Transforming Biomedical Engineering Education

BIOMEDICAL ENGINEERING
UNIVERSITY OF MICHIGAN

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What is Engineering Education?

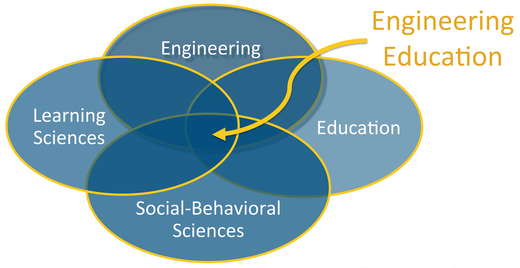


Figure 1: The Interdisciplinary Nature of Engineering Education Research

Engineering Education Research (EER) is an interdisciplinary field that seeks to:

1) Improve engineering education, and
2) Develop engineering students for a diverse workforce.

Some common *themes* in **EER** include:

- *Student motivation, engagement, and persistence*
- *Learning mechanisms and approaches*
- *Instructional and departmental change*
- *Interdisciplinary approaches*
- *Pathways to diversity and inclusions*
- *Career pathways*
- *Institutional practices & organizational change*

Need for EER in BME

Since inception as a profession in the 1950s, BME education has undergone significant growth and transformation.

> It is now *a discipline* where graduates are expected to have *"an integrative outlook to develop true expertise at the interface" of engineering, life sciences and clinical medicine.*

In one of the earliest publications on BME education (1975), the community was cautioned with a number of perceived issues:

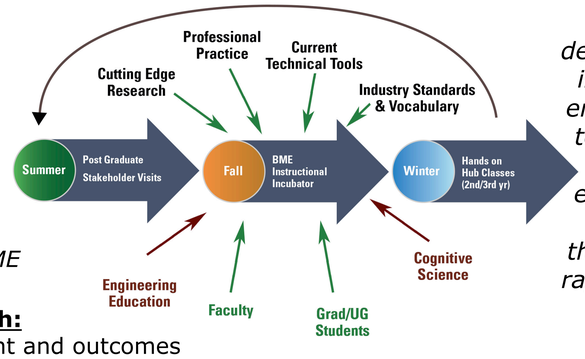
1) Students need to be taught how to rapidly adapt to external forces;
2) BME programs must be responsive to rapidly changing external needs;
3) BME should be grounded in fundamentals as well as interdisciplinarity; and,
4) By its nature, BME is broad and no single track can cover the full scope of the diversity of BME.

Over 40 years later, these issues still dominate the concerns of the BME instructional community.

bme.umich.edu

Project 1: Instructional Change and Curriculum Development

Figure 2: How the BME Instructional Incubator fits into the cohesive BME program.



Graduate Student Instruction

1) Grading
2) Design of Incubator Design of BME250-350 sequence curriculum to improve BME experience

Goal: To develop a more cohesive and high quality BME program for undergraduates

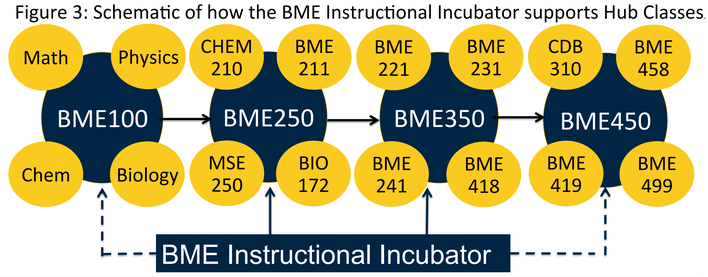
Graduate Student Research:

1) Development of assessment and outcomes of student learning
2) Research on instructional change
3) Research on development of shared BME Identity amongst student/faculty/staff
4) Research on education best practices
5) Research on interdisciplinary

Goal: To understand effective BME education practices to implement in BME curriculum

"iBME will create a departmental culture in which interdisciplinary faculty are empowered to work together to create a high quality and cohesive biomedical engineering (BME) program built on student learning theory and responsive to the rapidly changing environment of biomedical practice."

