

A Celebration of the Engineering Education Research Community

*Special ERM Session in partnership with the
The Journal of Engineering Education (JEE)*
Rigorous Research in Engineering Education Initiative (DUE 0817461)
CLEERhub.org

ASEE Annual Conference – June 27, 2011 – M722A – 6:00 pm – 8:00 pm

Facilitated By

Karl A. Smith
Purdue University and
University of Minnesota

Jack Lohmann
Georgia Tech

Ruth A. Streveler
Purdue University

Jeff Froyd
Texas A&M

Agenda

What are we going to do?

- Welcome and Overview (~5 min)
- Brief Report on Status of RREE Project (~15 min)
 - EER workshops and EER – JEE Collaboration
 - Collaboratory for Engineering Education Research (CLEERhub.org)
- Update on EER (~15 min)
 - ASEE 2010 EER & FIE 2010 Networking Sessions
 - National Research Council – Discipline Based Education Research
- Participant Networking Activity (~60 min)
 - Representatives of EER Centers and PhD programs
- Strategies to Connect, Expand, and Sustain the Emerging EER Community (~10 min)
- Wrap Up and Next Steps (~5 min)

Status of RREE Project

- **EER workshops and EER – JEE Collaboration**
 - **Fundamentals of Educational Research**
 - ASEE 2010
 - FIE 2010
 - **Selecting Conceptual Frameworks for Engineering Education Research**
 - RCEE/UTM Malaysia 2010
 - ASEE 2010
 - **Understanding Qualitative Research**
 - FIE 2010
 - **Quantitative Research**
 - ASEE 2011
- **Collaboratory for Engineering Education Research (CLEERhub.org)**

Getting Started in Engineering Education Research Fundamentals of Engineering Education Research

sponsored by the
ASEE Educational Research
and Methods Division

in partnership with
Rigorous Research in
Engineering Education Initiative
CLEERhub.org
And the *Journal of Engineering Education*

ASEE Annual Conference – June 20, 2010 – Session 0230



Ruth A. Streveler
Purdue University



Karl A. Smith
Purdue University and
University of Minnesota

Levels of Engineering Education Inquiry

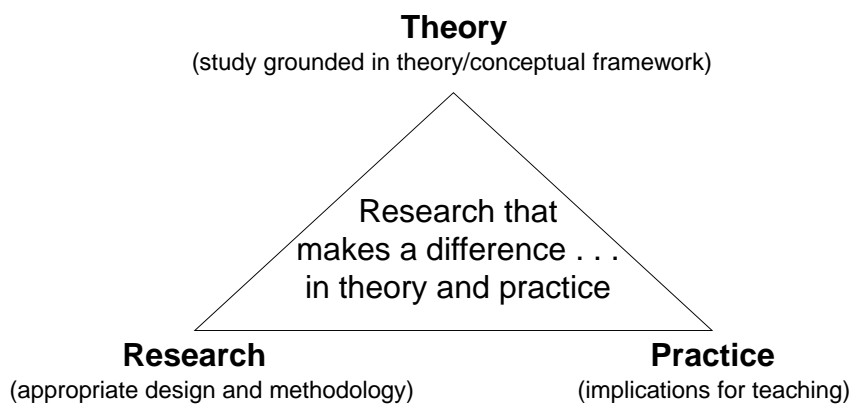
- **Level 0** Teacher
 - Teach as taught (“distal pedagogy”)
- **Level 1** Effective Teacher
 - Teach using accepted teaching theories and practices
- **Level 2** Scholarly Teacher
 - Assesses performance and makes improvements
- **Level 3** Scholar of Teaching and Learning
 - Engages in educational 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

