**What is engineering education research?**

Engineering research develops engineering principles, explores the phenomena associated with these principles and the scientific theories underlying them, and identifies ways that science can be applied to engineering processes. Engineering education research explores the educational environments in which these engineering principles are learned, and the experiences of students learning them.

Engineering education research leads to insights that not only help students to prepare for their professional futures, but also support faculty and institutions in designing more effective educational environments. In doing so, education research can enrich the types, quality, and innovativeness of engineering research.

**Data collection options in education research**

- In-depth interviews
- Secondary Data from Institutions
- Structured Observation
- Focus Groups
- Ethnography
- Individual Surveys

**Why individual surveys?**

- Resources – low cost and low time requirements
- Individualized information – consistency of data collected across individuals
- Scale – increases feasibility for large sample size data collection; increases scope for generalizability

**Our approach to survey design**

- Grounded in survey design research
  - Our choices reflect concepts such as “acquiescence” (bias towards responding in the positive when presented with agree/disagree, yes/no, or true/false opinion questions), “satisficing” (doing minimum amount to satisfy survey request, and nothing beyond this), and “stereotype threat” (being at risk for confirming negative stereotypes about groups to which we belong)
  - Survey timeline:
    - Initial design phase
    - Pilot phase launch
    - Revisions based on pilot
    - Launch survey

- Surveys are envisioned as conversations with participants, with sufficient opportunity for open-ended responses when fixed choice options may be too limiting or when respondents’ own words are preferred data

- Survey design choices included:
  1. Selecting item-specific response options rather than agree/disagree scales to minimize acquiescence (Krosnick, 1999; Saris, Revilla, Krosnick, & Shaef er, 2010):

- 2. Opting for longer response scales rather than yes/no questions to maximize variability in survey responses and minimize acquiescence (Krosnick, 1999):

- 3. Constructing questions to minimize acquiescence and avoid “satisficing” (Krosnick, 2000; Krosnick & Presser, 2010):

- 4. Placing questions about race and gender at the end of the survey, rather than at the beginning, to minimize stereotype threat (Danaher & Crandall, 2008; Steele & Aronson, 1995):

**Example survey: Engineering Majors Survey (EMS)**

- Launched in Winter 2015 to over 30,000 engineering juniors and seniors at 26 engineering schools across the U.S.
- Schools were selected using a stratified, quasi-random sampling design (i.e., we stratified the larger universe of U.S. engineering schools according to three key parameters, and quasi-random-sampled within each stratification “cell”)
- The EMS is an online, 10-minute questionnaire composed of 35 main questions (~160 survey items across these 35 questions)
- The EMS was designed around Social Cognitive Career Theory (SCCT) as a way to investigate predictors of engineering students’ career goals surrounding innovation
- This study was conducted with support from the National Center for Engineering Pathways to Innovation (Epicenter), a center funded by the National Science Foundation (grant number DUE-1125457) and directed by Stanford University and VentureWell

**Data Quality Control**

- Survey Fatigue – when respondents lose motivation and the quality of their answers deteriorates

  - Participants may answer a majority of questions with “N/A” or “I prefer not to answer” responses
  - Straight-line responses (choosing answers down the same column)

- Questions may include alternate wording to test for consistency among responses throughout the survey. The percentage of nonresponses, partials, “prefer not to answer”, and straight-line responses are taken into account when cleaning the data.

**Response Rates**

- Response rate – percentage of people who completed the survey out of the sample size

  - Rates vary depending on the type and medium of the survey. There has been a decline in response rates over time. Now, an average rate can fluctuate around 20%.

  - For the Engineering Majors Survey, response rates ranged from 12% to 100%

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