## EER&I Networking Session

# Connecting and Expanding the Engineering Education Research & Innovation (EER&I) Communities

ASEE Annual Conference – June 18, 2019– T474 – 1:30 pm – 3:00 pm

**Facilitated By**

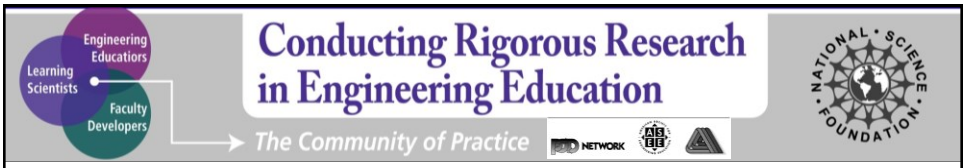

**Karl A. Smith**
Purdue University and
University of Minnesota

**Ruth A. Streveler**
Purdue University

**Rocio Chavela Guerra**
American Society for
Engineering Education


## Agenda

| | |
|---|---|
| **Introduction of session and facilitators** | **~10 min** |
| **Updates on status of EER&I** | **~35 min** |
| • EECHA - Engineering Education Chairs and Heads Association – Cindy Finelli<br>• EER&I Networking Session – Reflection on the first ten years – Karl Smith<br>• Brief Reports<br>  • National Academy of Engineering – Beth Cady<br>  • EER Impact Study - Audeen Fentiman<br>  • EER Departments & DBER Programs<br>  • Hans van Oostrom – University of Florida<br>  • Lance Perez – University of Nebraska Lincoln<br>  • Monica Cox – The Ohio State University<br>  • Jenni Case – Virginia Tech<br>  • Audeen Fentiman – Purdue Engineering Education Online | |
| **Participant Networking** | **~35 min** |
| • Rapid introductions around guided questions – Brief conversations in groups of 3 – as a way to meet many people<br>• Identification of "intellectual neighborhoods" around research and innovation questions and opportunities – individual reflection and writing | |
| **Reflection on strategies to connect, expand, and sustain the emerging EER and EEI communities** | **~10 min** |




# What *IS* Rigorous Research in Engineering Education?

ASEE Global Colloquium
Cape Town, South Africa
2008

**Ruth Streveler**

**Karl Smith**

**School of Engineering Education**

**Purdue University, US**

## Overview

- Welcome and introductions
- Background about engineering education research
  - Global landscape
  - RREE projects in US
- What IS rigorous research in engineering education
  - Compare and contrast with technical engineering education
  - Global considerations
- Format
  - Interactive
  - "Team" based

# Who's Here

- Introduce yourself
  - Name, Institution, Country, Discipline, etc.
  - Engineering education research experience
  - Expectations/goals for the session
    - What would make this more useful and valuable for you?

# Engineering Research

**What are the guiding principles for rigorous technical research in your engineering discipline?**

**Technical engineering research can be called rigorous when….**

**→Take a few moments individually to list the qualities and characteristics of rigorous research in engineering.**

**→As a group, develop a list of research standards in engineering.**

# Education Research

**What are the guiding principles for rigorous research in engineering education?**

**Engineering education research can be called rigorous when….**

**→Take a few moments individually to list the qualities and characteristics of rigorous engineering education research.**

**→As a group, develop a list of research standards in engineering education research.**

# Fundamentals of Engineering Education Research

Rigorous Research in Engineering Education Initiative
(NSF DUE 0817461)
**https://stemedhub.org/groups/cleerhub**

Texas State University – San Marcos – October 6, 2017

**Ruth A.Streveler**
Purdue University

**Karl A. Smith**
Purdue University and
University of Minnesota

## 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 in your discipline 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 in the previous list 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

**A Workshop on**

# Building Capability and Communities in Engineering Education Research

*sponsored by the*

National Science Council

National Ping Tung University of Science and Technology

Meiho Institute of Technology

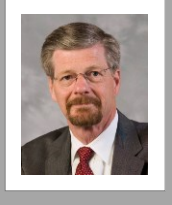
*in partnership with*

Annals of Research in Engineering Education

*Journal of Engineering Education*

Rigorous Research in Engineering Education Initiative

Kaohsiung—Taipei, Taiwan • 2-5 February 2009



**Jack R. Lohmann**
Georgia Institute of Technology

**Karl A. Smith**
Purdue University and University of Minnesota

# Building Engineering Education Research Capabilities and Communities

**Karl A. Smith**
Engineering Education – Purdue University
Civil Engineering - University of Minnesota

**Advancing Taiwan-US Collaborations for Excellence in Engineering Education**

**American Society for Engineering Education**

**June 17, 2009**

**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

# Agenda

What are we going to do?