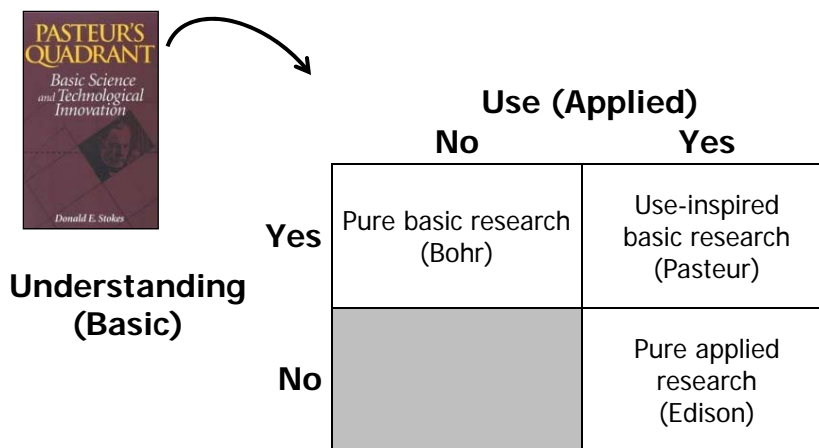
- **Rigorous Research in Engineering Education (RREE1)**
 - One-week summer workshop, year-long research project
 - Funded by National Science Foundation (NSF), 2004-2006
 - About 150 engineering faculty participated
- **Goals**
 - Identify engineering faculty interested in conducting engineering education 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



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

Research can be inspired by ...



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

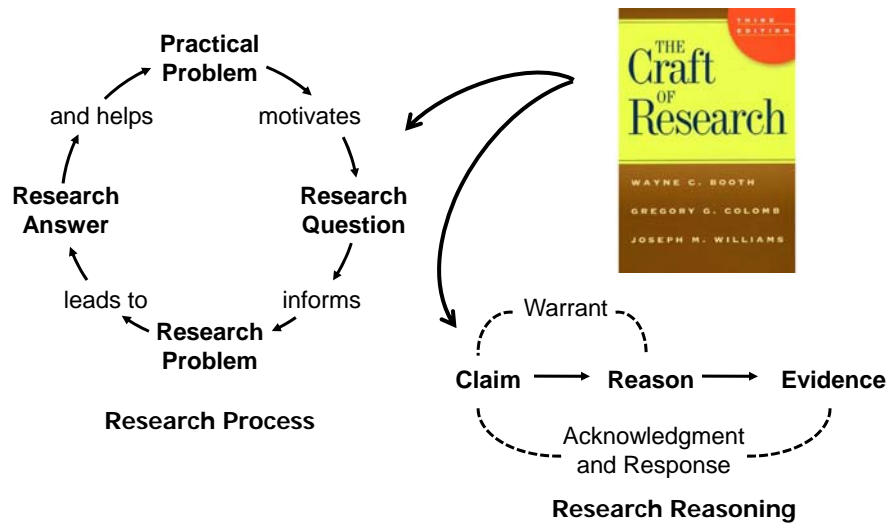


Guiding Principles for Scientific Research in Education

1. **Question:** pose *significant* question that can be investigated *empirically*
2. **Theory:** link research to relevant theory
3. **Methods:** use methods that permit direct investigation of the question
4. **Reasoning:** provide coherent, explicit chain of reasoning
5. **Replicate and generalize** across studies
6. **Disclose** research to encourage professional scrutiny and critique

National Research Council, 2002

Research Process



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

The screenshot shows the homepage of CLEERhub.org. The header includes the site name 'CLEERHUB' and the tagline 'Collaboratory for Engineering Education Research'. A navigation menu is located below the header. The main content area features a large banner with a cityscape image and the text 'Welcome to CLEERhub.org!'. Below the banner, there are several sections: 'Announcements', 'Upcoming Events', 'What's New in Resources', 'Guide Books', 'Rigorous Research in Engineering Education', 'Workshops', 'Collaborate', and 'Useful Links'. The footer contains copyright information and a logo for the National Science Foundation.

