Fundamentals of Educational Research

in partnership with
Rigorous Research in Engineering Education Initiative
(DUE 0817461)
CLEERhub.org

ASEE/IEEE Frontiers in Education Conference – October 27, 2010 – W1A – 11:00 am – 2:00 pm

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Overview

What are we going to do?

- **Welcome and introductions**
- **Topics of the workshop**
  - Background and context
  - Features of engineering education research
  - Research questions and methodologies
  - Print and online resources
  - Global communities and their networks
- **Format of the workshop**
  - Interactive and team-based work

Workshop frame of reference

- **Workshop is about**
  - Identifying faculty interested in engineering education research
  - Deepening understanding of engineering education research
  - Building engineering education research capabilities
- **Workshop is NOT about**
  - Pedagogical practice, i.e., “how to teach”
  - Convincing you that good teaching is important
  - Writing engineering education research grant proposals or papers
  - Advocating all faculty be engineering education researchers

Levels of inquiry in engineering education

- **Level 0** Teacher
  - Teach as taught
- **Level 1** Effective Teacher
  - Teach using accepted teaching theories and practices
- **Level 2** Scholarly Teacher
  - Assesses performance and makes improvements
- **Level 3** Scholar of Teaching and Learning
  - Engages in educational experimentation, shares results
- **Level 4** Engineering Education Researcher
  - Conducts educational research, publishes archival papers

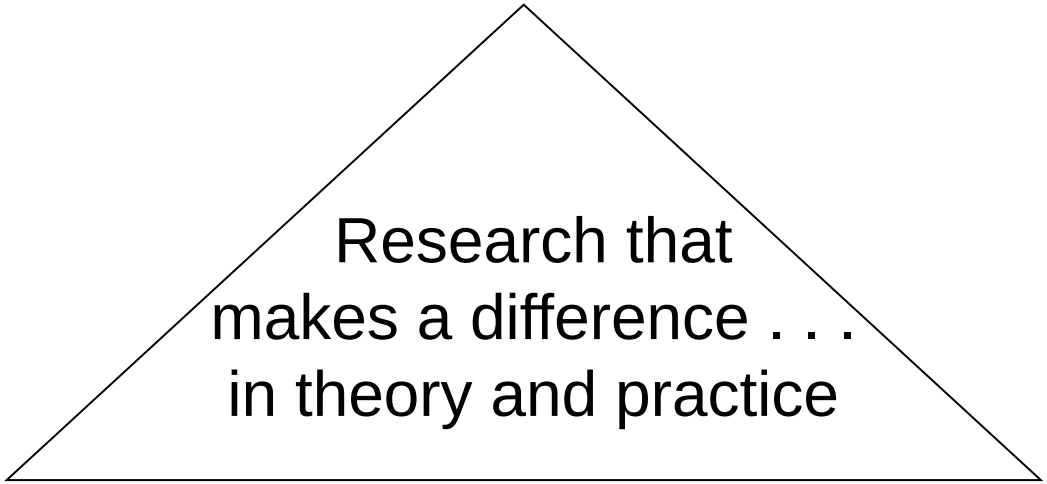
Source: Streveler, R., Borrego, M. and Smith, K.A. 2007. Moving from the "Scholarship of Teaching and Learning" to "Educational Research:" An Example from Engineering. *Improve the Academy,* Vol. 25, 139-149.

Some history about this workshop

- **Rigorous Research in Engineering Education (RREE1)**
  - One-week summer workshop, year-long research project
  - Funded by National Science Foundation (NSF), 2004-2006
  - About 150 engineering faculty participated
- **Goals**
  - Identify engineering faculty interested in conducting engineering education research
  - Develop faculty knowledge and skills for conducting engineering education research (especially in theory and research methodology)
  - Cultivate the development of a Community of Practice of faculty conducting engineering education research

RREE Approach

Theory
(study grounded in theory/conceptual framework)



Research
(appropriate design and methodology)

Practice
(implications for teaching)

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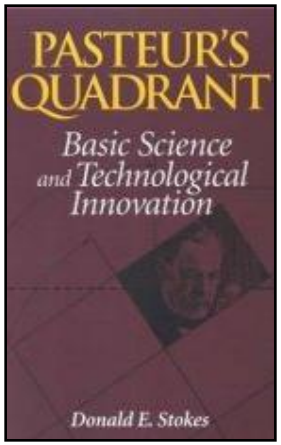
http://inside.mines.edu/research/cee/ND.htm

Research can be inspired by …



Understanding (Basic)	Use (Applied): No	Use (Applied): Yes
Yes	Pure basic research (Bohr)	Use-inspired basic research (Pasteur)
No		Pure applied research (Edison)

Source: Stokes, D. 1997. Pasteur's quadrant: Basic science and technological innovation. Washington, DC: Brookings Institution.

