A Workshop on

Selecting Conceptual Frameworks for Engineering Education Research

hosted by the
Valparaiso University

in partnership with
Rigorous Research in
Engineering Education Initiative

Valparaiso, IN – February 17, 2010

Ruth A.Streveler
Purdue University

Karl A. Smith
Purdue University and
University of Minnesota

Overview
What are we going to do?

- **Welcome and introductions**

- **Topics of the workshop**
  - Review of RREE Principles
    - 6 Principles
  - Conceptual Hurdles
  - What is a Conceptual Framework
    - Why Have One?
  - Major Conceptual Frameworks in Educational Research
  - Apply to Your Research Question

- **Format of the workshop**
  - Interactive and team-based work

Background and Context

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

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

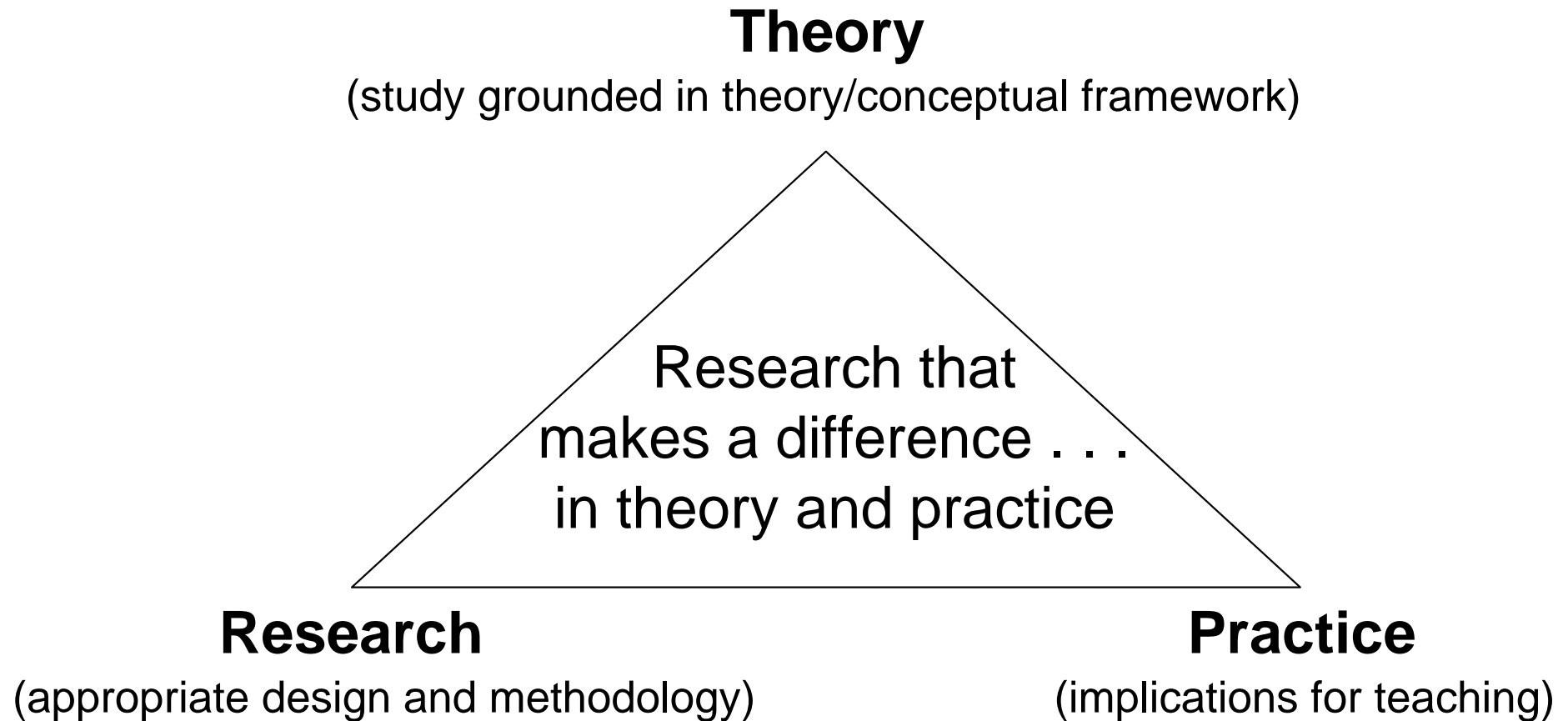# Research can be inspired by ...

