

# Shaping the Future of Geoscience Education Research: A Community Effort

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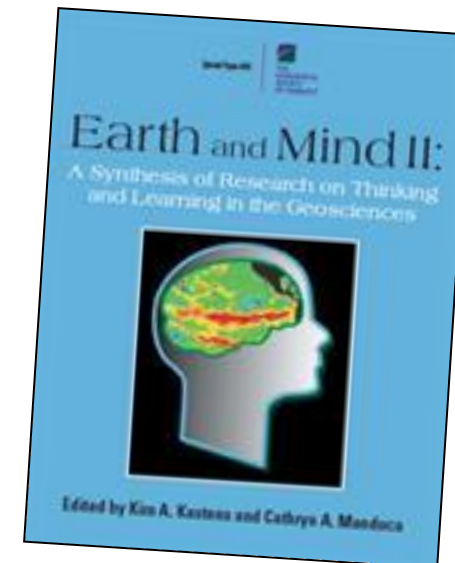
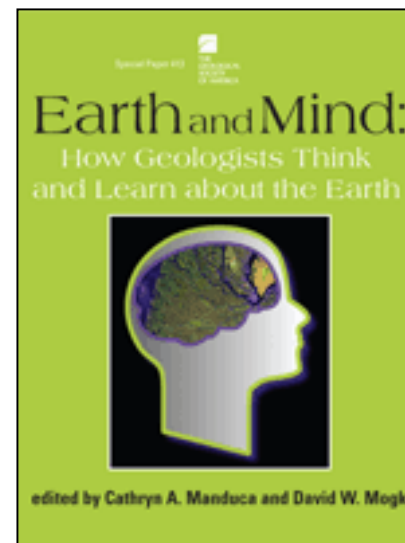
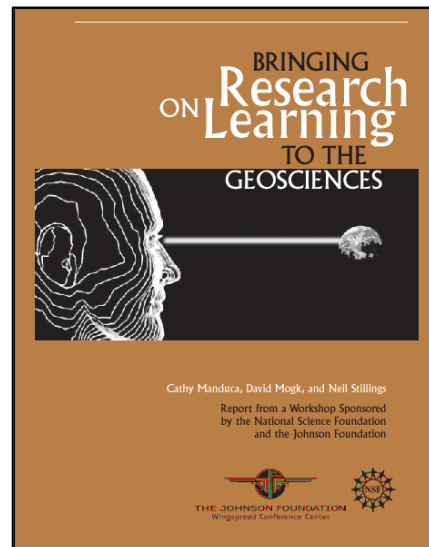
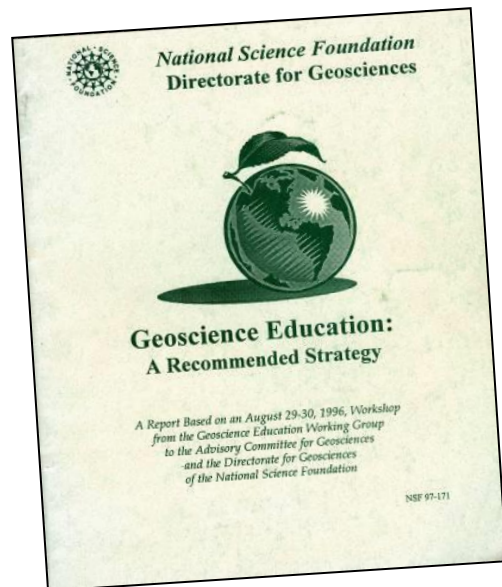
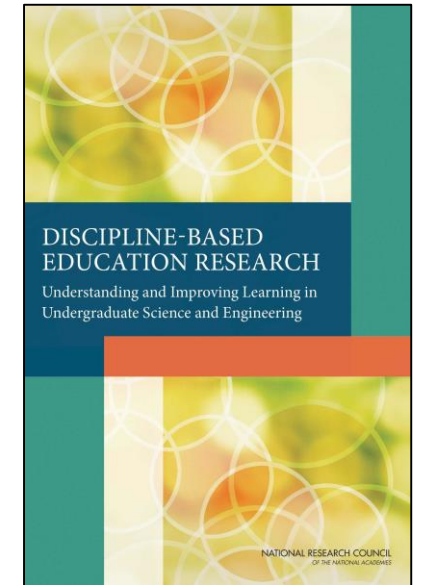