<http://cleerhub.org>

Engineering Education Research Networking Session
Connecting Engineering Education
Research Programs from Around the World

sponsored by the
 ASEE International Division

in partnership with
 Rigorous Research in
 Engineering Education Initiative
 CLEERhub.org
 And the *Journal of Engineering Education*

ASEE Annual Conference – June 22, 2010 – Session 2123

Facilitated By

Karl A. Smith
 Purdue University and
 University of Minnesota

Jack Lohmann
 Georgia Tech

Hans Hoyer
 ASEE

Ruth A. Streveler
 Purdue University

Satish Udpa
 Michigan State University

Stephanie Eng
 ASEE

ASEE 2010 – EER PhD Program Briefings

- Utah State University – Kurt Becker
- Purdue University – David Radcliffe & Robin Adams
- Universidad de las Americas, Puebla, Mexico – Enrique Palou
- Virginia Tech – Maura Borrego
- Universiti Teknologi Malaysia – Zaini Ujang
- Clemson University – Lisa Benson
- NITTTRs – India – R. Natarajan
- Arizona State University – Tirupalavanam Ganesh & Chell Roberts
- University of Washington – Cindy Atman
- Ohio State University – Lisa Abrams
- Carnegie Mellon University – Paul Steif
- University of Michigan – Cindy Finelli
- Washington State University – Denny Davis
- University of Georgia – Nadia Kellam & Joachim Walther
- Michigan State University – Jon Sticklen
- University of Colorado – Boulder – Daria Kotys-Schwartz

Session slides and links to programs posted to CLEERhub.org

Engineering Education Research Networking Session Connecting and Expanding the Engineering Education Research Community

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

ASEE/IEEE Frontiers in Education Conference – October 29, 2010 – F3B – 4:30 pm – 6:00 pm

Facilitated By

Karl A. Smith
Purdue University and
University of Minnesota

Ruth A. Strevler
Purdue University

Kaiser Malik
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Guest Editorial From the Margins to the Mainstream: The Emerging Landscape of Engineering Education Research

RUTH A. STREVELER
Purdue University
KARL A. SMITH
Purdue University and University of Minnesota

In 2005, Kaiser (highlighted) introduced engineering education research (EER) as a “controversial” and “marginal” field of research within the “margin” of engineering education research (EER) in the journal *Journal of Engineering Education*. Although the field has since grown significantly, it has not been included in the list of EER research areas in the journal’s special issue “Engineering Education Research” (Smith, Strevler, and Malik, 2008). Kaiser’s EER article has inspired and inspired many engineering education researchers to explore the field of engineering education research (EER) and its relationship to the broader field of engineering education research (EER). The early and mid-2000s saw a flurry of activity focused on engineering education research and the emergence of engineering education Ph.D. programs. In January 2003, EER researchers began to address the need for a journal dedicated to engineering education research. The 2003 special issue of *Journal of Engineering Education Research*, “Engineering Education Research: Addressing the Needs of the Field” (Smith, Strevler, and Malik, 2008) marked the beginning of a new era of engineering education research. The journal, *Journal of Engineering Education Research*, was established as a platform for the field’s research and to provide a venue for the community to discuss engineering education research. The journal’s focus is on the field of engineering education research and its relationship to the broader field of engineering education research. The journal’s focus is on the field of engineering education research and its relationship to the broader field of engineering education research.

A review of these published programmatic addresses can provide some insights into the current engineering education research landscape. In the early 2000s, U.S. committees on engineering education Ph.D. programs included Kansas State University, Georgia Tech, Case Western Reserve University, North Carolina State University, the Ohio State University, University of Washington, University of Georgia, Washington State University, and the University of California at Berkeley. International perspectives on EER are expanding and continue to expand. The benefit of global participation is reflected in the growth of international academic partnerships with EER Ph.D. programs in engineering education, including the EER Ph.D. programs in engineering education at the University of Michigan, Michigan State University, and the University of California at Berkeley. A networking session for engineering education Ph.D. program administrators at the International Conference on Engineering Education Research (ICEER) at the 2010 conference drew over 40 attendees (ASEE, 2010). Further EER networking sessions will be held at the 2012 Frontiers in Education Conference (Smith and Strevler, 2011) and will focus on the opportunities and challenges of creating both online and on-campus programs.

