Influences on Engineering Faculty Members’ Emphasis on Interdisciplinarity in Undergraduate Courses

Problem Statement
Solving many of today’s technological and social challenges will require interdisciplinary thought and action (NIH, 2006), and the growth of interdisciplinary engineering programs suggests that the field is acknowledging its role in preparing students to tackle these complex problems and develop innovations that will advance quality of life, economic growth, and national security (Cosco and Bailey, 2010). Efforts to enhance students’ interdisciplinary knowledge and skills include the development of interdisciplinary design courses through the NSF-funded SUCCEED Coalition and ABET’s later accreditation mandate for undergraduate programs to prepare new engineers to work on multidisciplinary teams (Dr. Knight, 2001).

Richer and Paretis’s (2009) review of engineering journals and conference proceedings identified more than 1,500 articles on interdisciplinary courses and projects published in an 8-year time period. During this same period, two reports on engineering education—The Engineer of 2020 (2004) sponsored by the National Academy of Engineering and Creating a Culture for Scholarly and Systematic Innovation in Engineering Education (Jamieson & Lohmann, 2009)—published by American Society for Engineering Education placed the responsibility and challenge of promoting the development of future engineers’ interdisciplinary habits of mind on engineering faculty.

Our analysis draws on a nationally representative data set of 31 four-year institutions that allowed us to examine the extent to which engineering faculty members emphasized interdisciplinary skills and content in undergraduate courses.

Data Collection Strategy
Six national surveys assessing the alignment of undergraduate programs with the vision of The Engineer of 2020
86 undergraduate programs in 31 institutions

Stratified, random sample of institutions, including:
7 engineering disciplines (biomedical, chemical, civil, electrical, general, industrial, mechanical)
Public/private institutions and 3 levels of highest degree offered
Including 5 minority-serving institutions

Response Rate
38%
1,119 usable surveys from 2,942 faculty members contacted
987 tenure-track or tenured faculty (for this analysis)

Research Design

Participating Institutions
Research Institute
California Polytechnic State University
California State University, Long Beach
Colorado State University
Georgia Institute of Technology
Institute of Design (SOM)
Lafayette College
Loyola University Chicago
Milwaukee School of Engineering
North Dakota State University
Ohio Northern University
Purdue University
Rutgers University
Stanford University
University of California, Los Angeles
University of California, Santa Barbara
University of Colorado at Boulder
University of Colorado, Boulder
University of Delaware
University of Florida
University of Illinois at Urbana–Champaign
University of Iowa
University of Kansas
University of Michigan
University of Texas at Austin
University of Texas, El Paso
Virginia Tech
Virginia Polytechnic Institute and State University
Rose-Hulman Institute of Technology
Manhattan College
California Polytechnic State University
Colorado State University

In this course: how much do you emphasize?
1=Little/No emphasis, 2=Slight, 3=Moderate, 4=Strong, 5=Very Strong, 6=Not applicable

Interdisciplinarity course emphasis scale (alpha=.86)

Related variables:
• Making explicit connections to knowledge and skills from other fields
• Integrating knowledge from engineering and other fields to solve engineering problems
• Applying knowledge from other fields to solve an engineering problem
• Understanding how an engineering solution can shape/be shaped by environmental, social, cultural, political, legal, economic, and other considerations
• Understanding how non-engineering fields can help solve engineering problems

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Control Variables
Gender (ref=male)
Underrepresented Minority (ref=White)
Other race (ref=White)
Biomedical/Engineering (ref=electrical)
Civil engineering (ref=electrical)
Industrial engineering (ref=electrical)
Mechanical Engineering (ref=electrical)
Other discipline (ref=electrical)
Faculty rank
Course type: design (ref=All others)
Years teaching at the college level
Years in industry while faculty
Years in industry before faculty

Significant results
Among the strongest relationships: Believing that it is one’s responsibility as a teacher to ask students to make connections across engineering disciplines, and to help them understand the world from multiple perspectives. Faculty who believe it is their responsibility to teach about diversity in terms of race, gender, and culture report making interdisciplinary connections in their courses, but these topics do not appear widespread across the engineering curriculum.

NEXT PHASE OF OUR RESEARCH
Examine the influences identified as significantly related to faculty members’ emphasis on interdisciplinary in their courses (i.e., the findings of this study) alongside ”external” and ”institution level” influences that are also potential curricular influences to provide a fuller picture of the factors related to faculty members’ decisions to emphasize interdisciplinary in their undergraduate courses.