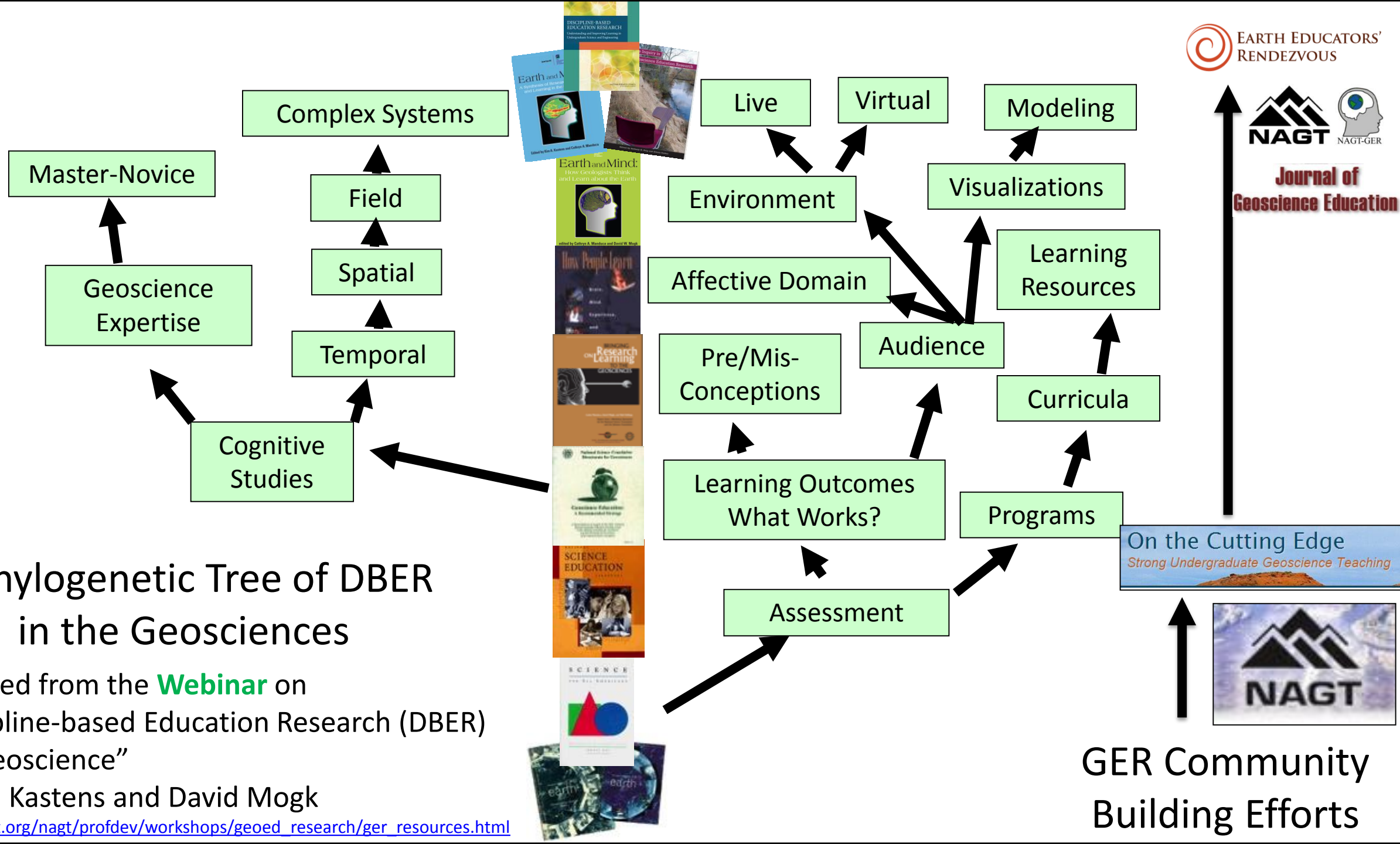
This project is funded by the **National Science Foundation** under grant DUE-1513519, *Shaping the Future of Geoscience Education Research: Synthesizing Results and Articulating Future Directions*.