Figure 3: Schematic of how the BME Instructional Incubator supports Hub Classes.



Project 2: BME Identity & Interdisciplinarity

Graduate Student Research

BME Professional Identity

Goal: Explore how undergraduate BME students conceptualize themselves as a function of *values, motives,* and *experiences*

Research Questions:

1. How do incoming students perceive BME Professional Identity?
2. How do student perceptions of BME Professional Identity change over time?
3. What are BME faculty perceptions of BME Professional Identity?
4. How do student and faculty perceptions of BME Professional Identity align?

Interdisciplinarity

Goal: Explore how to analyze, synthesize and harmonize links between disciplines into a coordinated and coherent whole

Research Questions:

1. What pedagogical practices support student learning in interdisciplinary environments?
2. How can faculty from different disciplines co-create interdisciplinary exercises that teach novices to not just identify content from different fields, but understand and integrate new values through experimentation?

Recent Publications

Huang-Saad, A. and Celis, S., "How Student Characteristics Shape Engineering Pathways to Entrepreneurship Education." *International Journal of Engineering Education,* 2017 (March)
Huang-Saad, A., Fay, J., and Sheridan, L., "Closing the divide: accelerating technology commercialization by catalyzing the university entrepreneurial ecosystem with I-Corps", *The Journal of Technology Transfer*, 2016, pp. 1–21.
Huang-Saad, A., Gibson, M., Goebel, J., McNaughton, B., Sheridan, R., Student Learnings from a Multidisciplinary Capstone Entrepreneurship Course, *The Journal of Engineering Entrepreneurship*, 7:1, pp. 13-23, 2016.
Huang-Saad, A.Y., Morton, C.S., Libarkin, J.C., Unpacking the Impact of Engineering Entrepreneurship Education that Leverages the Lean Launch Curriculum: 2016 Frontiers in Education, Erie, Pennsylvania, 2016
Morton, C.S., **Huang-Saad, A.Y.**, Libarkin, J.C., Entrepreneurship education for women in engineering: A systemic review of entrepreneurship assessment literature with a focus on gender: ASEE 123rd Annual Conference, New Orleans, Louisiana, 2016 (2nd place Best Research Paper Award, ENT Div)
Huang-Saad, A., "Fostering the Entrepreneurial Mindset in the Engineering Classroom." *Frontiers in Education Conference, 2009.*

Funding

1. *National Science Foundation,* "Establishing Strong Biomedical Professional Identity by Fostering Interdisciplinarity in BME Students Through a Shared Vision of Instructional Change." Submitted. $1,999,987. PI: Shea, Huang-Saad, Stegemann.
2. *University of Michigan Center for Research in Learning and Teaching,* "Assessing the Development of Self-Agency, Innovativeness and Risk-taking Skills in Engineering Design and Entrepreneurship Courses." 01/17-06/18. $8,000. PI: Shekhar and Huang-Saad.
3. *National Science Foundation, "I-Corps Node: Activating the Midwest I-Corps Network."* 01/01/17-12/31/21. PI: Hu, Fay, and Huang-Saad.
4. *University of Michigan M-Cubed*, "Strategies for Front-end Design." 10/15-9/16. $15,000. PI: Daly, Siefert, and Huang-Saad
5. *National Science Foundation (REE),* "Examining the Effect of Entrepreneurial Pedagogy on the Development of Women in STEM." 08/15-07/18. $463,822. PI: Huang-Saad.
6. *National Science Foundation (IUSE-Exploratory),* "Investigating Entrepreneurship Education as a Means to Developing the 21st Century Engineer." 06/15-05/17. $249,944. PI: Huang-Saad.
7. *U-M Institute for Research on Women and Gender Faculty Seed Grant,* "Examining the Effect of Entrepreneurial Education Pedagogy on the Development of Women in STEM." 01/15-05/16. $10,000. PI: Huang-Saad.

Collaborators

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