

## **PERFORMING DESIGN RESEARCH IN CAPSTONE CLASSES**

**Joshua Summers**, Mechanical Engineering, Clemson University  
300 students/yr with 1 semester capstone design methods course and  
2<sup>nd</sup> semester capstone project course (3-4 parallel teams per project)

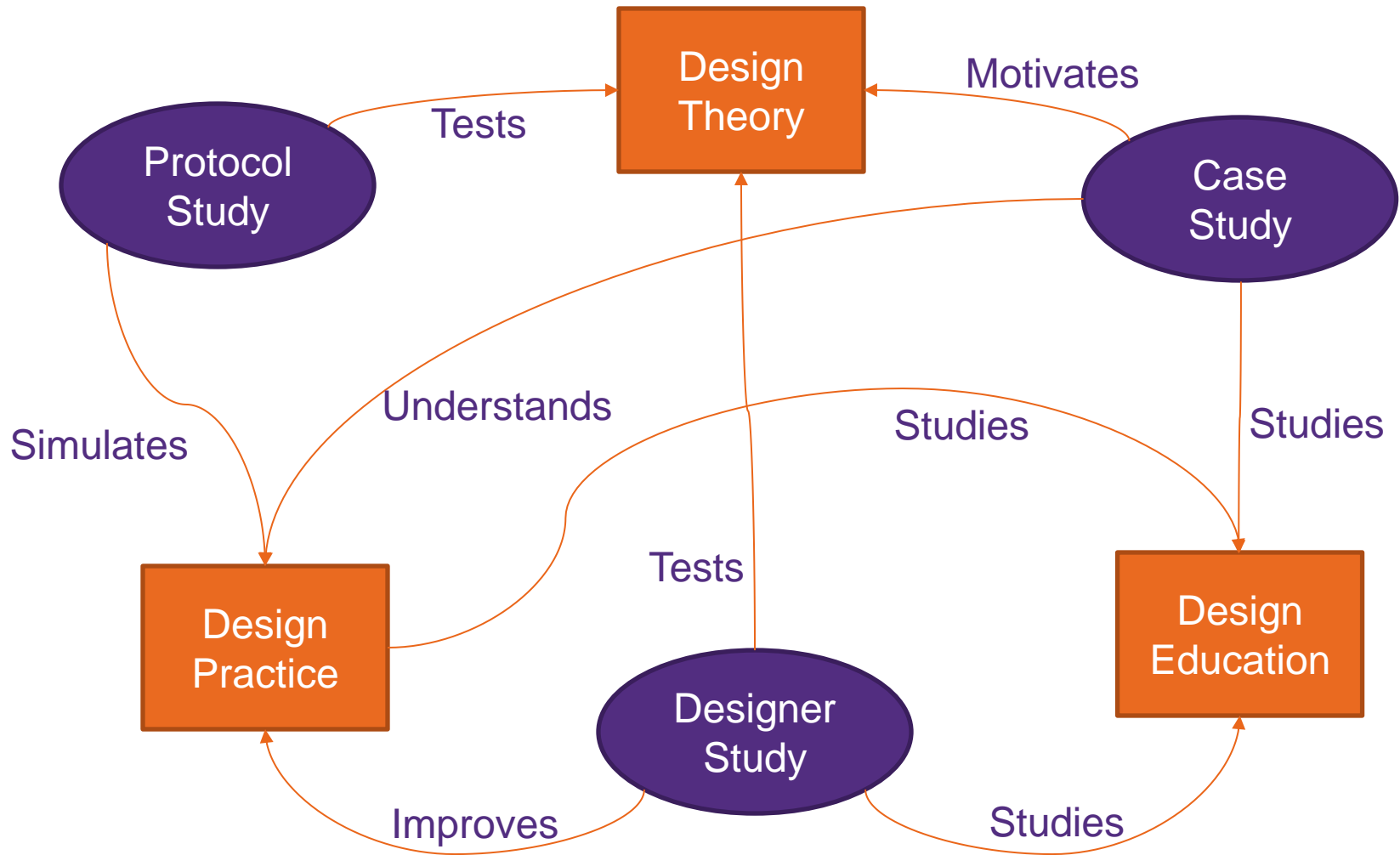
**Shraddha Sangelkar**, Mechanical Engineering, Penn State Behrend  
110 students/yr with 4 students per team on year long industry projects

**Mohammad Fazelpour**, Design Research Program for Undergraduates,  
University of Maryland

## Session Goals

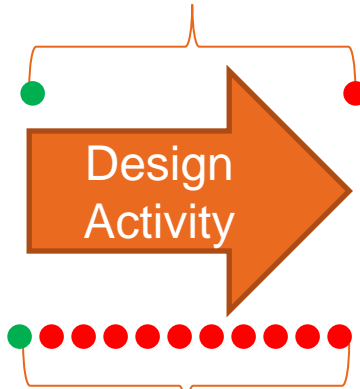
- Stimulate interest in using the capstone course as a laboratory for research (awareness of scholarship opportunities in what is often conceived of as a service course).
- Identify perceived barriers to doing research in the capstone environment.
- Share strategies for generating research results with small numbers of people/projects

# Design Research



# Research Methods

Designer Study  
(input controlled, output measured)



Protocol Study  
(input controlled, process studied)



Case Study  
(untampered)

# Method Choices

	Improve Practice	Improve Education	Develop Understanding
What happens?	Protocol Study Case Study	Case Study	Case Study Protocol Study
How do they relate?	Designer Study Protocol Study	Designer Study	Designer Study Protocol Study
How much does it influence?	Designer Study	Designer Study	Designer Study
Why?	Designer Study Protocol Study	Designer Study Protocol Study	Designer Study Protocol Study

# Overall Steps

- Define Motivation
- Define Research Goals (general questions, theoretical models)
- Select Research Method
- Refine Research Questions
- Develop Research Plan
  - How many individuals/teams needed (statistical power vs. deep context)
  - How long (1 class, 3 hours, 1 week, 1 semester, 1 year...)
  - How much control is needed to answer the question
  - How can you qualify the research (repeating another study, defining objective measures, triangulate...)
  - What data will be collected (concepts generated, verbal transcripts, email exchanges...)
  - How will data be analyzed (define rubrics a priori)
  - FMEA on research plan (what will go wrong?)
  - Submit IRB exempt requests based on plan
- Pilot study elements (high risk – check with “throwaways”, e.g., summer classes, graduate students, research labs)
- Do study
- Analyze results
- Disseminate (moral imperative for public institutions to share findings)

## Major Considerations

- Do I need to observe an entire development process?
- Are students surrogates for practitioners?
- Will my observations change the process?
- How will I use this understanding?
- Is this limited to this cohort, this discipline, this school?
- How much time will it take to code the gathered information?
  - Protocol (verbal) = 40:1
  - Protocol (behavior) = 10:1
  - Interview (transcription) = 20:1
  - Interview (coding) = 5:1
  - Document (sketch coding) = fast
  - Document (text coding) = medium
  - Document (semantic coding) = slow
- Who would like to know about this?