Engineering Education Research Networking Session

Connecting and Expanding the Engineering Education Research (EER) and Engineering Education Innovation (EEI) Communities

ASEE Headquarters Session T106D in partnership with the
Rigorous Research in Engineering Education Initiative
(DUE 0817461)
http://CLEERhub.org

ASEE Annual Conference – June 12, 2012 – T106D – 7:00 am – 8:30 am

Facilitated By

Karl A. Smith
Purdue University and
University of Minnesota

Ruth A. Streveler
Purdue University

Slides posted - http://www.ce.umn.edu/~smith/links.html

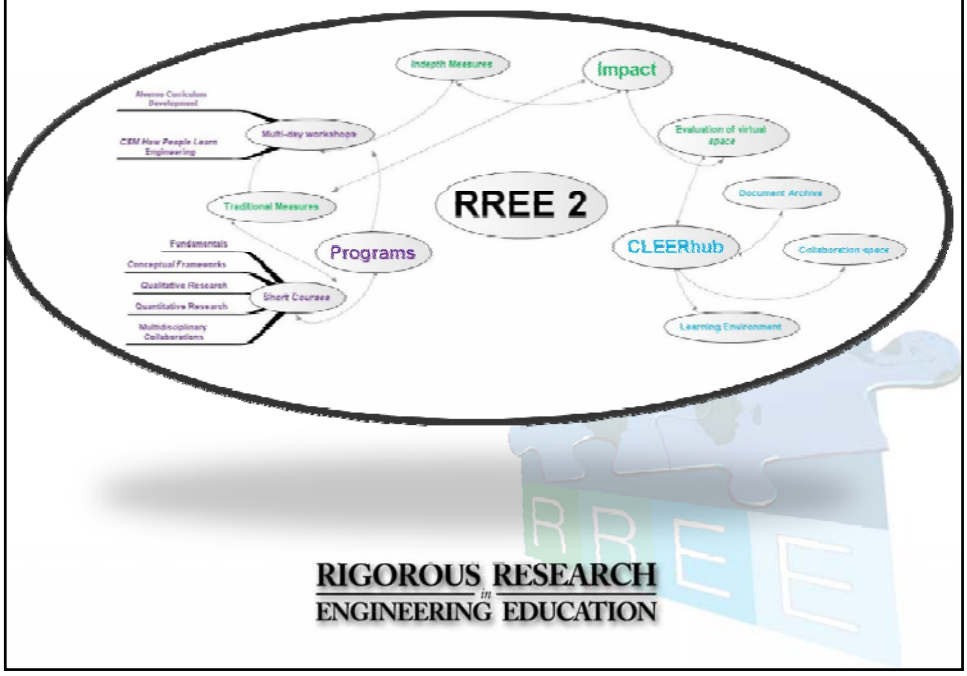
Activity	Time Allotted
Introduction of session and facilitators	5
Brief report on status of EER & EEI	
Update on RREE – CLEERHub.org (Collaboratory for Engineering Education Research)	10
Update on EER – NRC DBER report	5
Update on EEI – ASEE Innovation with Impact & NAE FOEE	10
Participant Networking	
Rapid introductions around guided questions – Four to five conversations in groups of 3 – as a way to meet many people	25
Identification of "intellectual neighborhoods" around research and innovation questions and opportunities – individual reflection and writing	5
Brainstorming on strategies to connect, expand, and sustain the emerging EER and EEI communities	10
Summary of ideas for (1) local, (2) national – conferences, etc. and (3) virtual community	5
Individuals share reflections with the large group, facilitators sum up the session and participants complete feedback forms	10