	Use (Applied)	
	No	**Yes**
Yes	Pure basic research (Bohr)	Use-inspired basic research (Pasteur)
No		Pure applied research (Edison)

Understanding (Basic)

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

RREE Approach

Theory
(study grounded in theory/conceptual framework)

Research that
makes a difference . . .
in theory and practice

Research
(appropriate design and methodology)

Practice
(implications for teaching)

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

RREE2 Short Courses*

- Fundamentals of Educational Research
  - ASEE, FIE

- Selecting Conceptual Frameworks
  - ASEE

- Understanding Qualitative Research
  - FIE

- Designing Your Research Study

- Collaborating with Learning and Social Scientists
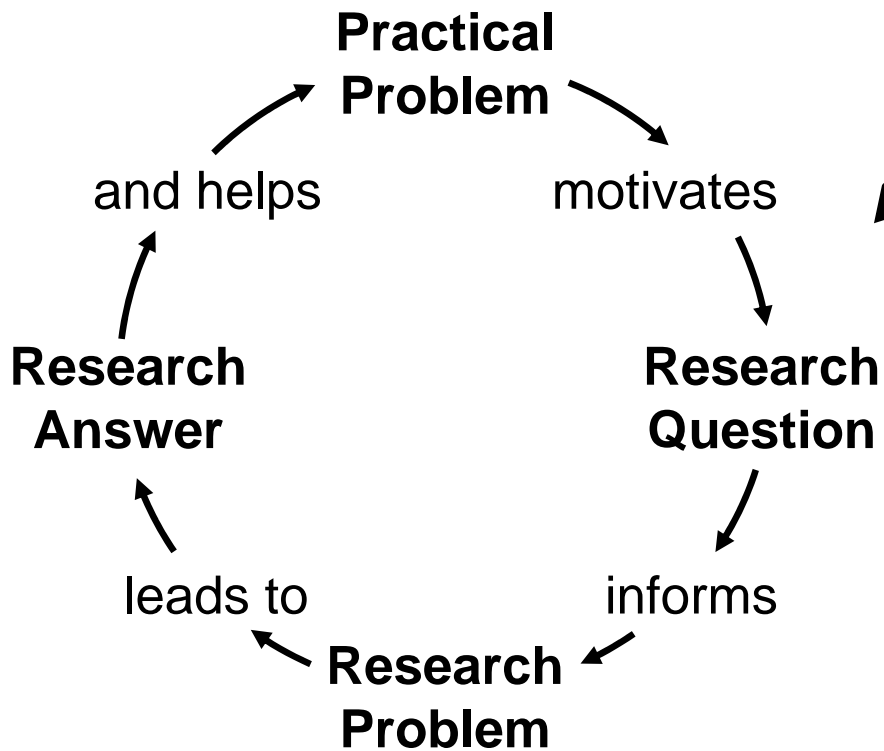
*To be recorded and posted on the CLEERhub.org

Today's objectives

1) Identify principal features of engineering education research (Review)

2) Frame and situate research questions and methodologies

3) Gain familiarity with major conceptual frameworks in educational research

4) Apply to your research questions

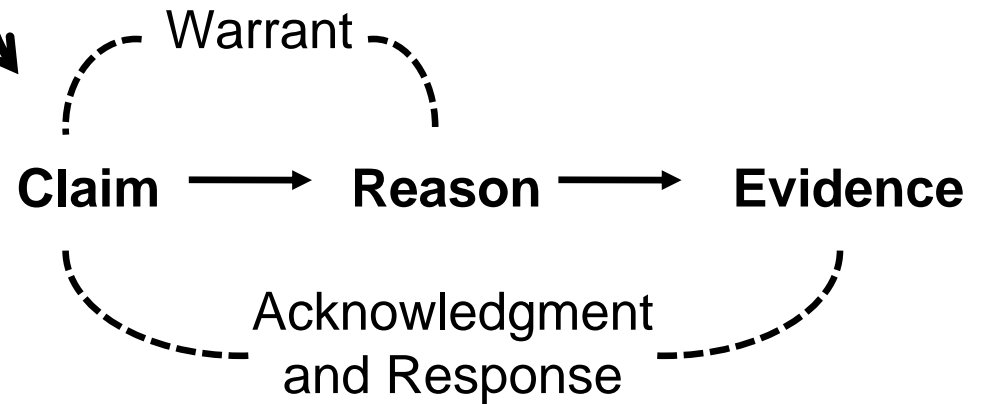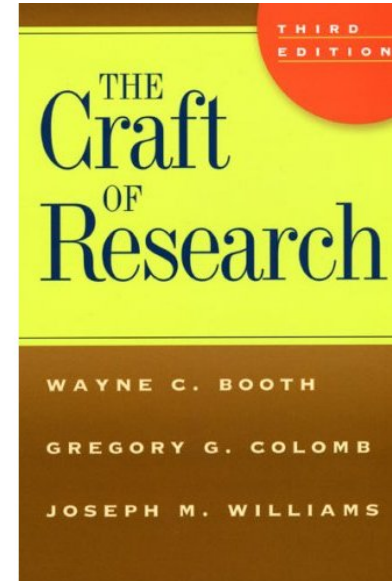# Guiding principles for scientific research in education