RREE2

Follow-up proposal has been awarded (RREE2)

- Includes a series of 5 short courses*
  - Fundamentals of Engineering Education Research
  - Selecting Conceptual Frameworks
  - Understanding Qualitative Research
  - Designing Your Research Study
  - Collaborating with Learning and Social Scientists

*To be recorded and posted on the CLEERhub.org

Today's objectives

1) Identify principal features of engineering education research
2) Frame and situate research questions and methodologies
3) Gain familiarity with several print and online resources
4) Become aware of global communities and their networks

What does high-quality research in your discipline look like?

- What are the **qualities, characteristics, or standards** for **high-quality** research in your discipline?
- Think of it this way: "**Research in my field is high-quality when….**"

☞ Individually, list the qualities, characteristics or standards in your discipline

☞ Compare your lists, and as a group, develop a list of high-quality research qualities, characteristics or standards

What does education research look like?

- What are the **qualities, characteristics, or standards** for **high-quality education** research in your discipline?

Individually, list:

1) Which qualities, characteristics, or standards identified so far DO NOT apply?

2) What qualities, characteristics, or standards can you envision that are DIFFERENT for education research?

As a group, combine your lists.

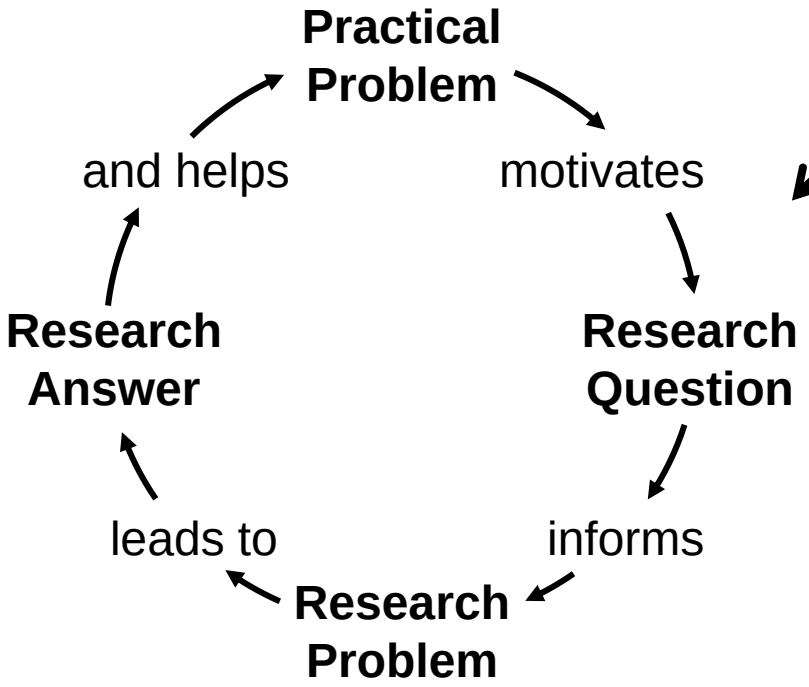
Guiding principles for scientific research in education

1. Pose **significant questions** that can be investigated **empirically**
2. Link research to relevant **theory**
3. Use **methods** that permit **direct investigation** of the question
4. Provide coherent, explicit chain of **reasoning**
5. Replicate and **generalize** across studies
6. Disclose research to encourage professional **scrutiny and critique**

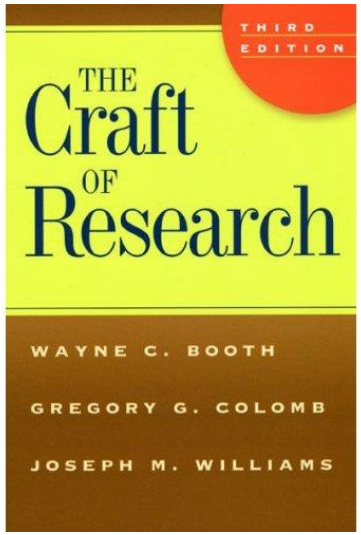
- **How do our lists compare with the NRC six?**
- **Is a global list possible? Do cultural contexts matter?**

