

Educational Research on Teaching: Integrating your Research & Teaching



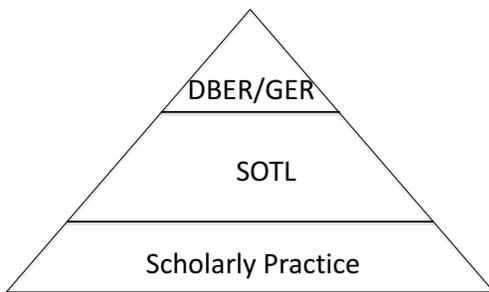
Tuesday July 24th
Kaatje Kraft

with contributions from Karen Kortz, Carol Ormand, and Cindy Shellito

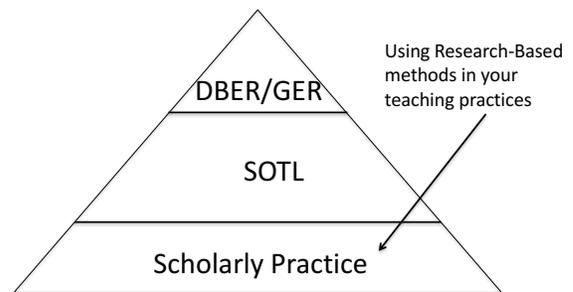
Questions to answer for this session:

- What is this learning alphabet soup?
- How does research on learning compare to traditional geoscience research?
- How does one get started conducting research on learning?
- What questions can I answer about my own classroom?

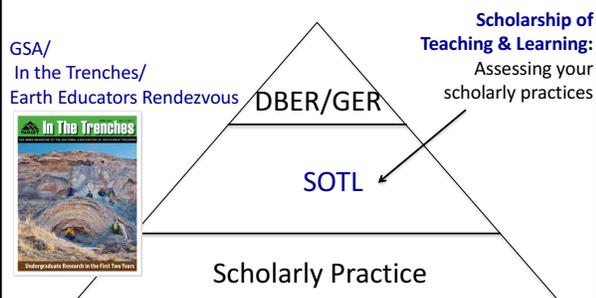
Welcome to the Alphabet Soup...



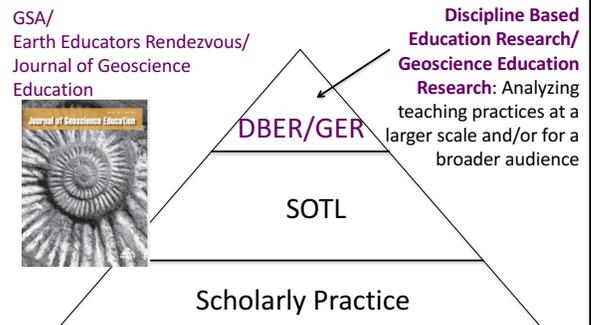
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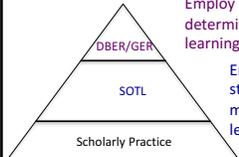


Welcome to the Alphabet Soup...



Revisit Scenario 2 from Monday's Session

How might you go about testing how to improve your instruction?



Employ Reading Apprenticeship (RA) model within the framework of motivational theory of expectancy x value. Employ intervention strategies in more than one classroom, determine how RA impacts learning gains and motivation of learning.

Employ Reading Apprenticeship model, but test students comprehension of one article without the method and one with, determine if there are learning gains.

Employ reading strategies that others have found to be effective (e.g., Reading Apprenticeship): Great starting point is serc.carleton.edu

Kinesthetic continuum

- On a line from Scholarly practitioner to DBER, put yourself where you currently see your practice.
- 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 do you see as the challenges of getting to where you want to be/where you are?
 - What questions do you have?

DBER: Discipline Based Educational Research

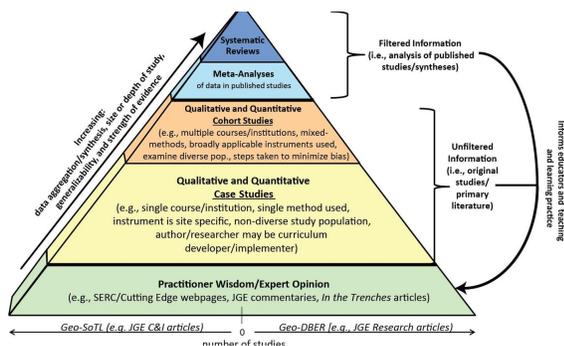
- Understand how people learn the concepts, practices, and ways of thinking of geoscience
- Understand the nature and development of expertise
- Identify and measure learning objectives and instructional approaches
- Contribute to the knowledge base to transfer DBER findings to classroom practice
- Identify approaches to make geoscience education broad and inclusive

Singer et al., (2012) Discipline Based Education Research, National Academies Press.

Theoretical vs. Applied Research

- Theoretical (Research)
 - The cognitive processes underpinning perception, understanding, learning
 - Metacognition, affect (motivation, emotions, interest), place-based learning
 - Programmatic analysis
- Applied (Curriculum and Instruction)
 - The links between classroom experiences and learning
 - Application of research to developing and implementing new educational tools or materials to enhance learning

Strength of Evidence Pyramid



From St. John and McNeal, 2017. JGE, 65(4), 363-372. <https://doi.org/10.5408/17-264.1>

Determine if the following research questions are Theoretical or Applied

1. Do students learn concepts better if they have illustrations or animations?
2. How do spatial visualization skills affect learning?
3. How do students move from novices to experts, from pre-college to professional geoscientists?
4. What is the effectiveness of process-of-science labs?
5. How does student motivation influence learning in the classroom?

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)
 - St. John, K. (2016) JGE 64(2) 99-100.
 - 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

- Identify a question that intrigues you
 - What do you want to know about the learning process?
 - What do you want to know about what works in your own classes?
- Watch your students and where/why/who struggles
- Most faculty start with applied research



Getting Started

Read the science education literature & other key meta-studies

Go to research on learning sessions at conferences (e.g. GSA) into

Read successful educational research proposals

<http://nagt.org/nagt/geoderechsearch/toolbox/index.html>

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



Quick Ideas

- Spend a few minutes coming up with a small research project you can implement next semester.
 - What question do you want to answer?
 - What methods will you use to answer your question?
 - How will you collect data?

Other Resources

- St. John, K (Ed.) (2018). A Community Framework for Geoscience Education Research. National Association of Geoscience Teachers: https://nagt.org/nagt/geoedresearch/GER_framework/index.html
- GER Toolbox: <http://nagt.org/nagt/geoedresearch/toolbox/index.html>
- Earth & Mind Blog: <https://serc.carleton.edu/earthandmind/index.html>
- Discipline Based Education Research Report (2012): <https://www.nap.edu/catalog/13362/discipline-based-education-research-understanding-and-improving-learning-in-undergraduate>
- Outcome of DBER Report (2015): <https://www.nap.edu/catalog/18687/reaching-students-what-research-says-about-effective-instruction-in-undergraduate>