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Development for the Other 80%: Engineering Hope

Engineering education is confronting challenges on numerous fronts: a fundamentally different generation of students (Tapscott 2008) with a declining interest in engineering (NSF 2004; Sims 2004), calls for a new set of knowledge and skills (NAE 2004) despite entrenched methods of ineffective instruction and curricular design (Bok 2007; Sheppard et al. 2008), and numerous grand challenges facing humanity (NAE 2008) constrained by the supply of well-trained technical professionals (Friedman 2005). This work examined some of the results to date from more than a decade of international sustainable development engineering programs at Michigan Tech. Notably, these programs form a consortium called the D80 Center, which focuses on research, education, and service programs supporting development for the poorest 80% of the world's population.

The D80 Center is a grass-roots effort to supplement traditional academic programs, growing through entrepreneurial program development by faculty, staff, and students across campus. Through observation and anecdote, the D80 Center programs, and ones like them at other universities, appear to be defying practice and outcomes in engineering academics. Are the participants in these programs better prepared than their peers? Why are these programs yielding such different results? What are these programs' key attributes? Can traditional curricula be "genetically-modified" using these attributes?

Despite the emergence of similar programs around the world, little assessment data exists to provide resolution to such questions. This paper presents some information to begin filling this void, and in turn, engineering hope for the many challenges above. While each of the programs within the D80 Center has been created to provide unique opportunities, all programs share four key attributes: (1) project-based service learning, (2) international sustainable development focus, (3) voluntary participation, and (4) multi-disciplinary teams. This work built off the recent addition of a rigorous five-part assessment implemented within the D80 Center: (1) participant surveys, (2) intercultural development inventory, (3) content analysis of student work, (4) alumni surveys, and (5) program performance statistics. This research focuses on the last in order to provide a foundation for understanding the summative outcomes of these programs.

Preliminary evidence from some of the other assessment components is also shared. Major findings from the D80 Center programs to date paint a very different picture for engineering. Enthusiasm for such programs is strong with more than 50%/yr growth in student participation sustained over the past five years and with more than 300 students on campus in one or more programs. There are no gender problems in these engineering programs, nearly half (49.7%) of

the participating students are women, more than twice the university level (24.4%).

D80 programs have partnered with communities in 27 developing countries, yielding a considerable body of knowledge for better practices in international sustainable development. Collectively, these programs are creating a strong community of international engineering students on campus. The university is featuring these programs in marketing efforts and it is paying off; nearly half (48.4%) of the students in D80 programs say they chose to attend Michigan Tech because of these programs.

Assessing students has led to a better understanding of the challenges with this initiative. One is scalability; nearly half of engineering students report wanting to participate in an international experience. Conservatively, this would mean creating opportunities for nearly 600 engineering students each year. Yet, many barriers keep actual participation rates much lower: program expenses, time demands, and being concerned with their curricular studies are cited as top reasons for avoiding these programs. The same survey hints at what makes these programs so attractive: the chance to help others, gain professional experience, challenge oneself, fulfill ethical obligations, travel, and demonstrate leadership are mentioned as top reasons among participants. Examining participation rates also reveals considerable differences between disciplines (environmental engineering majors participate at three times the rate that civil engineering majors do, for example) and year (interest in participating falls from 50% for first-year students to 25% for seniors, and this is mirrored by a rise in actual participation rates from 5% to 20% for the same years). It is clear that promoting international experiences to students needs to account for these factors. A second challenge is program sustainability. As these programs evolve outside the domain of traditional academic structures, they are typically sustained by the enthusiasm of faculty champions and student participants capable of paying the real and perceived costs. Restructuring traditional university resource allocation models is needed to ensure the long-term existence of such programs. On-going research has begun to more deeply explore the attributes of these programs and the students they attract; the programs defy the issues that plague most engineering programs, they motivate students to immerse themselves in rich challenges, and can readily be scaffolded onto existing curricular foundations. Research into the DNA of these programs may provide clues not only into why they succeed but also how to "genetically modify" traditional curriculum with these attributes.

Research into the students at Michigan Tech and elsewhere is needed to better understand how these international sustainable development experiences impact their knowledge, skills, attitudes and identity. Alumni research is needed to better understand impacts to the profession and society. Insight into these issues may offer considerable hope to engineering education, the profession, and the communities served. Fortunately, several multi-institutional collaborative research initiatives are currently underway. The successes in Michigan Tech's D80 Center would not be possible without the dozens of faculty and hundreds of students who stride beyond

the typical path to participate in these programs. Good program partners are critical and we are lucky to have a wide range of governmental and non-governmental supporters, including the National Science Foundation, U.S. Peace Corps, and EWB-USA, among others. Michigan Tech is fortunate to have an entrepreneurial spirit among its faculty and administrators, encouraging the development of initiatives like D80. Lastly, none of the programs would thrive without the openness and willingness to share from hundreds of communities around the world. It may be that the greatest hope for engineering emanates from the lessons learned there.

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