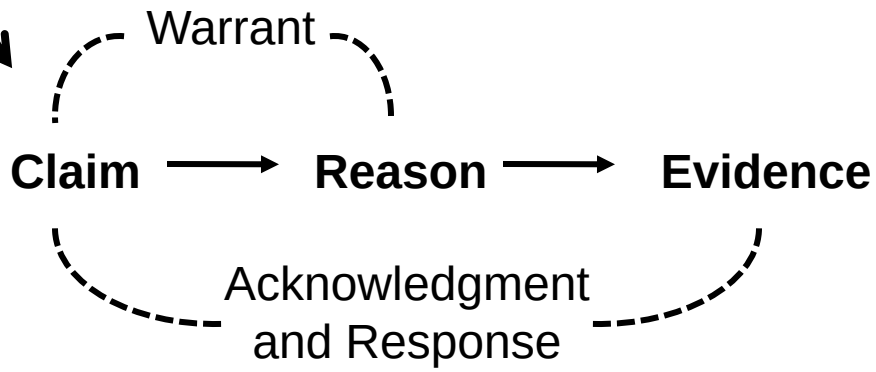
Source: Scientific Research in Education, National Research Council, 2002

The research process and reasoning



Research Process





Research Reasoning

Most common frameworks in educational research

- **Theories of learning**
- **Theories of motivation**
- **Theories of development**
- **Theories of contextual effects**

See Marilla Svinick's Handbook — A Guidebook On Conceptual Frameworks For Research In Engineering Education. http://cleerhub.org/resources/gb-svinicki

Multiple theoretical frameworks

Which comes first: framework or observation?

Can go in either direction

Multiple theoretical frameworks

Going from framework to research question to research study

Framework

Self-determination framework says - students' motivation for a task is affected by the degree of control they have over it.

Therefore

If we manipulate the degree of student control, we should see variations in motivation levels.

Design

Different groups are given different degrees of control over the topic and process of their project and their motivation for the project is measured at various times throughout the semester.

Multiple theoretical frameworks

Going from observation to framework to research question to research study and back to observation

Observation

Some students in a class participate more than others.

Possible Frameworks

- Learning theory: Prior knowledge differences
- Motivation theory: Goal orientations, task value, self-efficacy
- Contextual variables: Course contingencies; classroom climate

Design possibilities

- Measure and regress level of participation on potential variables.
- Manipulate course contingencies or course practices.

Books, journals, online resources

- The Craft of Research
- Scientific Research in Education
- Journal of Engineering Education (JEE)
- Thomson ISI Citation Index
- Some other journals

What is your experience?

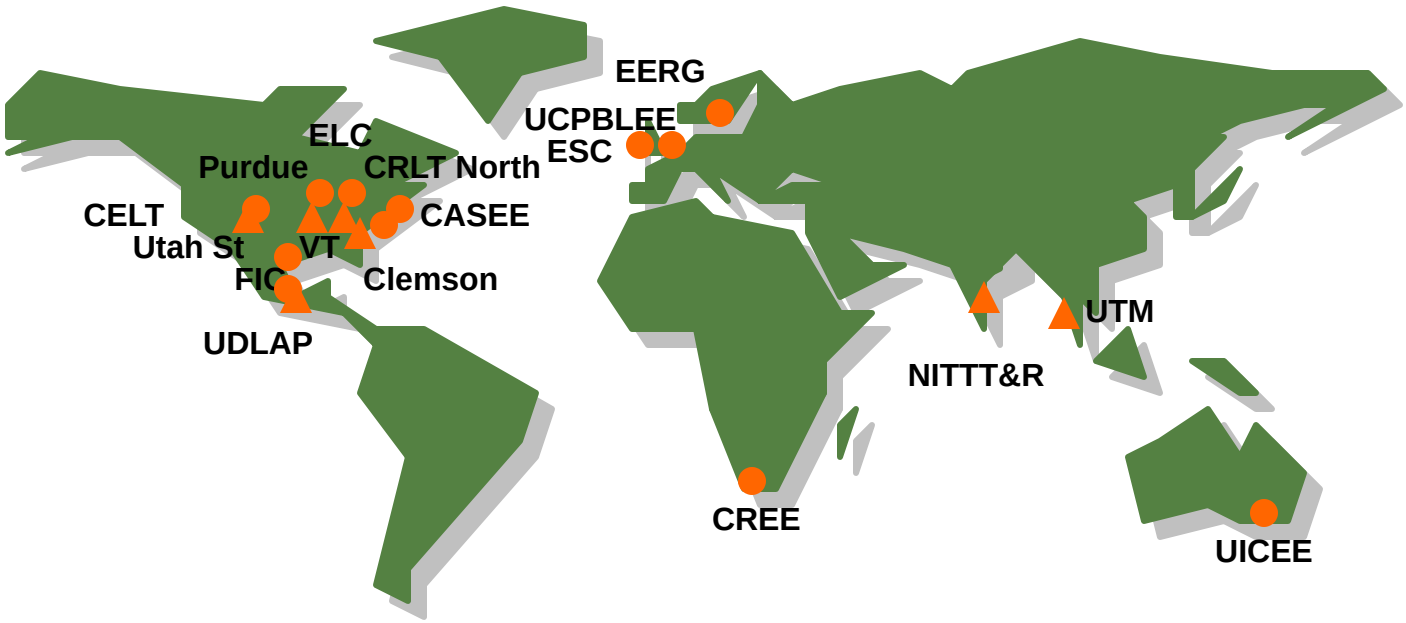
- Silently reflect on your experience as an emerging engineering education researcher
- Jot down
  - What has been the most exciting opportunity for you in this area?
  - What has been the most difficult challenge you have faced?
- Share with the person next to you