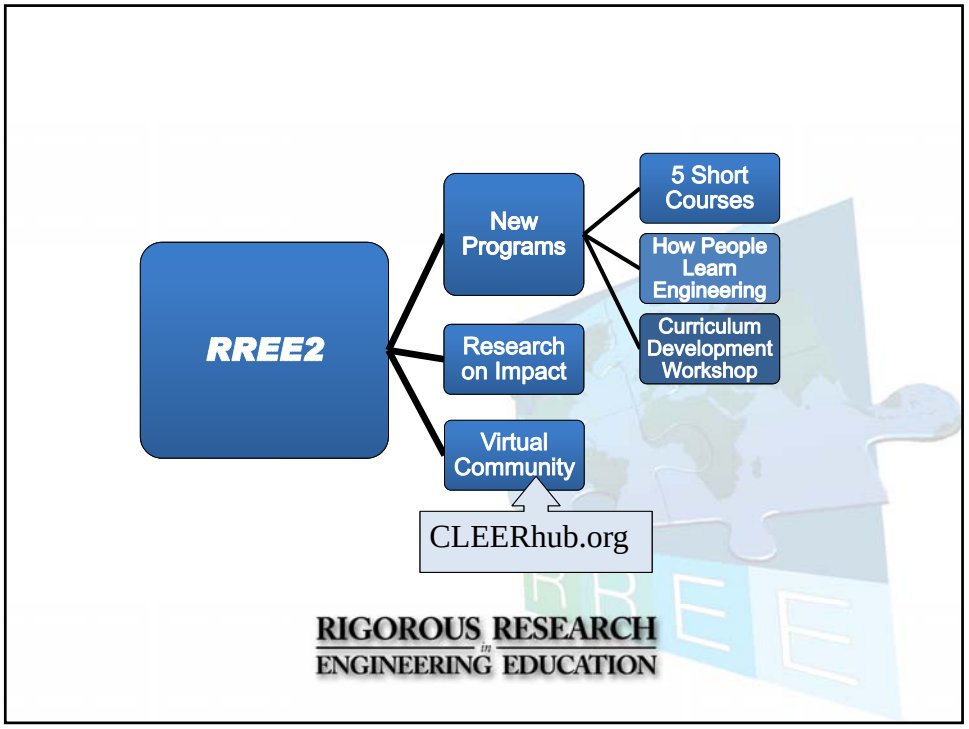
RIGOROUS RESEARCH in ENGINEERING EDUCATION

Funded by the National Science Foundation through awards DUE 0341127 and DUE 0817461

Expanding and sustaining research capacity in engineering and technology education: Building on successful programs for faculty and graduate students

Collaborative partners: Purdue (lead), Alverno College, Colorado School of Mines, Howard University, Madison Area Technical College, National Academy of Engineering




RREE2
New Programs
Research on Impact
Virtual Community
5 Short Courses
How People Learn Engineering
Curriculum Development Workshop
CLEERhub.org
RIGOROUS RESEARCH in ENGINEERING EDUCATION


CLEERHUB
Collaboratory for Engineering Education Research
Welcome to CLEERhub.org!
Getting Started in Educational Research
Guide Books
Rigorous Research in Engineering Education
Collaborate
Workshops

Objectives

- Explore available resources for your use.
- Share information about upcoming improvements.

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CLEERhub's Vision & Mission

Vision:

- To be the leader in engineering education research content and collaborative opportunities.

Mission:

- Partnering with the community to develop engaging and useful content.
- Continually improving user experience with regards to information availability, platform ease of use, and tools that enable collaboration.

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What's Available Now

Some of our most popular resources:

- Fundamentals of Engineering Education Research
- Qualitative and Quantitative Research Methods
- Exploring How People Learn Engineering

Example of a Learning Module.

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What's Coming Up

- Expanding accessibility by adopting the HTML 5 standard.
  - This enables users to access content via tablets and mobile devices.
- Self-scoring quizzes to help you gain insight into your understanding.

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Self-Scoring Quizzes

- Many of our resources will have self-scoring quizzes to help you gain insight into your understanding.

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I Want More Information!

Request more info from your mobile phone.

Or...

Complete the request for more information from a computer. We've shortened the URL to make it easier to write down.

http://bit.ly/Lj3zb6

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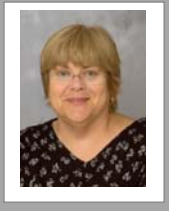
Getting Started in Engineering Education Research

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

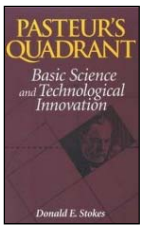
Karl A. Smith
Purdue University and
University of Minnesota

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.

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.