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**

The research process and reasoning

Practical Problem

motivates

and helps

Research Answer

Research Question

leads to

informs

Research Problem

Research Process

Warrant

Claim → **Reason** → **Evidence**

Acknowledgment and Response

Research Reasoning

THIRD EDITION

THE Craft OF Research

WAYNE C. BOOTH

GREGORY G. COLOMB

JOSEPH M. WILLIAMS

Conceptual Frameworks

What is a conceptual framework?

How People Learn (HPL) Framework

Serves as an example of a framework
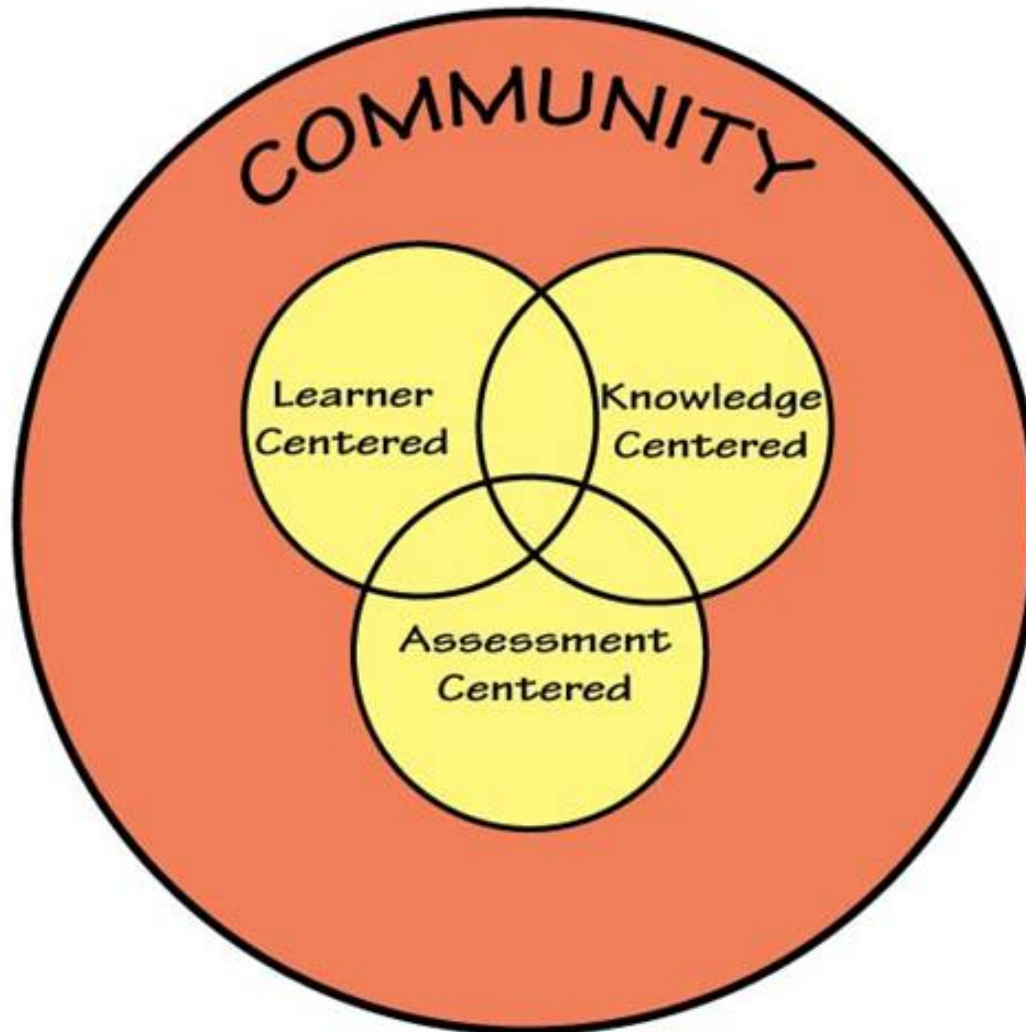
And an organizer for our discussion