Becoming an Engineering Education Researcher—Adams, Fleming & Smith

1. Find and follow your dream.
2. Find and build community.
3. Do your homework. Become familiar with engineering education research.
4. Remember what it is like to be a student—be open to learning and the associated rewards and challenges.
5. Find balance. You will feel like you have multiple identities.
6. Be an architect of your own career.
7. Wear your researcher “lenses” at all times.
8. Use research as an opportunity for reflective practice.

Adams, R., L. Fleming, and K. Smith. 2007. Becoming an engineering education researcher: Three researchers stories and their intersections, extensions, and lessons. Proceedings, International Conference on Research in Engineering Education; http://www.ce.umn.edu/%7Esmith/docs/Adams-Fleming-Smith-Becoming_an_engineering_education_researcher-ICREE2007.pdf

Groups, centers, departments…



- **Engineering Teaching and Learning Centers** — Australia: UICEE, UNESCO International Centre for Engineering Education; Denmark: UCPBLEE, UNESCO Chair in Problem Based Learning in Engineering Education; South Africa: CREE, Centre for Research in Engineering Education, U of Cape Town; Sweden: Engineering Education Research Group, Linköping U; UK: ESC, Engineering Subject Centre, Higher Education Academy; USA: CELT, Center for Engineering Learning and Teaching, U of Washington; CRLT North, Center for Research on Learning and Teaching, U of Michigan; Faculty Innovation Center, U of Texas-Austin; Engineering Learning Center, U of Wisconsin-Madison; CASEE, Center for the Advancement of Scholarship in Engineering Education, National Academy of Engineering.
- **Engineering Education Degree-granting Departments** — USA: School of Engineering Education, Purdue U; Department of Engineering Education, Virginia Tech; Department of Engineering and Science Education, Clemson U; Department of Engineering and Technology Education, Utah State U; Malaysia: Engineering Education PhD program, Universiti Teknologi Malaysia; India: National Institute for Technical Teacher Training and Research; Mexico: Universidad de las Americas, Puebla

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Welcome to CLEERhub.org!

CLEERhub.org is a digital habitat with the mission to address the continued need for developing engineering education researchers by leveraging the success of past NSF-funded programs such as RREE, ISEE and CAEE and the expertise gained by various project team members.

CLEERhub.org is part of a NSF-funded project called Expanding and sustaining research capacity in engineering and technology education: Building on successful programs for faculty and graduate students (DUE-0817461).

Guide Books

- Building a Network of Mentors
- Quantitative Research in Education
- Conceptual Frameworks For Research
- Qualitative Research Basics

Upcoming Events

OCT 27 Understanding Qualitative Research
Workshop- Understanding Qualitative Research FIE (Frontiers in Education) Conference ...

OCT 27 Getting Started in Educational Research
Workshop - Fundamentals of Educational Research FIE (Frontiers in Education) Conference ...

More events ›

Rigorous Research in Engineering Education

Creating a Community of Practice (PPT)

Workshops

- Exploring How People Learn Engineering August 2010
- Malaysia 2010: Qualitative Research
- ASEE 2010: Connecting EER Programs from Around the World
- Merida, Mexico 2009
- Taiwan 2009

more...

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What Are Your Plans?

- Silently reflect on your interests and plans for becoming an engineering education researcher
- Jot down
  - What do you plan to do next?
  - What are your longer range plans?
- Share with the person next to you

Please fill out the post-workshop questionnaire

- We acknowledge the National Science Foundation for funding this work (DUE 0817461)
- COLLABORATIVE RESEARCH: Expanding and sustaining research capacity in engineering and technology education: Building on successful programs for faculty and graduate students

- **An e-copy of this presentation may be found at:**
- **http://CLEERhub.org**