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

SCIENCE EDUCATION AT THE NATIONAL RESEARCH COUNCIL
www.nationalacademies.org/bose

Discipline-Based Education Research (DBER)

Understanding and Improving Learning in Undergraduate Science and Engineering

http://www.nap.edu/catalog.php?record_id=13362

Undergraduate Science and Engineering Education: Goals

- Provide all students with foundational knowledge and skills
- Motivate some students to complete degrees in science or engineering
- Support students who wish to pursue careers in science or engineering

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Undergraduate Science and Engineering Education: Challenges and Opportunities

- Retaining students in courses and majors
- Increasing diversity
- Improving the quality of instruction

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What is Discipline-Based Education Research?

- Emerging from various parent disciplines
- Investigates teaching and learning in a given discipline
- Informed by and complementary to general research on human learning and cognition

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Study Charge

- Synthesize empirical research on undergraduate teaching and learning in physics, chemistry, engineering, biology, the geosciences, and astronomy.
- Examine the extent to which this research currently influences undergraduate science instruction.
- Describe the intellectual and material resources that are required to further develop DBER.

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Committee on the Status, Contributions, and Future Directions of Discipline-Based Education Research

- **SUSAN SINGER** (Chair), Carleton College
- **ROBERT BEICHNER**, North Carolina State University
- **STACEY LOWERY BRETZ,** Miami University
- **MELANIE COOPER**, Clemson University
- **SEAN DECATUR**, Oberlin College
- **JAMES FAIRWEATHER**, Michigan State University
- **KENNETH HELLER**, University of Minnesota
- **KIM KASTENS**, Columbia University
- **MICHAEL MARTINEZ**, University of California, Irvine
- **DAVID MOGK**, Montana State University
- **LAURA R. NOVICK**, Vanderbilt University
- **MARCY OSGOOD**, University of New Mexico
- **TIMOTHY F. SLATER**, University of Wyoming
- **KARL A. SMITH**, University of Minnesota and Purdue University
- **WILLIAM B. WOOD**, University of Colorado

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Structure of the Report

- Section I. Status of Discipline-Based Education Research
- Section II. Contributions of Discipline-Based Education Research
- Section III. Future Directions for Discipline-Based Education Research

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Section I. Status of Discipline-Based Education Research

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Status of DBER: Goals

- Understand how people learn the concepts, practices, and ways of thinking of science and engineering.
- Understand the nature and development of expertise in a discipline.
- Help to identify and measure appropriate learning objectives and instructional approaches that advance students toward those objectives.
- Contribute to the knowledge base in a way that can guide the translation of DBER findings to classroom practice.
- Identify approaches to make science and engineering education broad and inclusive.

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Status of DBER: Types of Knowledge Required To Conduct DBER

- Deep disciplinary knowledge
- The nature of human thinking and learning as they relate to a discipline
- Students' motivation to understand and apply findings of a discipline
- Research methods for investigating human thinking, motivation, and learning

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Status of DBER: Conclusions

- DBER is a collection of related research fields rather than a single, unified field. (Conclusion 1)
- High-quality DBER combines expert knowledge of:
  - a science or engineering discipline,
  - learning and teaching in that discipline, and
  - the science of learning and teaching more generally.

  (Conclusion 4)

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Section II. Contributions of Discipline-Based Education Research

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Contributions of DBER: Conceptual Understanding and Conceptual Change

- In all disciplines, undergraduate students have incorrect ideas and beliefs about fundamental concepts. (Conclusion 6)
- Students have particular difficulties with concepts that involve very large or very small temporal or spatial scales. (Conclusion 6)
- Several types of instructional strategies have been shown to promote conceptual change.

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Contributions of DBER: Problem Solving and the Use of Representations

- As novices in a domain, students are challenged by important aspects of the domain that can seem easy or obvious to experts. (Conclusion 7)
- Students can be taught more expert-like problem-solving skills and strategies to improve their understanding of representations.

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Contributions of DBER: Research on Effective Instruction

- Effective instruction includes a range of well-implemented, research-based approaches. (Conclusion 8)
- Involving students actively in the learning process can enhance learning more effectively than lecturing.