# Project Goals

- Characterize the current state of geoscience education research (GER).
- Identify community needs, and make recommendations to build a stronger GER community.
- Facilitate the next steps in GER.
- Build on recent reports on Discipline-Based Education Research (DBER), as well as previous education and geoscience education research and synthesis efforts.
- Provide opportunities for broad GER community input.





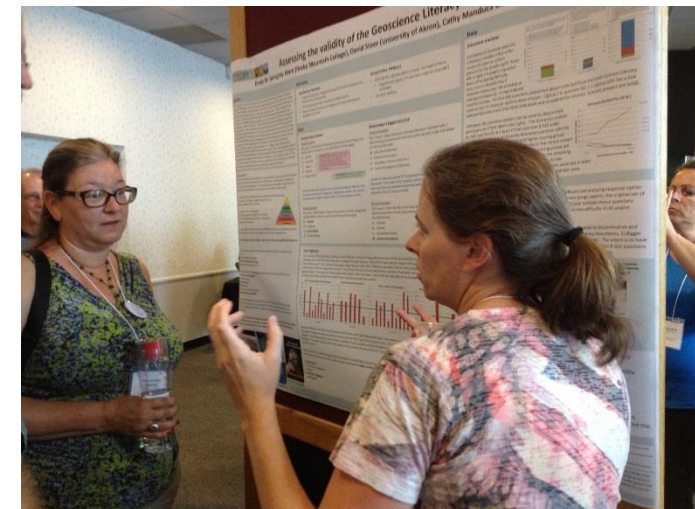


# EARTH EDUCATORS' RENDEZVOUS

JULY 2015

UNIVERSITY OF COLORADO

- Our workshop: *Synthesizing Geoscience Education Research: Where are we? What is the path forward?*
- Oral and poster sessions: Geoscience Education Research
- Other workshops and mini-workshops
- Evening Town Hall on GER





# Develop a GER Workshop Program that Builds on DBER

<b>DBER long-term Goals</b> (from p. 9 of Singer et al., 2012)	<b>DBER <span style="color: purple;">established</span> or <span style="color: green;">emerging</span> Topical Areas</b> (from p. 55 of Singer et al., 2012)
Understanding how people learn concepts, practice, and ways of thinking.	<span style="color: purple;">Studies on students' conceptual understanding [Ch 4]</span>
	<span style="color: purple;">Studies on students' problem solving and use of representation [Ch 5]</span>
	<span style="color: green;">Metacognition [Ch 7]</span>
Understanding the nature and development of expertise in a discipline	
Help ID and measure appropriate learning objectives and instructional approaches that advance students towards those objectives	<span style="color: purple;">Studies of instructional strategies to improve science and engineering learning [Ch 6]</span>
Contribute to the knowledge base in a way that guides translation of DBER finding into classroom practice	<span style="color: green;">Science and engineering practice [Ch 7]</span>
	<span style="color: green;">Applying knowledge in different settings (translation) [Ch 7]</span>
ID approaches to make science and engineering education broad and inclusive	<span style="color: green;">Students' dispositions and motivations to study science and engineering [Ch 7]</span>