We have set out to trace the current landscape of engineering education research programs. The emergence of many new programs globally as well as the success of recent EER Ph.D.s and faculty provide evidence that the community is no longer marginalized but is heading toward mainstream acceptance. Exciting opportunities await us to build knowledge that will make a difference in engineering education curricula and pedagogy.

Strevler, R.A. & Smith, K.A. 2010. From the Margins to the Mainstream: The Emerging Landscape of Engineering Education Research. *Journal of Engineering Education*, 99(4), 285-287.

<http://www.asee.org/papers-and-publications/publications/jee>

Engineering Education: Departments, Degrees and Directions*

LISA C. BENSON,¹ ALBERT BECKER,² MELANIE M. COOPER,³ G. HAYDEN GRIFFIN,⁴ AND KARA A. SMITH⁵

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The aim of this volume is to explore an issue that has been identified by the engineering education research community as a major research priority: the development of departments and directions in engineering education. This is a primary objective of the discipline-specific research in a major research program supported by the National Science Foundation and the National Academy of Engineering. The volume provides a synthesis of research in this area, and is intended to be a resource for researchers and practitioners in the field of engineering education. The volume is organized into three parts: (1) the current state of the discipline, (2) the future of the discipline, and (3) the role of the discipline in the development of engineering education. The volume is intended to be a resource for researchers and practitioners in the field of engineering education. The volume is organized into three parts: (1) the current state of the discipline, (2) the future of the discipline, and (3) the role of the discipline in the development of engineering education.

INTRODUCTION

THE CALL for a transformation in how engineers are educated is well documented [1-5]. The main reason for this call for change is the rapid pace of change in the world, which has led to a need for engineers who are able to adapt to a rapidly changing environment and who can solve complex problems. This requires a new approach to engineering education, one that focuses on developing the skills and abilities of engineers to solve complex problems in a rapidly changing environment. This requires a new approach to engineering education, one that focuses on developing the skills and abilities of engineers to solve complex problems in a rapidly changing environment.

Engineering education research is a multidisciplinary field that involves the study of the development of engineering education. This research is conducted by researchers in a variety of disciplines, including engineering, education, psychology, and sociology. The research in this field is focused on understanding the factors that influence the development of engineering education, and on identifying ways to improve the quality of engineering education.

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There is growing acceptance of discipline-based education as a valuable research enterprise, on the same level as research into, say, mechanical engineering or organic chemistry. Evidence of innovative ways that discipline-based education programs are taking root in higher education include the establishment of cross-disciplinary departments in science, technology, and engineering education. These departments bring together faculty whose research area is education, who can tackle large-scale problems across the curriculum in addition to discipline-specific research projects.

Benson, L.C., Becker, K., Cooper, M.M., Griffin, O.H. & Smith, K.A. 2010. Engineering Education: Departments, Degrees and Directions. *Int. J. Engng Ed.* Vol. 26, No. 5, pp. 1042–1048.

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June 22, 2011

Status, Contributions, and Future Direction of Discipline-Based Education Research (DBER)

The National Science Foundation has funded a synthesis study on the status, contributions, and future direction of discipline-based education research (DBER) in physics, biological sciences, geosciences, and chemistry. DBER combines knowledge of teaching and learning with deep knowledge of discipline-specific science content. It describes the discipline-specific difficulties learners face and the specialized intellectual and instructional resources that can facilitate student understanding.

This 30-month study will build on two workshops held in 2008 to explore evidence on **improving practices** in undergraduate Science, Technology, Engineering, and Mathematics (STEM) Education. It will answer questions that are essential to advancing DBER and broadening its impact on undergraduate science teaching and learning. An interdisciplinary panel of experts will synthesize empirical research on undergraduate teaching and learning in the sciences; explore the extent to which the research currently influences undergraduate instruction; and identify the intellectual and material resources required to further develop DBER.

