Educational Research on Teaching: Integrating your Research and Teaching Programs

Tuesday July 30th
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Questions to answer for this session:
- What are examples of educational research and how does that relate to the kinds of research one can do?
- What are resources to help one get started?
- What questions can I answer about my own classroom?

Kinesthetic continuum
- On a line from curious about how the research can inform your teaching to already practicing educational research, put yourself where you currently see yourself.
- Now move to where you would like to see yourself (or stay still if you are content with your current location). Talk with your neighbors:
  - What questions do you have?
  - What are some of the challenges of getting to where you'd like to be on this continuum?

Evidence for Active Learning?
10.1073/pnas.1319030111

Evidence for Active Learning?

Active learning can close equity gaps

Evidence for Active Learning?

Peer Instruction improves learning

Strength of Evidence Pyramid

Brainstorm with your neighbor(s):

• How is research on learning similar to and different from traditional geoscience research?

Similarities to Geoscience Research:
• Answering significant and interesting questions
• Testing hypotheses (often with experiments)
• Collecting data via observations
• Interpreting large, incomplete data sets (sometimes using statistical analyses)
• Inferring process and cause from observed behaviors
• Collaborating with scientists in other fields
• Data only good if instrument is calibrated/valid and reliable
• Qualitative vs. quantitative
• Theoretical vs. applied

Differences from Geoscience Research:
• Human subjects!
  – IRB (Institutional Review Board)
  – So many possible confounding factors....
• Your classroom may be your laboratory
• How you collect data
  – Instruments used
• Attitude of other faculty/administrators
• Less professional support

Getting Started
• Read the science education literature & other key meta-studies
• Go to research on learning sessions at conferences (e.g. GSA)
• Read successful educational research proposals

A Community Framework for GER
nagt.org/209169
Example Future GER Projects

- Conceptual understanding of Environment, Ocean, Atmosphere, Climate:
  - **Grand Challenge 1**: How do we identify and address the challenges to conceptual understanding specific to each discipline: environmental science, ocean sciences, atmospheric sciences and climate science?
  - **Grand Challenge 2**: How do we teach complex interconnected Earth Systems to build conceptual understanding of, for example, climate change?
  - **Grand Challenge 3**: What approaches are effective for students to understand various models (numerical and analytical) that are used for prediction and research in atmospheric, oceanic, and climate sciences, including model limitations?
  - **Grand Challenge 4**: How do the societal influences, affective elements, personal background and beliefs, and prior knowledge impact students conceptual understanding of Earth system sciences?

Grand Challenge 1 Research Projects

- Literature review of what we already know from student conceptions, across different populations
- Identify the most common barriers to conceptual understanding including misconceptions and pre-conceptions

Grand Challenge 2 Research Projects

- Identify examples from other disciplines (e.g., physics) that can provide context for future research on conceptual change
- Testing instructional strategies that have shown impact on learning to a broad range of learning environments and populations
- Examine the learning progression research from K-12 literature to inform GER strategies for implementing curriculum that works to develop student understanding of complex Earth systems
- Study how conceptual understanding evolves from intro to upper level courses within different programs and how we should prepare geoscience majors for graduate school and the profession.

Grand Challenge 3 Research Projects

- Work with the cognitive spatial and temporal reasoning and cognitive problem solving, quantitative reasoning and models communities to apply their work to the fluid Earth community
- Expand current research on learning impacts of various models
- Research students’ attitudes towards models and modeling, and the efficacy of different approaches to stimulate students’ interest in learning about models.

Grand Challenge 4 Research Projects

- Use research-based evidence in developing curriculum and formal and informal instructional guides for instructors on how to teach controversial topics like climate change
- Work to better understand the efforts and agenda of groups that work to undermine understanding of anthropogenic climate warming in order to inform students about the misinformation
- Connect with social scientists who are doing similar work to broaden the impact of reach of the research and assure multiple disciplinary perspectives are considered

Your own practice

- Spend a few minutes coming up with a small research question you can implement next year.
  - What question do you want to answer? What is something you’d like to know about your students/your practice?
  - What are the next steps to answer this question? Develop an action plan and time frame
  - Who/what are some resources you may want to consider to help you?
Other Resources


Ready to publish? Some tips

- Strategies for aspiring authors for “Journal of Geoscience Education”
  - Do your homework, and put your work in literature-based context.
  - Provide a well-defined purpose with methods that are appropriately explained and applied.
  - Description of the study setting and population
  - Evidence of effectiveness is essential to a strong argument: conclusions need to be evidence-based with validity and reliability
  - Do not just report results; discuss why they are meaningful both to your particular situation and more broadly.
  - Have IRB approval

**Remember, you don’t have to do this alone: don’t be afraid to collaborate**


- Strategies for aspiring authors of “In the Trenches”
  - Document your experiences with new teaching methods in an informative, accessible, and entertaining way
  - Share your thoughts about teaching and interesting ideas — start a trend!
  - Share your photos with the NAGT community (or have your students share their photos)