# Develop a GER Workshop Program that Builds on DBER

Project Research Questions			DBER long-term Goals (p. 9 of DBER report)	DBER report <b>established</b> or <b>emerging</b> Topical Areas (p. 55 of DBER report)	Workshop Working Group Topics
<b>Research question #1:</b> What is geoscience education research?	<b>Research question #3:</b> What are the key findings of geosci ed research in various topical areas, and what is their strength of evidence?	<b>Research question #4:</b> What methods are used to conduct geosci ed research, both qualitative and quantitative? What methods are appropriate for different types of questions?	Understanding how people learn concepts, practice, and ways of thinking.	Studies on students' conceptual understanding [Ch 4]	<ul style="list-style-type: none"> <li>Conceptual understanding</li> <li>System thinking/complexity               <ul style="list-style-type: none"> <li>Geocognition and understanding of complex earth systems, misconceptions and preconceptions about the Earth system</li> </ul> </li> </ul>
				Studies on students' problem solving and use of representation [Ch 5]	<ul style="list-style-type: none"> <li>Temporal reasoning</li> <li>Spatial reasoning/visualization               <ul style="list-style-type: none"> <li>Teaching with models and visualizations; role of figures and animations in earth-science learning</li> </ul> </li> <li>Problem-solving</li> </ul>
				Metacognition [Ch 7]	
			Understanding the nature and development of expertise in a discipline	No clear topical match?	<ul style="list-style-type: none"> <li>The nature of geoscience expertise: novice-expert conceptions               <ul style="list-style-type: none"> <li>Learning in the field setting; understanding the knowledge and skills that geoscientists use when working on complex, field-based problems and the novice-expert continuum</li> </ul> </li> </ul>
			<b>Research question #2:</b> What constitutes "good understanding" by undergrad students in geosci? What are the "metrics of success"?	Studies of instructional strategies to improve science and engineering learning [Ch 6]	<ul style="list-style-type: none"> <li>The effectiveness of teaching methods and strategies; assessing the impact of classroom interventions on learning in large lecture and lab settings; the role of technology in geoscience instruction; ways to improve geocognition</li> <li>Effectiveness of research and research-like experiences</li> </ul>
		<b>Research question #5:</b> How can we translate research results into practice? And how can we use practitioner wisdom and experience to inform research?	Contribute to the knowledge base in a way that guides translation of DBER finding into classroom practice	Science and engineering practice [Ch 7] Applying knowledge in different settings (translation) [Ch 7]	<ul style="list-style-type: none"> <li>Recruitment and retention, time to degree; successful strategies</li> </ul>
			ID approaches to make science and engineering education broad and inclusive	Students' dispositions and motivations to study science and engineering [Ch 7]	<ul style="list-style-type: none"> <li>Cognition and the affective domain               <ul style="list-style-type: none"> <li>K-12 teacher preparation?</li> </ul> </li> <li>Geoscience education research focused on target audiences; diversity and inclusion</li> <li>Place-based and cross-cultural geoscience learning</li> </ul>

**Research question #6:**  
What are recommendations for future research directions across geosci ed research and ways to support such efforts?

# Workshop Overview

## Monday: What is the scope of geoscience education research?

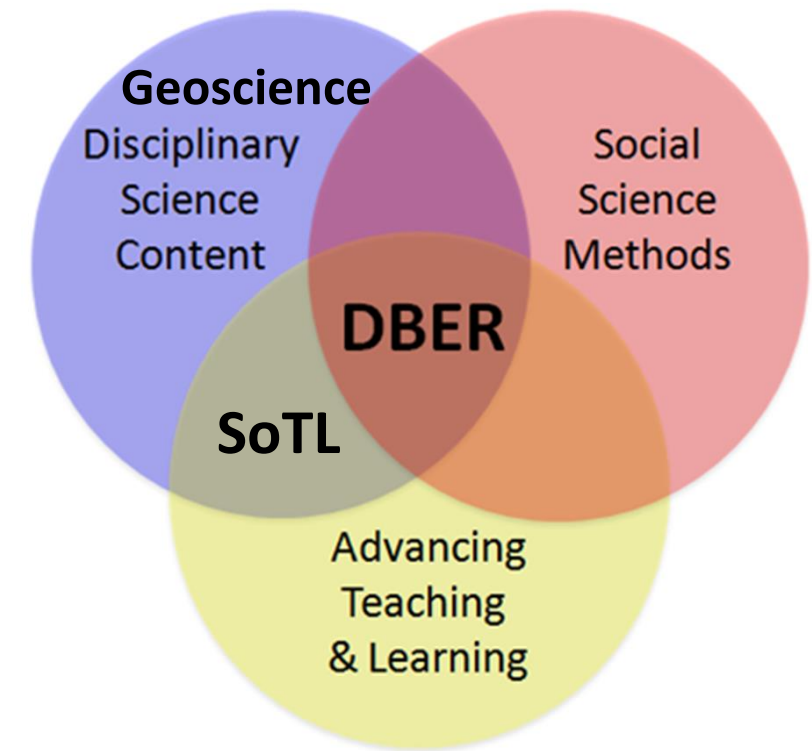
- Scope of geoscience education research (GER) and how it can be used
- Evaluating the strength of GER results  
→ **community claims must be evidence based**

