article:1949

Diversifying the U.S. Engineering Workforce: A New Model

Considerable resources have been invested to improve racial/ethnic and gender diversity of the enrollment in engineering degree programs and the engineering workforce. Reported analyses of enrollment and workforce trends indicate that progress toward increasing diversity has slowed considerably, at best, or is losing ground, at worst. Given this result, it seems appropriate time to reconsider how the challenge of increasing diversity is framed and how solutions have followed from that formulation.

Study of the existing literature on diversity in engineering and programs intended to improve diversity showed that the most prevalent metaphor used to state the problem was a pipeline. From this formulation, the following solution alternatives flowed: (a) stop leaks either through community building or through cognitive ability development, and (b) increase intake through occupational choice development. From this background, the paper posed the following two questions:

1. Is there sufficient evidence to believe that doing more of the same with better coordination will yield significantly better outcomes?

2. After years of interventions in community building, cognitive abilities, and career aspiration development, with much evidence that the interventions have been profoundly successful in influencing people who might not otherwise have entered or persisted in engineering, participation levels of underrepresented groups in US engineering are lower than desired. Should the magnitude of current interventions be significantly increased or should they be fundamentally altered?

The paper addressed the questions through a review of the nature of current interventions coupled with a review of the theory or science supporting each of the interventions. Community-building interventions focus on changing the self-identity development of individuals to increase the likelihood that they will persist within the system. The principal underlying theory is identity development, that is, how does a person develop their conceptions of who they are and how do they relate to others. Cognitive development interventions focus on improving the cognitive capabilities of underrepresented individuals to increase the likelihood that they will persist within the system. The underlying theory is the vast literature on learning, especially conceptions of what learning is and how it occurs. Occupation choice interventions focus on improving the likelihood that more individuals will continue to consider the choice of engineering as a career. For the underlying science, we drew on the staged model of occupational choice developed offered by Gottfredson and Holland’s typological theory. Exploration of current interventions intended to increase diversity, as well as a study of the underlying assumptions on which the interventions are based, demonstrated that current interventions focus on changing the individuals flowing through the pipeline, not the pipeline.

All three interventions, community building, cognitive ability development, and occupational

choice development, assume that the current educational and working environments for engineers will remain unchanged and that individuals from underrepresented groups need to adjust or be adjusted to increase the likelihood that they will choose and persist in engineering.

Since individuals from underrepresented groups continue to enter the pipeline, current interventions are required to be continued indefinitely. Further, increasing participation of underrepresented groups in engineering educational programs to the current representation in the general population requires that interventions be scaled according to the magnitude numbers of students to achieve this goal. As a result, we concluded that the interventions have not been insufficient, but they have been framed as an add-on to current engineering education system. Even with more expansive or improved versions of current interventions, the system will remain unchanged. Therefore, we contend that a new model is required to frame the problem of increasing diversity in engineering.

We proposed a new model that started from the energy that was available for learning and required to achieve learning outcomes. Energy, called Inuguq, could be modeled following through a transmission line system, instead of a pipeline, in which identity development, cognitive ability development, and occupational choice development occur concurrently and synergistically within undergraduate engineering curricula that prepare graduates in accordance with the program learning outcomes that have been established by other researchers and accreditation agencies. With this formulation, transmission line metaphors were developed for both current and desired system.

From our analysis, we offered the following recommendations:

· Focus on the attributes of the receiver as described in section 3 to construct Program Objectives, as defined in ABET Engineering Criterion 2. Remember the importance of an additional characteristic of the receiver: **Graduates will recognize they bring a diverse perspective to every situation and will understand the value of diverse perspectives from those marginalized in a group.** From these characteristics, develop program learning outcomes.

· To assist monitoring progress toward achievement of Learning Outcomes as well as monitor development of self-identity, establish a research-based, peer-reviewed collection of assessment processes and instruments. Start each term with students taking a bank of assessment instruments inventories and attending seminars by faculty and students on team projects.

· To recognize the different starting points of a diverse entering student body, be sure to start from at least three different conceptual understanding levels.

· To support innovative learning activities, establish a research-based, peer-reviewed collection of instructional modules and sub-modules.

· Assess the student’s competency level with each learning outcome and use this as both a guide for next semester or quarter assignments and for inter-term interventions.

· Assign each student modules and sub-modules to study. Each module should begin and conclude with an assessment of student competencies with respect to the desired outcomes of the module.

· Report competency levels achieved on learning outcomes. Only if necessary provide equivalent hour credits. Omit grades.

Author 1: Karan Watson watson@tamu.edu

Author 2: Jeffrey Froyd froyd@tamu.edu

Article Link: www.asee.org

: Back to 2007 Winter Issue Vol. 3, No. 1

: Back to List of Issues

: Back to Table of Contents