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Section III. Future Directions for Discipline-Based Education Research

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Future Directions for DBER: Translating DBER into Practice

- Available evidence suggests that DBER and related research have not yet prompted widespread changes in teaching practice among science and engineering faculty. (Conclusion 12)
- Efforts to translate DBER and related research into practice are more likely to succeed if they:
  - are consistent with research on motivating adult learners,
  - include a deliberate focus on changing faculty conceptions about teaching and learning,
  - recognize the cultural and organizational norms of the department and institution, and
  - work to address those norms that pose barriers to change in teaching practice. (Conclusion 13)

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Future Directions for DBER: Recommendations for Translating DBER Into Practice

- **RECOMMENDATION:** With support from institutions, disciplinary departments, and professional societies, faculty should adopt evidence-based teaching practices.
- **RECOMMENDATION**: Institutions, disciplinary departments, and professional societies should work together to prepare current and future faculty to apply the findings of DBER and related research, and then include teaching effectiveness in evaluation processes and reward systems throughout faculty members' careers. (Paraphrased)

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Future Directions for DBER: Advancing DBER through Collaborations

- Collaborations among the fields of DBER, and among DBER scholars and scholars from related disciplines, although relatively limited, have enhanced the quality of DBER. (Conclusion 15)

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Future Directions for DBER: Research Infrastructure

- Advancing DBER requires a robust infrastructure for research. (Conclusion 16)
- **RECOMMENDATION**: Science and engineering departments, professional societies, journal editors, funding agencies, and institutional leaders should:
  - clarify expectations for DBER faculty positions,
  - emphasize high-quality DBER work,
  - provide mentoring for new DBER scholars, and
  - support venues for DBER scholars to share their research findings

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Future Directions for DBER: Some Key Elements of a Research Agenda

- Studies of similarities and differences among different groups of students
- Longitudinal studies
- Additional basic research in DBER
- Interdisciplinary studies of cross-cutting concepts and cognitive processes
- Additional research on the translational role of DBER

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Acknowledgements

- National Science Foundation, Division of Undergraduate Education (Grant No. 0934453)
- Various volunteers:
  - Committee
  - Fifteen reviewers
  - Report Review Monitor (Susan Hanson, Clark University) and Coordinator (Adam Gamoran, University of Wisconsin-Madison)
- Commissioned paper authors
- NRC staff (Natalie Nielsen, Heidi Schweingruber, Margaret Hilton)

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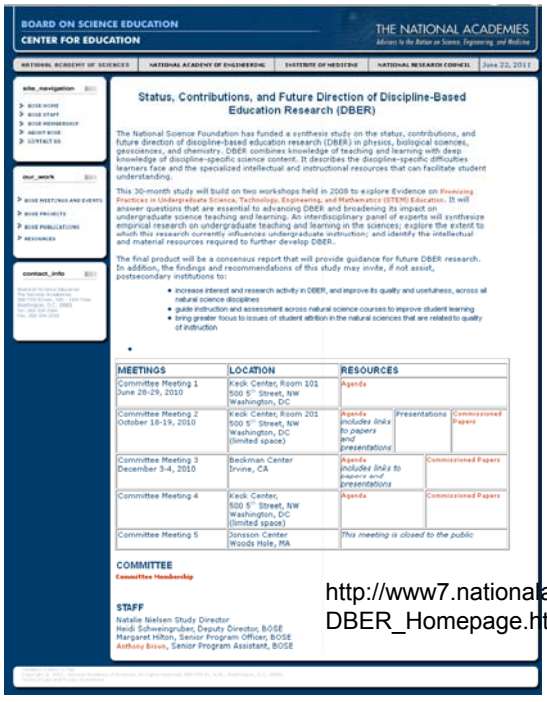

http://www7.nationalacademies.org/bose/DBER_Homepage.html

Emphasis on Innovation

- ASEE Innovation with Impact report
  - Excerpt from Presentation by Leah Jamieson, Dean, College of Engineering, Purdue
- NAE Engineering Education Research and Innovation Activities
  - Briefing by Beth Cady, Program Officer, Engineering Education, National Academy of Engineering

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ASEE Reports - A Path Forward

Seven Recommendations for Innovation with Impact

Who

1. Grow professional development in teaching and learning.
2. Expand collaborations.

What

3. Expand efforts to make engineering more engaging, relevant, and welcoming.

How

4. Increase, leverage, and diversify resources for engineering teaching, learning, and innovation.
5. Raise awareness of proven practices and of scholarship in engineering education.