The final product will be a consensus report that will provide guidance for future DBER research. In addition, the findings and recommendations of this study may invite, if not assist, postsecondary institutions to:

- Increase interest and research activity in DBER, and improve its quality and usefulness across all natural science disciplines
- Guide instruction and assessment across natural science courses to improve student learning
- Bring greater focus to issues of student ability in the natural sciences that are related to quality of instruction

MEETINGS	LOCATION	RESOURCES
Committee Meeting 1 June 28-29, 2010	Kend. Center, Room 201 500 5 th Street, NW Washington, DC	Appendix
Committee Meeting 2 October 28-29, 2010	Kend. Center, Room 201 500 5 th Street, NW Washington, DC (limited space)	Appendix Includes links to papers and presentations
Committee Meeting 3 December 3-4, 2010	Bedkman Center Drine, CA	Appendix Includes links to papers and presentations
Committee Meeting 4	Kend. Center, 500 5 th Street, NW Washington, DC (limited space)	Appendix Commissioned Papers
Committee Meeting 5	Danvers Center Woods Hole, MA	This meeting is closed to the public

COMMITTEE
Committee Membership

STAFF
Natalie Nielsen, Study Director
Heidi Schwesinger, Deputy Director, BOSE
Margaret Hilton, Senior Program Officer, BOSE
Andrew Blevins, Senior Program Assistant, BOSE

http://www7.nationalacademies.org/bose/DBER_Homepage.html

Participant Networking

Engineering/STEM Education Graduate Programs

- Arizona State University
- University of California-Berkeley
- Clemson University
- University of Cincinnati
- University of Kentucky
- Linkoping University (Sweden)
- University of Minnesota
- The College of New Jersey
- Niagara University
- North Carolina State University
- Old Dominion University
- The Ohio State University
- Purdue University
- Tufts University
- Universidad de las Americas Puebla (Mexico)
- Universiti Teknologi Malaysia
- Uppsala University (Sweden)
- Utah State University
- Virginia Tech

Participant Networking

Engineering Education-Related Certificate Programs

- Arizona State University
- Boise State University
- Clemson University
- Michigan State University
- University of Michigan
- North Carolina State University
- Virginia Tech
- Wichita State University

Participant Networking

Innovative Engineering and Inter/Cross-Disciplinary Programs

- Aalborg University
(Denmark)
- Carnegie Mellon University
- North Dakota State
University
- Stony Brook University
- Texas A&M University
- University of Georgia
- University of Washington

<http://engineeringeducationlist.pbworks.com/w/page/27610307/Engineering-Education-Degree-and-Certificate-Programs>

Participant Networking Activity (~60 min)

- **Introductions with Guided Format**
- **Four (~10 min) Conversations in Groups of 2-3**
 - Your Name & Organization
 - Status of EER Center or PhD Program/Interest in EER
 - Suggestions for Starting/Questions About Starting
 - Exchange Business Cards/Contact Information
 - Identify "intellectual neighborhoods" around common research, organization or other questions and interests
 - Talk about ways to follow up
- **Bell will ring once after 9 min and twice after 10 min**
- **Move to a New Group**

Connecting, Expanding & Sustaining the Emerging EER Community (~ 10 min)

- **Small Group (2-3) Brainstorming**
 - Ideas for (1) local, (2) national, (3) international Community
 - Ideas for Virtual Community
 - Further Ideas
- **Summarize Ideas and Record**

Next Steps (~ 5 min)

- **Silently reflect on your interests and plans for engineering education research**
- **Jot down**
 - What do you plan to do next?
 - What are your longer range plans?
- **Continue the conversation during the ASEE conference and beyond**
 - EER Networks – CLEERhub, REEN, SEFI
 - Meet again at FIE Conference, October, 2011

Acknowledgement

- We acknowledge the National Science Foundation for funding Karl Smith and Ruth Streveler's participation (DUE 0817461)
 - COLLABORATIVE RESEARCH: Expanding and sustaining research capacity in engineering and technology education: Building on successful programs for faculty and graduate students
- And the ASEE ERM Division and JEE for Sponsoring

Thank you!

An e-copy of this presentation will be posted to:

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