## Tuesday: What do we know, what do we want to know, what do we need to move the field forward?

- Identifying outcomes, gaps, and next steps for topical areas within GER

## Wednesday: What are future directions and priorities of GER?

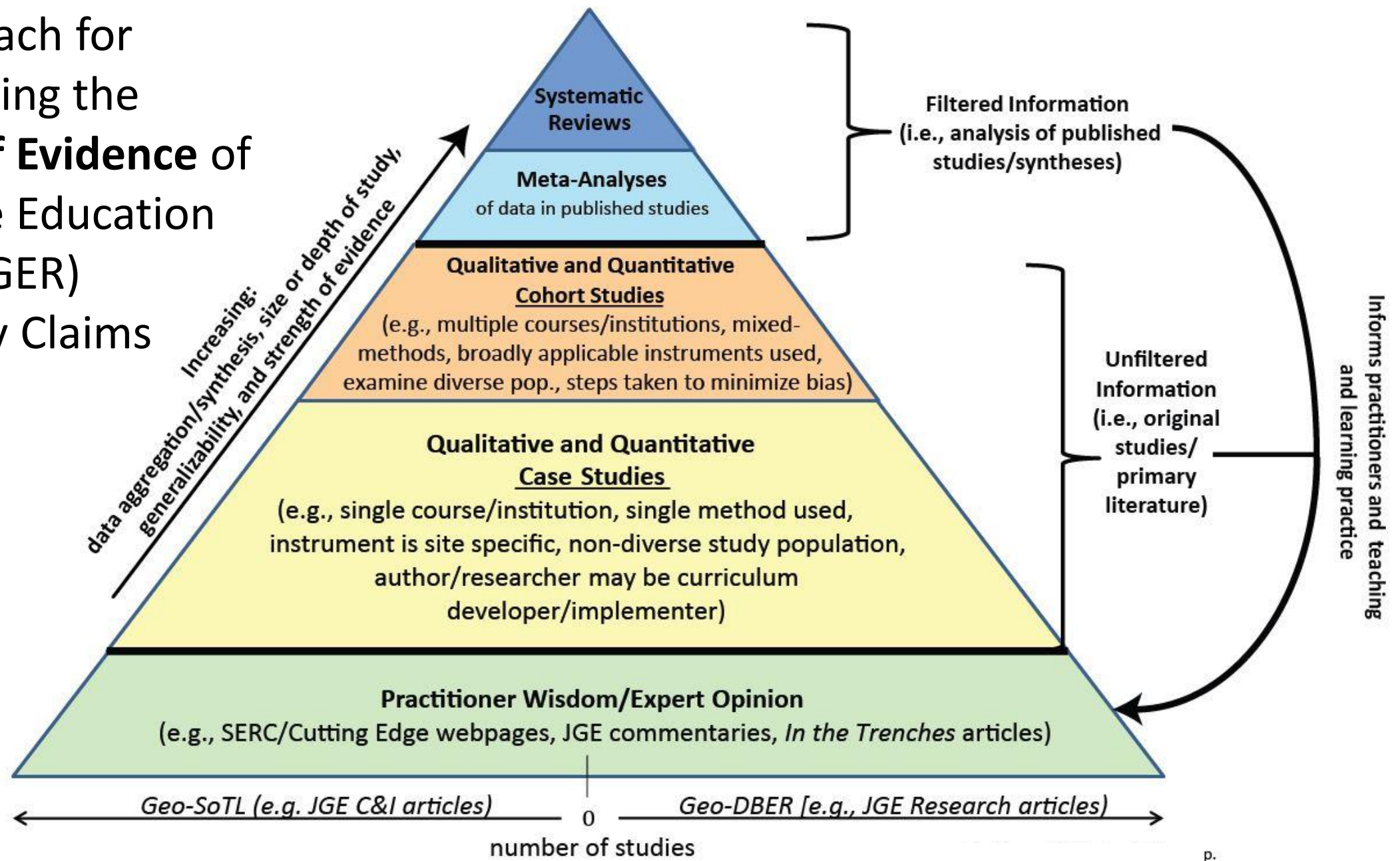
- Shaping the future of GER and the GER community
- Next steps for GER: Community recommendations and action plans