Which comes first: framework or observation?

- **Going from framework to research question to research study**
  - e.g., the experiential learning cycle
- **Going from observation to framework to research question to research study and back to observation**
  - e.g., classroom community
  - Please describe observations that have sparked your curiosity

Customizing to your interests

Think-pair-share

List your research interests

Identify the area of the HPL that best describes your greatest interest

COMMUNITY

Learner Centered

Knowledge Centered

Assessment Centered
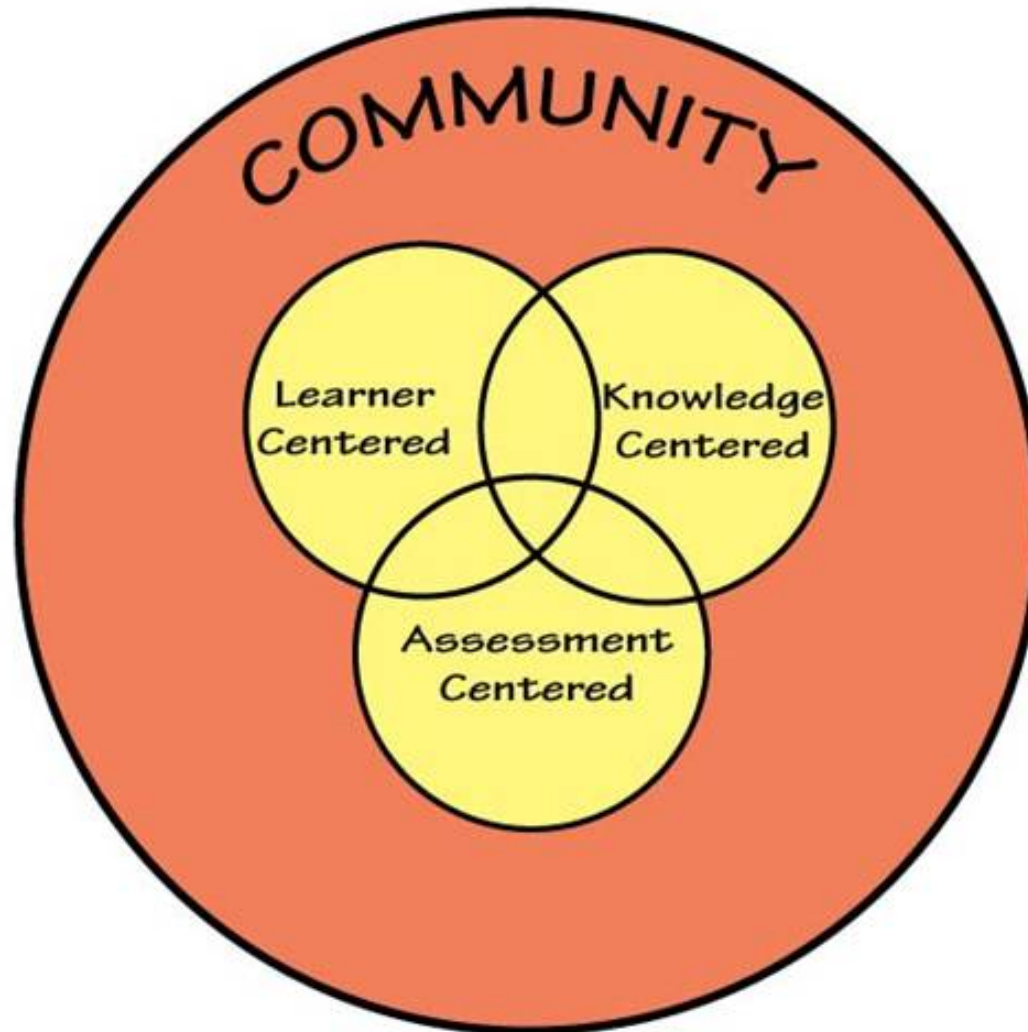
Discuss at your table

