



Educating Engineers: Designing for the Future of the Field

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with whom they interact in the community. An emerging body of research suggests that service learning is experienced differently by students from underrepresented groups and that boundaries are blurred creating different outcomes for students and community members alike. The perspectives of students of color or students from working class families, for example, are also unheard voices in service learning.

In illuminating the experiences and perspectives of community organizations in *The Unheard Voices* Stoecker and Tryon provide service learning educators (in the broadest and most inclusive definition) with a very useful resource for the effective and respectful design and implementation of service learning. If their findings and recommendations therein are taken to heart and seriously, service learning programs will not only look very different but so too will faculty involvement and most importantly, intended benefits to community organizations may actually be realized.

Educating Engineers: Designing for the Future of the Field,
by Sheri D. Sheppard, Kelly Macatangay, Anne Colby, &
William M. Sullivan. Jossey-Bass, 2008. 272 pp. \$40.00 (cloth).
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Educating Engineers: Designing for the Future of the Field is the third volume in a series of comparative studies performed by scholars at the Carnegie Foundation for the Advancement of Teaching. Sheppard, Macatangay, Colby, and Sullivan base their book on a multi-year study of 11 mechanical and electrical engineering programs at 6 engineering schools: California Polytechnic State University, Carnegie Mellon University, Colorado School of Mines, Georgia Institute of Technology, Howard University, and the University of Michigan. The rationale for this selection was that these schools represent a diverse set of institutions and these two disciplines produce over half of the engineering graduates in the United States each year. The overarching aim of this work was to explore the strengths and weaknesses of current curricular goals and teaching practices in the context of the modern, global era of professional engineering practice.

Educating Engineers provides some important insights. For example, the book aptly describes the misalignment between the heavy curricular emphasis on abstract analysis applied to well-structured problems in contrast to the type of thinking that is required in practice: “in professional practice, problems are rarely well-posed ... they require approximation and judgment—thinking at the highest level of reflection” (p. 30). To address this issue Sheppard and colleagues propose a networked model to reframe strategies for developing technical knowledge such that the emphasis is on interconnectedness of concepts, with skills and concepts being revisited at increasing levels of sophistication. The networked approach moves pedagogy away from the traditional deductive

method and towards challenging students to develop deeper levels of understanding, a capacity for reflective thinking, and healthy attitudes such as persistence, flexibility, and adaptiveness that are necessary for professional success.

Moreover, the book brings the human aspect of engineering to the forefront, noting the complex social, global, and informational interconnections that enable modern technologies to function. Project-centered learning, design projects, cooperative education, and internships are all approaches within engineering education that emphasize interpersonal interaction and afford the opportunity for students to develop professional skills such as teamwork and effective communication, and to confront and resolve issues of professional ethics. Furthermore, the book gives appropriate recognition to how learning science theories can help guide engineering educators in designing educational approaches and assessment methods that put students on the trajectory of developing expertise.

However, while the networked approach pushes engineering educators to think differently about the curriculum, the approach may be viewed as missing an important organizational context. In particular, the organization of faculty into departments causes a silo effect that serves as a barrier to a networked approach, or any innovative curricular model for that matter. Departmental core courses are often taught in a linear manner, in isolation, and teaching load is assigned according to narrow expertise related to a specific course. This structure makes the transition to a more networked approach often insurmountable even to faculty with the best intentions and passion for reform.

While the book suggests that engineering faculty will be the “key players” in reform and that “reconceptualizing undergraduate engineering will demand enormous effort on the part of the faculty” (p. 207), it is imperative to situate the call to reform in the broader organizational structure of the university system. It is pertinent to ask, even if we have the most qualified and passionate faculty to implement a networked curriculum based on solid learning science principles, can it possibly succeed within the traditional departmental and reward infrastructure? If the community takes the design approach as described in the book, a first step would be to redefine the problem such that it less a curricular one, and more of an institutional one. Then, the reframing of the problem should result in solutions that address these more nuanced and systemic barriers to reform.

Taking an organizational perspective perhaps has an even more powerful potential to reshape the community’s thinking about curricular reform. That is, the interconnectedness afforded by a networked curriculum approach as suggested by Sheppard et al. is implicitly embedded in the engineering system that requires a solution. Finding solutions to the grand challenges facing society (NAE Grand Challenges, 2009), such as providing access to clean water, making solar energy affordable and restoring and improving urban infrastructures are indeed the challenges our engineering graduates will encounter.

Furthermore, the challenges are authentic and arguably motivating to students since they represent how the application of engineering knowledge can make a difference in the world. By refocusing engineering education on the immediate impact of learning, and its application to urgent societal needs may also address the longstanding issue of lack of participation of women and underrepresented groups in the engineering profession. That is, the engineering profession may have broader appeal, and increased relevancy, if we focus on challenges rather than curricular elements.

Educating Engineers is an important contribution to the literature. The book takes a scholarly approach to understanding the status of engineering education by performing in-depth case studies of six diverse institutions. Several faculty and schools in the community are taking meaningful steps to adapt the curriculum to meet the changing needs of students and society. However, one critique is that the book may have missed an opportunity to explore the institutional factors that impact educational reform.

This observation does not necessarily detract from the book's contribution; rather, it serves as a call to the community for further work. Indeed, engineering education is evolving into a scholarly community such that we are developing a deeper understanding of our students as learners, our faculty as educators, and the curricular and organizational factors that influence the learning environment (e.g., see special issues of the *Journal of Engineering Education*, 2005, 2008; ASEE, 2009). Finally, engineering education no longer resides just at the university level. Significant efforts are underway to introduce engineering in K–12 (e.g., NAE, 2009; The Bridge, 2009). This is an exciting time for the engineering education community; we are evolving in new directions and *Educating Engineers* provides important insights for us stay on the path to educational innovation.

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