Seven Recommendations for Innovation with Impact *(continued)*

Creating a Better Culture

To measure progress in implementing policies, practices, and infrastructure in support of scholarly and systematic innovation in engineering education:

6. Conduct periodic self-assessments in our individual institutions.
7. Conduct periodic community-wide self-assessments.

National Academy of Engineering

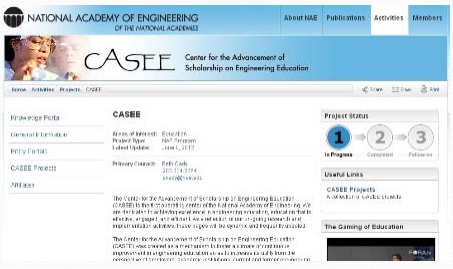
Engineering Education Research and Innovation Activities

Beth Cady
Program Officer, Engineering Education
ecady@nae.edu

Center for the Advancement of Scholarship on Engineering Education

- Created to foster continuous improvement
- Extensive set of resources at www.nae.edu/casee
  - Research-to-Practice documents
  - Meeting agendas and reports of CASEE projects
  - Equity-related resources
  - Videos
  - Summaries

- Please help us organize the site!
  - Search terms, categories



Real-World Engineering Education

- Sponsored by AMD
- Innovative programs infusing real-world experiences
- Final publication to be released over the summer
- Includes program description and discussion of barriers/solutions

Frontiers of Engineering Education (FOEE)

- Catalyze a vibrant community of *emerging* engineering education leaders
- Recognize faculty accomplishment, facilitate learning, broaden collaboration, and promote dissemination of innovative practice in engineering education

FOEE (continued)

- Attendees share their work with peers
- Speakers on topics of interest to attendees
- Speakers/Coaches provide mentoring advice
- Opportunities to network with peers and coaches
- 150 alums
- Nominations for 2012 currently open
  - Nominations from dean or NAE member
  - Applications due in July
- Symposium will be October 14-17 in Irvine, CA

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

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Purdue University and University of Minnesota

Jack Lohmann
Georgia Tech

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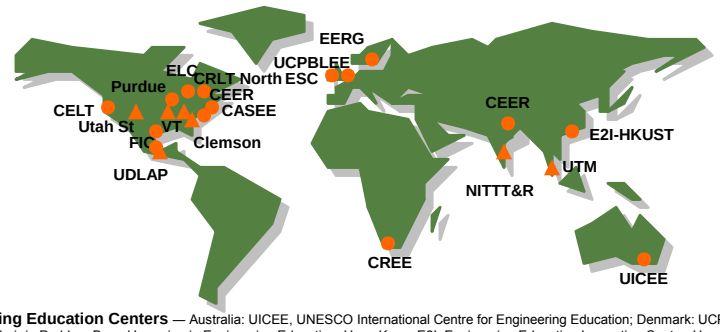
Ruth A. Streveler
Purdue University

Satish Udpa
Michigan State University

Stephanie Eng
ASEE

Groups, centers, departments…



● **Engineering Education Centers** — Australia: UICEE, UNESCO International Centre for Engineering Education; Denmark: UCPBLEE, UNESCO Chair in Problem Based Learning in Engineering Education; Hong Kong: E2I, Engineering Education Innovation Center, Hong Kong University of Science and Technology; Pakistan: Center for Engineering Education Research, NUST, National University for Science and Technology; 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; EEIC, Engineering Education Innovation Center, Ohio State University; CEER, Center for Engineering Education Research, Michigan State University.