**SoTL** = scholarship on teaching and learning

Modified from Dolan et al.,  
(in revision; figure adapted  
from Lukes et al., 2015)

# One Approach for Characterizing the **Strength of Evidence** of Geoscience Education Research (GER) Community Claims



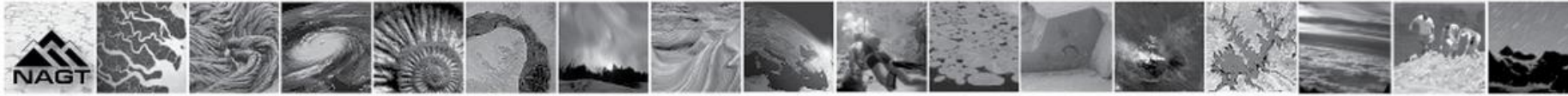


# What do we know? What do we want to know? What do we need to move the field forward?

Topical areas of work in GER (that overlap/intertwine)

1. Students' conceptual understanding
2. Cognitive domain and problem-solving
3. Instructional strategies to improve geoscience learning
4. Affective domain / students' self-regulated learning / metacognition
5. The nature of science / the nature of geoscience
6. Access and success
7. Professional development of college/university educators





# Journal of Geoscience Education

<http://nagt-ige.org/>

## Theme Issue Call for Papers

### *Synthesizing Results and Defining Future Directions of Geoscience Education Research*

**Objective:** To compile a collection of articles that describes the evolution, current status, and future directions of Geoscience Education Research (GER), with a focus on undergraduate education and the community of practice among GER workers.

Example topics that fit this theme:

- **Commentaries** that set priorities for promoting and supporting the GER research community
- **C&I papers** on translating research results into practice
- **Research papers** on cognitive domain and geoscience problem-solving
- **Literature Review articles** that synthesize best practices for research methodologies

#### **Deadlines:**

- Letter of Intent: December 1, 2015
- Manuscript Submission: August 31, 2016

# What are future directions/priorities for GER?

Break-out groups:

1. How to better support those interested in *becoming* geoscience education researchers?
2. How to better supporting those already in the GER field?
3. Developing basic skills “toolbox” for those new to GER
4. Developing/deploying research skills for established/advanced GER workers
5. Metrics of geoscience major student success? General education student success?
6. How to better translate research results into educational practice?
7. Exploring the possibility of a community research agenda

# Emerging Themes

## to Support and Strengthen the GER Community

- ☐ Mentoring by active/senior geoscience education researchers
- ☐ Identify/Share/Develop appropriate instruments to address research questions in GER
- ☐ Identify/Share/Develop best practices in quantitative & quantitative GER research methodologies
- ☐ Develop/Compile a GER resource “Toolbox”
- ☐ Access/Analyze past GER results → Write Literature Reviews & Develop a GER data repository
- ☐ Identify Common “Core” Curricula for GER graduate education
- ☐ Strategic “Outreach” to non-GER colleagues on the value and importance of GER to geoscience education practice
- ☐ Collaborate-collaborate-collaborate, and include social scientists



**A Community Level Action Plan**