Opportunities in Statistics Education Research

Beth L. Chance

Cal Poly – San Luis Obispo

(bchance@calpoly.edu)

Why you might want to

- Improve your teaching
- Synergy with classroom teaching
- Collaboration
- Grant, publication, conference opportunities

Why you might not want to

- Distracts from research agenda for tenure
- Less "stature"?
- Requires some retraining and background reading
  - Educational psychology
  - Qualitative research
  - History across multiple disciplines

Start with

- Theory on how students learn
- Theory on how students learn statistics
  - Garfield (1995), Garfield & Ben-Zvi (2007)
  - Constructivism
    - *Active learning increases student performance in science, engineering, and mathematics*, Freeman et al (*PNAS,* 2014)
  - Learning with technology
  - Assessment (Eliciting student understanding)

Resources

- *Handbook of Research Design in Mathematics and Science Education*
  - Kelly and Lesh, Eds. (2000)
- *International Handbook of Research in Statistics Education*
  - Ben-Zvi, Makar, and Garfield, Eds. (2018)
- CAUSEweb.org
  - https://www.causeweb.org/cause/research

Start with

- *Journal of Statistics Education, Statistics Education Research Journal, Technology Innovations in Statistics Education, Teaching Statistics*
- What has been done before?
- What are the open questions?
- How can I contribute?

Start with

- Approach individuals in the field
- Form collaborative networks
  - USCOTS research clusters
  - Colleagues in education
  - Senior colleagues

First project?

- Did this work in my classroom?
  - Quantitative data
  - Qualitative data (focus on process, not just final grades)
  - How does this relate to past work, what can be learned moving forward
- Does this work in different types of classrooms, with different types of students?

Research Techniques

- Randomized comparative experiments
  - *Using statistics effectively in mathematics education research* (Scheaffer et al., 2007)
- Cautions
  - long vs. short-term
  - confounding variables
  - realism
  - time delays
  - ethical issues
  - external perspective

Qualitative Research

- *SERJ* special issue: Qualitative approaches in statistics education research (Nov. 2010)
- Standards
  - Validity
  - Generalizability
  - Reliability
  - Objectivity
- Consistent, Replicable, Well-documented, Fair and equitable

Classroom-Based Research

- "Teachers researching their own practice of teaching."
  - Feldman & Minstrell in Kelly & Lesh (2000)
- "It is most simply defined as ongoing and cumulative intellectual inquiry by classroom teachers into the nature of teaching and learning in their own classrooms."
  - Cross and Steadman (1986)

Classroom-Based Research

- Narrows gap between theory and practice
  - direct link to classroom environment
- Further insight into classroom, students
  - combined with nonparticipant viewpoint
- Dynamic
- Open to alternative student interpretations
- Focus on process

Human Subjects

- Talk to your institution's Institutional Review Board (IRB)
  - Exemption?
    - https://content-calpoly-edu.s3.amazonaws.com/research/1/documents/Research%20Decision%20Chart%20Nov18rev.pdf
    - https://www.nsf.gov/pubs/2007/nsf07006/nsf07006.jsp
    - https://www.nsf.gov/bfa/dias/policy/human.jsp

Some Current Questions

- Expert vs. Novice
- Student experience vs. instructor demonstration
- Large classes
- Analyzing student interaction with technology
- Preparation of future teachers
- Retention
- Student attitudes
- Statistics vs. Data Science

Some Current Efforts

- Service learning (e.g., Doehler; Nordmoe; Hydorn; Phelps), Experiential learning (e.g., Morris)
- Context-driven statistics (e.g., Dierker, ProCivicStats, Strengthening Data Literacy across the Curriculum)
- Beyond the first course (e.g., Kuiper; Tintle et al.; Chihara & Hesterberg; Nolan)
- Connections to ed research (e.g., Son & Stigler)
- Assessment, Adaptive testing (e.g., Beckman; Sabbag; Broaddus; Cheng)
- Interdisciplinary collaboration (e.g., STUB)

Advice – Designing a Lesson

- What are the learning goals?
  - What are common student difficulties
- How will I assess whether students have met those goals?
- How does it connect to content before/after this lesson?
- What is an engaging context?
- How/when do I actively engage the students
  - Directly confront student difficulties
- Will technology be helpful?
- Immediate reflection

Advice – Designing a Research Question

- What is my audience?
- What are the learning goals?
  - What are common student difficulties
- What do I plan to do differently?
  - What are my preconceptions?
- How does it connect to prior research?
  - Review for a journal (including *JRME*, *MTL*)
- How will I assess whether students have met those goals/whether it works?

Advice – Designing a Research Study (Grant)

- Familiarize yourself with the research, assessment tools
  - NSF Award Search
- Connect with others across institutions, disciplines, generations
  - Share proposals
- Talk with program officer
- Initial "seed" grant

NSF Grant Funding Opportunities

- Improving Undergraduate STEM Education (IUSE, formally TUES)
  - Computing in Undergraduate Education
- Advancing Innovation and Impact in Undergraduate STEM Education at Two-year Institutions of Higher Education
- Faculty Early Career Development Program (CAREER)
- Innovative Technology Experiences for Students and Teachers

NSF Grant Funding Opportunities

- The IUSE program (formerly TUES) at the National Science Foundation supports curricular innovation, experimentation, and implementation

Track	Level
Engaged student learning	Level 1/Level 2/Level 3
Institutional and community transformation	Capacity building/Level 1/Level 2

Conferences

- JSM
  - Section on statistics and data science education
- USCOTS
- ICOTS
  - The best locations! (Rosario, Argentina, 2022)
- MathFest, NCTM, ICTCM…
- Colloquia

Summary

- Look to history
- Importance of collaboration
  - Student involvement
- Not all randomized experiments
  - Qualitative research, Think-aloud protocols, Learning trajectories, Classroom-based research
- New measurement tools
- Not only about students
  - Teacher preparation
  - Role of technology in teaching
  - Integration with data science, other disciplines

Any Questions?

- bchance@calpoly.edu
- Or if you want more complete reference citations…