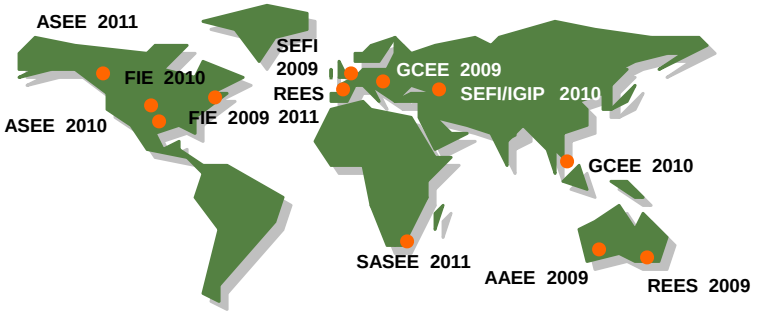
▲ **Engineering Education Degree-granting Departments** — USA: School of Engineering Education, Purdue U; Department of Engineering Education, Virginia Tech; Department of Engineering and Science Education, Clemson U; Department of Engineering and Technology Education, Utah State U; Malaysia: Engineering Education PhD program, Universiti Teknologi Malaysia; India: National Institute for Technical Teacher Training and Research; Mexico: Universidad de las Americas, Puebla

Engineering education societies…

Societies with Engineering Education Research Groups — ASEE, American Society for Engineering Education, Educational Research Methods Division; SEFI, Société Européenne pour la Formation des Ingénieurs (European Society for Engineering Education), Engineering Education Research Working Group; Australasian Association for Engineering Education, Engineering Education Research Working Group; Community of Engineering Education Research Scholars, Latin America and Caribbean Consortium for Engineering Institutions

Societies with Engineering Education Research Interests — Indian Society for Technical Education, Latin American and Caribbean Consortium of Engineering Institutions, Asociación Nacional de Facultades y Escuelas de Ingeniería (National Association of Engineering Colleges and Schools in Mexico), Internationale Gesellschaft für Ingenieurpädagogik (International Society for Engineering Education), International Federation of Engineering Education Societies, South African Engineering Education Association (SASEE)

Forums for dissemination…

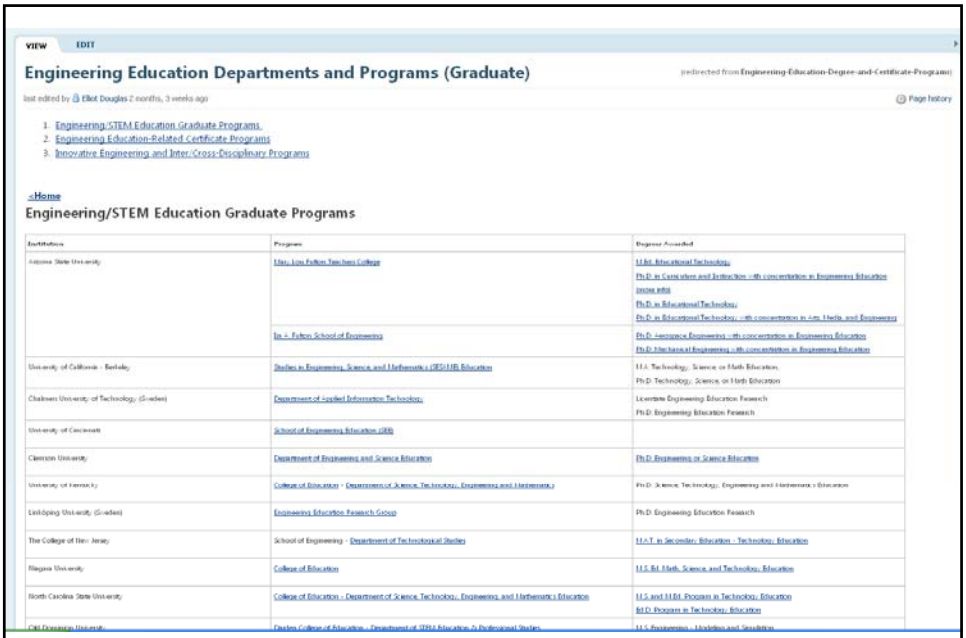


Conferences with engineering education research presentations:

- **ASEE** — Annual Conference, American Society for Engineering Education, see www.asee.org
- **AAEE** — Annual Conference, Australasian Association for Engineering Education, see www.aaee.com.au
- **FIE** — Frontiers in Education, sponsored by ERM/ASEE, IEEE Education Society and Computer Society, /fie-conference.org/erm
- **GCEE** — Global Colloquium on Engineering Education, sponsored by ASEE and local partners where the meeting is held, see www.asee.org
- **SEFI** — Annual Conference, Société Européenne pour la Formation des Ingénieurs , see www.sefi.be
- **REES** — Research on Engineering Education Symposium, rees2009.pbwiki.com/
- **SASEE** – South African Society for Engineering Education,

Participant Networking
EER & STEM Centers and Programs

- Arizona State University
- University of California-Berkeley
- Clemson University
- University of Cincinnati
- University of Georgia
- Georgia Tech
- University of Kentucky
- Linkoping University (Sweden)
- Michigan State University
- University of Michigan
- University of Minnesota
- North Carolina State University
- The Ohio State University
- Pennsylvania State University
- University of Pittsburgh
- Purdue University
- Tufts University
- Universidad de las Americas Puebla (Mexico)
- Universiti Teknologi Malaysia
- University of Texas – Austin
- Uppsala University (Sweden)
- Utah State University
- Virginia Tech
- Washington State University
- University of Washington
- Wichita State University


VIEW EDIT

Engineering Education Departments and Programs (Graduate)

(redirected from Engineering-Education-Degree-and-Certificate-Programs)

last edited by Elliot Douglas 2 months, 3 weeks ago

Page history

1. Engineering/STEM Education Graduate Programs
2. Engineering Education-Related Certificate Programs
3. Innovative Engineering and Inter/Cross-Disciplinary Programs

«Home

Engineering/STEM Education Graduate Programs

Institution	Program	Degree Awarded
Arizona State University	Mary Lou Fulton Teachers College	M.Ed. Educational Technology Ph.D. in Curriculum and Instruction – 4th concentration in Engineering Education (more info) Ph.D. in Educational Technology Ph.D. in Educational Technology – 4th concentration in Arts, Media, and Engineering
	Ira A. Fulton School of Engineering	Ph.D. Aerospace Engineering – 4th concentration in Engineering Education Ph.D. Mechanical Engineering – 4th concentration in Engineering Education
University of California - Berkeley	Studies in Engineering, Science, and Mathematics (ESM) MS Education	M.A. Technology, Science, or Math Education Ph.D. Technology, Science, or Math Education
Chalmers University of Technology (Sweden)	Department of Applied Information Technology	Licentiate Engineering Education Research Ph.D. Engineering Education Research
University of Cincinnati	School of Engineering Education (SEE)	
Clemson University	Department of Engineering and Science Education	Ph.D. Engineering or Science Education
University of Kentucky	College of Education - Department of Science, Technology, Engineering and Mathematics	Ph.D. Science, Technology, Engineering and Mathematics Education
Linköping University (Sweden)	Engineering Education Research Group	Ph.D. Engineering Education Research
The College of New Jersey	School of Engineering - Department of Technological Studies	M.A.T. in Secondary Education - Technology Education
Niagara University	College of Education	M.S. Ed. Math, Science, and Technology Education
North Carolina State University	College of Education - Department of Science, Technology, Engineering, and Mathematics Education	M.S. and M.Ed. Program in Technology Education Ed.D. Program in Technology Education
Old Dominion University	Darden College of Education - Department of STEM Education & Professional Studies	M.S. Engineering – Modeling and Simulation

http://tinyurl.com/engredu

Participant Networking Activity (~25 min)

- **Introductions with Guided Format**
- **Three (~8 min) Conversations in Groups of 2-3**
  - **Your Name & Organization**
  - **Status of EER Center or PhD Program / Interest in EER & EEI**
  - **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 7 min and twice after 8 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 FIE conference and beyond
  - EER Networks – CLEERhub, REEN, SEFI
  - Meet again at ASEE Conference, June, 2012

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 ASEE Headquarters for hosting

Thank you!

An e-copy of this presentation will be posted to:
http://CLEERhub.org
http://www.ce.umn.edu/~smith/links.html

ASEE Annual Conference – June 12, 2012 – T106D – 7:00 am – 8:30 am

Facilitated By

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