Rearrange yourself so that all with the same interest area (in HPL framework) are sitting together

Learner-centered frameworks

- Learning processes frameworks
- Developmental processes frameworks
- Motivational processes frameworks

Knowledge-centered frameworks

- Levels of cognitive complexity models
- Disciplinary differences in the structure of knowledge

Assessment-centered frameworks

- Objectives based assessment
- Situated learning and authentic assessment

Community-centered frameworks

- Socioconstructivist theory and collaborative learning
- Distributed cognition

Conceptual Frameworks
Cooperative Jigsaw

- Cooperative Jigsaw: An alternative to lecture or individual study for learning new conceptual material.

- Objectives
  - Participants will be able to elaborate on conceptual frameworks used in engineering education research
  - Participants will identify framework(s) applicable for their research questions

Reference (with directions): Cooperative learning: Making "groupwork" work. New Directions for Teaching and Learning, 1996, 67, 71-82. [NDTLCL5.doc]

JIGSAW SCHEDULE

- COOPERATIVE GROUPS
- PREPARATION PAIRS
- CONSULTING/SHARING PAIRS
- TEACHING/LEARNING IN COOPERATIVE GROUPS
- WHOLE CLASS REVIEW

Conceptual Frameworks: Cooperative Jigsaw

- **Learner centered**
  - Learning Process – Svinicki 9-13
  - Motivation – Svinicki 15-20
  - Developmental – Svinicki 21-23
- **Knowledge Centered**
  - Learning Context – Svinicki 25-26
  - Disciplinary Thinking – Svinicki 26-27

Preparation Pairs

TASKS:
    a. Master Assigned Material – Skim Chapter
    b. Plan How to Teach It To Group

PREPARE TO TEACH:
    a. List Major Points You Wish to Teach – 3 – 5 points
    b. List Practical Advice Related to Major Points
    c. Prepare Visual Aids/Graphical Organizers
    d. Prepare Procedure to Make Learners Active, Not Passive

COOPERATIVE: One Teaching Plan From The Two Of You, Both Of You Must Be Ready to Teach

Jigsaw Schedule

- Preparation ~ 15-20'
- Teach and Learn ~ 15-20'
  - Each Section ~ 5' (15' total)
  - Learning Process – Svinicki 9-13
  - Motivation – Svinicki 15-20
  - Developmental – Svinicki 21-23
- Whole group discussion ~ 10'

Teach and Learn Group

TASK: Learn ALL the Material (All four sections)

COOPERATIVE:
     Goal: Ensure All Group Members Understand All Sections of Material
     Resource: Each Member Has One Part
     Roles: Teach, Learn

EXPECTED CRITERIA FOR SUCCESS: Everyone learns and teaches an area of expertise, Everyone learns others' area of expertise, Everyone summarizes and synthesizes

INDIVIDUAL ACCOUNTABILITY:
     Help other's learn
     Identify applicable frameworks for your research question

EXPECTED BEHAVIORS: Good Teaching, Excellent Learning, Summarizing, Synthesizing

INTERGROUP COOPERATION: Whenever it is helpful, check procedures, answers, and strategies with another group.

Jigsaw -- Role of Listening Members

Clarify material by asking questions

Suggest creative ways to learn ideas and facts

Relate information to other strategies and elaborate

Present practical applications of information

Keep track of time

Appropriate Humor

Jigsaw Processing

Things We Liked About It	Traps to Watch Out For

Apply to Your Research Questions

- **Next steps**
  - **Use an iterative cycle of**
    - **Refining your research questions within the appropriate conceptual frameworks**
    - **More reading to provide a deeper understanding of the appropriate frameworks**
  - **Use the framework as a guide to begin finding collaborators**
    - **Now you know some of the language needed to engage experts in other areas**
  - **Form cross-disciplinary research teams**
    - **What is needed is respect for each other and a language by which you can communicate**

Please fill out the post-workshop questionnaire

Thank you!

An e-copy of this presentation may be found at:
http://www.ce.umn.edu/~smith/links.html

Valparaiso, IN – February 17, 2010

streveler@purdue.edu   **ksmith@umn.edu**