

“Leading Learning: Questions for Faculty and Administrators”

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Engineers as Leaders

Among the characteristics identified as important for future engineering graduates in the NAE report on “The Engineering of 2020,” [1] is an ability to “understand and practice leadership.” But what is meant by leadership? In seeking to answer this question, one may look at domains of operation (e.g., professional, political, or societal). For example, professional leadership for engineers includes those who are creators of new technologies (“technical wizards”), those who build on new or existing technologies to spawn new firms and industries (“entrepreneurs”), and those who build on their engineering skills to lead in other professions.

Examples of persons trained as engineers

who exhibit leadership in a variety of domains are shown in the table below.

It’s noteworthy that Jimmy Carter and Bill Gates appear on the list twice under different guises.

In addition to looking at specific domains, one might also consider various dimensions of leadership that apply across domains. For example, the US Office of Personnel Management lists five dimensions of leadership expected of members of the senior executive service: leading change, leading people, results driven, business acumen, and leading coalitions [2]. As another example, one can exert leadership with respect to ethics in each of the domains indicated above.

DOMAIN	NAME	DESCRIPTOR
Professional/ Academic/Technical	Bill Gates	Founder and former chairman of Microsoft
	Shirley Ann Jackson	President of RPI and former chair of the Nuclear Regulatory Commission
	John B. Slaughter	President of NACME, Former president of Occidental College, former NSF director, former president of the University of Maryland System.
	Ellen Ochoa	Deputy director of Johnson Space Center and former astronaut
Political	Jimmy Carter	Former US President
	Ted Kauffman	US Senator - Delaware
	Joe Barton	US Representative, Texas (6 th District)
	Delores Etter	Former Undersecretary of Defense for Science and Technology
	Sheila Widnall	Former Secretary of the Air Force
	Societal	Jimmy Carter
Bill Gates		Philanthropist
Montel Williams		Talk show host
Bernard Amedei		Founding president, Engineers Without Borders - USA

Table 1. Engineers Who Are Leaders in Various Domains

Key Questions in Preparing Students for Leadership

Key questions to be considered in preparing students to be leaders include the following:

1. What are the key knowledge, skills, abilities, and attitudes (KSAs) that we wish to impart?
2. How will the KSAs be imparted (e.g., with what pedagogies and in what learning contexts)?
3. Who is to guide the student learning?
4. What learning environments will be used?
 - In Class – as part of distinct leadership course, or as modules within technical courses;
 - Out-of-Class (co-curricular) – as part of competitions (e.g., solar racer) and clubs (e.g., Engineers for Sustainable Development); and
 - Off Campus – as part of service learning activities or internship activities.

Developing the answers to these questions may pose significant challenges to faculty and administrators. The challenge for faculty is that it is difficult for faculty to teach leadership skills that they either have not acquired themselves or for which there are active disincentives for them to display (e.g., faculty receive promotion and tenure on the basis of individual work, so modeling true collaboration becomes difficult). The issue raised by this reality is that we need to think through additional questions about faculty knowledge, skills, abilities, and attitudes:

1. How do we develop the requisite competencies in current and future faculty?
2. What are the barriers and enablers within the current engineering faculty culture to modeling leadership?
3. How do we overcome the existing barriers and encourage more faculty to model leadership characteristics?
4. How do we prepare faculty to assess leadership characteristics?
5. What fraction of a department's faculty should be engaged in this effort? If only a subset, how should they be identified and selected?

The questions for administrators are even broader:

1. How do we modify the content and delivery of instruction so as to develop students as leaders?
2. How do we encourage, assess, and reward student and/or faculty leadership?
3. What systemic changes are required in

academic engineering culture, climate, and structure in order to achieve the desired faculty instructional behavior and student learning outcomes?

These faculty and administrator questions are researchable issues that my center pursues through direct action-research projects as well as by facilitating research by others. CASEE has defined six broad research areas [3] which within a discussion on developing students as leaders can be summarized as the following:

1. Research on HOW leadership is taught, learned, and assessed
2. Research on WHO becomes leaders and how they interact
3. Research on WHAT curricular, laboratory, and technological tools can be used to promote learning of leadership
4. Research on the GOALS of leadership
5. Research on the CONTEXTS of leadership
6. Research on how to DIFFUSE to others the knowledge of effective approaches to leadership

The National Science Foundation and other funds can advance research in the areas above by soliciting community input in order to define leadership domains (e.g., professional/academic/technical) and dimensions (e.g., ethics) of interest as well as to set priorities among research areas. Funding support is needed to foster the intellectual and tools infrastructure that will undergird the efforts of individual researchers as well as for direct support of key research questions. Funders will need to support pilot effective models of leadership instruction and the diffusion of research results to communities of researchers and practitioners as well as support adaptation and implementation of successful models.

References

1. National Academy of Engineering. (2004). *The Engineer of 2020: Visions of Engineering in the New Century*. Washington, DC: The National Academies Press.
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3. National Academy of Engineering. *CASEE Research Areas*. Retrieved June 25, 2009, from <http://www.nae.edu/Programs/CASEE/GeneralInformation/ResearchThrusts/ResearchAreas.aspx>

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