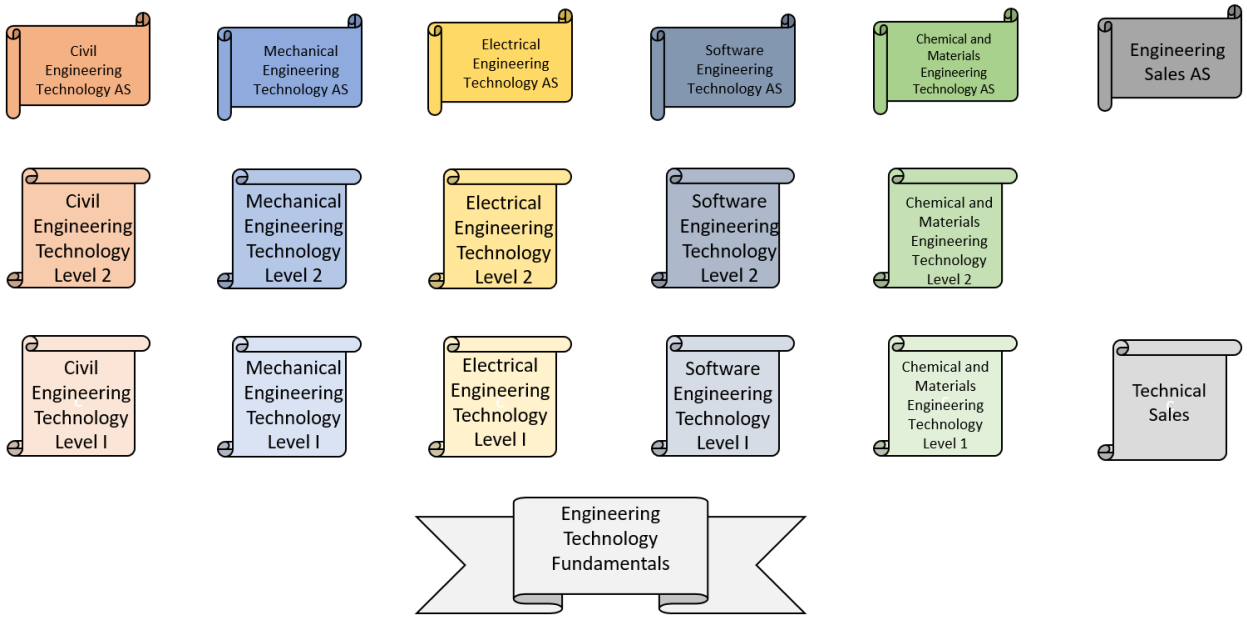

Figure 1: Certificate and Degree Programs in Engineering Technology Programs. Surveying not shown

Studies have found that individuals with an associate degree in a STEM field have better job prospects and higher earning potential compared to those with only a high school diploma or equivalent. In some cases, an associate degree in STEM can also serve as a stepping stone towards higher-level careers and advanced degrees [10]. Associate degree programs in STEM fields have been shown to provide a more accessible and affordable path towards a career in STEM, especially for individuals who may not have the resources or opportunity to pursue a four-year bachelor's degree [8]. Research has shown that associate degree programs in STEM fields often provide students with hands-on training and real-world experience, helping them develop technical and problem-solving skills that are in high demand in the

workforce [8]. With the increasing demand for workers in STEM fields, associate degree programs have become a key focus of efforts to prepare the workforce to meet these demands. Studies have shown that associate degree programs can play an important role in bridging the skills gap and increasing the number of individuals with the technical knowledge and experience necessary for careers in STEM [10]. Overall, the literature suggests that associate degree programs in STEM majors can have a positive impact on individuals and the workforce, providing individuals with the skills and opportunities necessary to pursue careers in STEM fields.

Onboarding and Orientation

As of Fall 2022, Mt. SAC has offered two sessions of the Engineering Summer Cohort (ESC) program. The first offering was offered in a remote format and the most recent offering was delivered in-person. Both sessions were successful in the goals of delivering a project-based engineering experience, personalized counseling, and customizing students' course schedules and career pathways. The program website and application is currently active for the second session in summer of 2022, with some applications already in. Outreach has been much more active this year with an in-person visit to Los Altos High School, presentations at virtual and in person outreach conferences, email marketing to Mt. SAC feeder high schools students, and direct advertisement to incoming students who have applied to Mt. SAC for the Fall. A new non-credit course is being submitted through the local curriculum process to institutionalize future sessions of this program. This will allow for students to enroll free of cost. On-campus space has been secured for the Computer-Aided Design (CAD) and counseling component of the ESC project, as well as the Makerspace for the engineering project fabrication component. So far, the Engineering Summer Cohort (ESC) program is on track for the primary goals of incorporating workplace relevant skills in the curricula (use of Makerspace mostly) and successfully orienting students from underserved populations/setting students on clear pathways to certificates/degrees/4-year transfer via schedule creation with the Mt. SAC STEM counselor and incorporation of the newly approved Engineering Technology certificates and degree programs.

Initial Results and Future Work

In the Spring of 2022, program students completed a survey on students' readiness for career and degree completion. Preliminary data undergoing parametric tests (using paired sample t-tests) were tested for normality via the Shapiro-Wilk test and skewness to check for normal distribution. Across all student respondents (n = 104) there are significant increases in self-reported knowledge and discipline interest when compared to baseline ratings, specifically:

- interest in acquiring a certificate in engineering technology increased from 49% before participating in the program to 67%
- interest in acquiring a two-year degree in engineering technology increased from 43% before participating in the program to 85%
- interest in obtaining a four-year degree in engineering technology increased from 52% before participating in the program to 70%
- Interest in a career in engineering technology increased from 59% before participating in the program to 69% after participating in the program.

Although there were significant increases in respondents' skills related to engineering and engineering technology, the lowest rated knowledge area at pre (M=2.51) and post (M=3.12) was robotics. Also, the majority of student survey respondents (94%) attended the general Mt. SAC new student

orientation/Mountie Academic Planning Session, and of the 46 students in their first semester of the Mt. SAC engineering program, only 15 respondents (33%) indicated that they participated in the Engineering Summer Cohort (ESC) program.

These results are subject to re-testing and confirmation. Additional analysis will disaggregate results for students from underrepresented groups, different engineering majors, and correlation to engineering coursework completion. Future work will incorporate marketing of new engineering program awards and transfer pathways, incorporating project-based learning into each engineering course, and working collaboratively with student services inside and outside of Mt. SAC. Our department has developed a new course in robotics and additional opportunities for students to participate in engineering competitions. Additionally, our department has formally created a new noncredit course, to support the growth of onboarding experiences for new engineering students.

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