Exploring the BME Instructional Incubator

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The BME Instructional Incubator: Looking Towards Change

The *What*

The Instructional Incubator is an experiential course that leads a cohort of students, post docs and faculty through the instructional design process. The course design addresses and is informed by learning theory and curriculum development best practices. At the beginning of the course, incubator participants interview stakeholders (e.g. BME undergraduates, practicing engineers, instructors) and learn about the current state of biomedical engineering in practice, including problems being solved, tools used, and expectations of new hires. Simultaneously, participants read and discuss literature on learning theories and pedagogical approaches. Insight gained from the interviews and discussed is used to create 1-credit "BME-in-Practice" modules to be taught the following semester.

Table 1. Outline of Instructional Incubator Design

Experiential Tuesdays	Discussion Thursdays
Phase I: Instructional Discovery	Active Learning
What is the current state of BME Curriculum?	Learning Theories
What are the constraints on BME Curriculum?	Pedagogy/Conceptual Change
What are the characteristics of strong instruction (Master Class observation)?	
Phase II: Introduction to Course Design	Pedagogical Content Knowledge
How do you design an exercise while taking into consideration:	Metacognition
• student learning	Classroom Discourse and Effective Questioning
• pedagogy	Collaborative Learning/Cooperative Learning
• misconceptions	
Phase III: Student Course Design	Problem/Project Based Learning
BME-in-Practice 1-credit module design	Assessment

The *Why*

- Active learning is recommended in research, but not actualized at an organizational level in instructional design
- Active learning is an umbrella term for several areas of research; it can be difficult to understand and enact without support
- Need: to create ways to support well-informed and engaged instructional design in engineering
- BME graduate students may not have experience with any instructional design due to research requirements (though it may be required in an academic position)
- The majority of graduate BME students do not enter academia
- Need: to connect BME students with more resources for teaching in academia and with career alternatives
- The goal of the BME Instructional Incubator is to address these needs with an experiential class that encourages increased participation in the engineering education community

Images from Discussion Classes

After the Instructional Incubator Pilot

Six new BME courses were created for sophomore students

Table 2. Current Courses Created

BME-In-Practice Course	Semester Offered
Introduction to Neural Engineering and Modeling	Winter 2018
Introduction to Medical Product Design, Prototyping and Testing	Winter 2018
Computational Cell Signaling: Roadmap to Drug Development	Winter 2018
Building a Tumor, an Introduction to Tissue Engineering	Winter 2018
Introduction to Medical Product Design Iteration and Validation	TBD
Biomechanical Design and Rapid Prototyping	TBD

Students expressed general satisfaction with the Instructional Incubator

- **Example feedback**: *"I really, really enjoyed the second half of this course. It was a great chance to be able to think about, synthesize and apply the teaching and learning theories that we had learned in the first half of the semester in both the final and the mock course design. I think it was this application that really helped me understand what we discussed in the first half of class."*

Initial Research on Instructional Incubator

Research Question

- What motivations for participating and conceptions of teaching and learning do graduate BME students articulate prior to engaging in the Incubator?

Methods

- Qualitatively assess student motivations and conceptions through preliminary, open-ended survey
- Descriptively code survey answers, then focus code surveys based on learning theory definitions

Initial Findings

BME graduate students enrolled in the incubator express a desire for educational change

- BME Graduate students were probed on their motivations for taking the course. 19/25 respondents expressed a desire for systemic educational change.
  Example Response:
    Response 1: "I'm interested in learning more about the current 'landscape' of engineering education and **how to improve how we teach engineers**, particularly in the design space"

BME graduate students describe learning in primarily cognitive ways

- BME graduate students were then probed on how they define the act of learning. In this exercise, 24/25 respondents spoke about learning in cognitive ways.
  Example Responses:
    Response 1: I would describe learning as the **assimilation of knowledge and problem solving.**
    Response 2: Learning is the process by which **one acquires the ability to physically or mentally process something** about the world that they were formerly unable to process, whether it be an action, idea, etc.

Future Work

- Iterating on the incubator design to include more teaching rehearsal
- Analyzing participant reflective beliefs across the incubator and into the course enactment
- Analyzing participant work and course design over time