- **Welcome and Overview (~10 min)**
- **Introductions and Brief Statement from Representative of Established EER PhD Programs (~20 min) – Ten Briefings, ~2 min each**
  - When the PhD program was started
  - Where it is located
  - Number of PhD students and graduates
- **Participant Networking Activity (~30 min)**
- **Brainstorming Strategies to Connect, Expand, and Sustain the Emerging EER Community (~10 min)**
- **Wrap Up and Next Steps (~5′ min)**

# 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**

## UNIVERSITI TEKNOLOGI MALAYSIA CENTRE FOR ENGINEERING EDUCATION: LOCAL & GLOBAL ACTIVITIES

**Scholarly Innovations, Research & PhD in Engineering Education**

More than 20 PhD graduates since 2011
Current students: 16

**Translating research into practice**

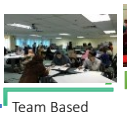
JICA-funded PBL for Low Carbon Society with Kyoto Environ. Activities Assoc. & Johor State Edu. Dept

**Training, Mentoring, & Recognition**

4 international & 8 national awards


**Research & knowledge implementation & dissemination**

Active Learning



Team Based Learning

Cooperative Problem Based Learning (CPBL)

Training: Effective SCL implementation for Engaging Millennials

**Community of practice – enable and support**

**Champions & Communities of change agents**

International Innovative Practices in Higher Education Expo (I-PHEX)

International Engineering Service Learning with Korea &

Champions and trainers (TOT) – World Bank-funded project with MOHE Afghanistan

Contact: khairiyah@utm.my

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## EER&I Networking Session

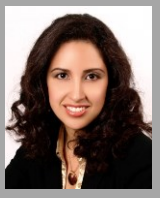
# Connecting and Expanding the Engineering Education Research & Innovation (EER&I) Communities

ASEE Annual Conference – June 28, 2016 – T459A – 1:15 pm – 2:45 pm

**Facilitated By**

**Karl A. Smith**
Purdue University and University of Minnesota

**Ruth A. Streveler**
Purdue University



**Rocio Chavela Guerra**
American Society for Engineering Education

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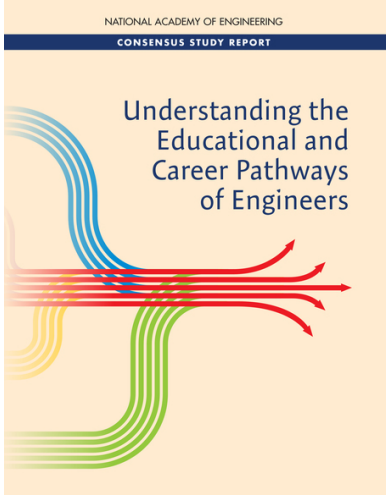
# National Academy of Engineering

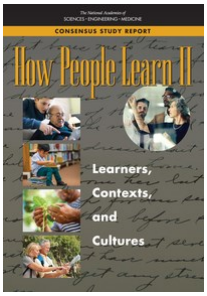
For questions please contact Beth Cady at
ecady@nae.edu

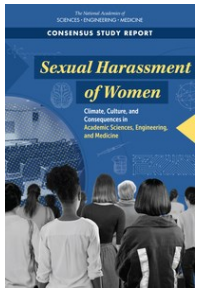

# Understanding the Educational and Career Pathways of Engineers

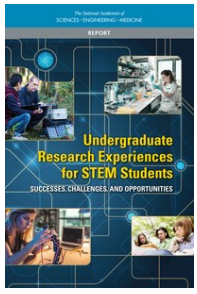
- Released December 2018
- Explore the career choices of engineering graduates and those employed as engineers with non-engineering degrees in the United States.
  - Characteristics of those working as engineers and those formally educated as engineers who are not working in engineering in the United States.
  - Factors that influence the career decisions of those working as engineers and those formally educated as engineers who are not working in engineering.
  - Consider the implications of current educational and career pathways on a variety of stakeholders.

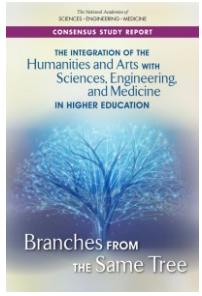


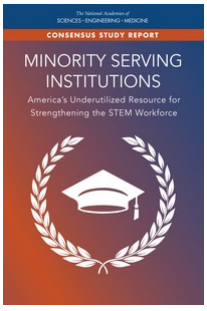
# Recent Education-related NASEM Reports

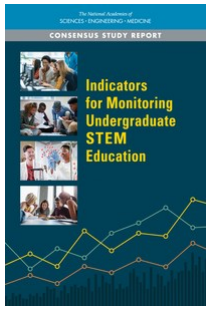


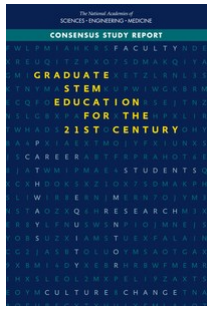



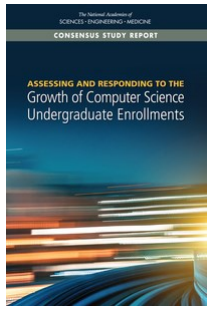



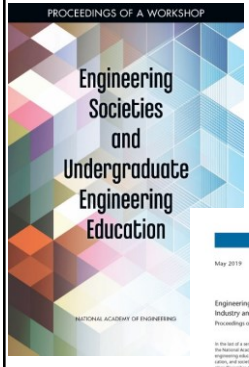



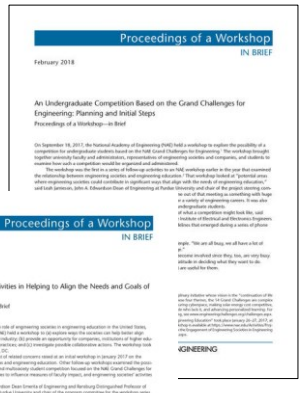




# Engagement of Engineering Societies in Undergraduate Engineering Education

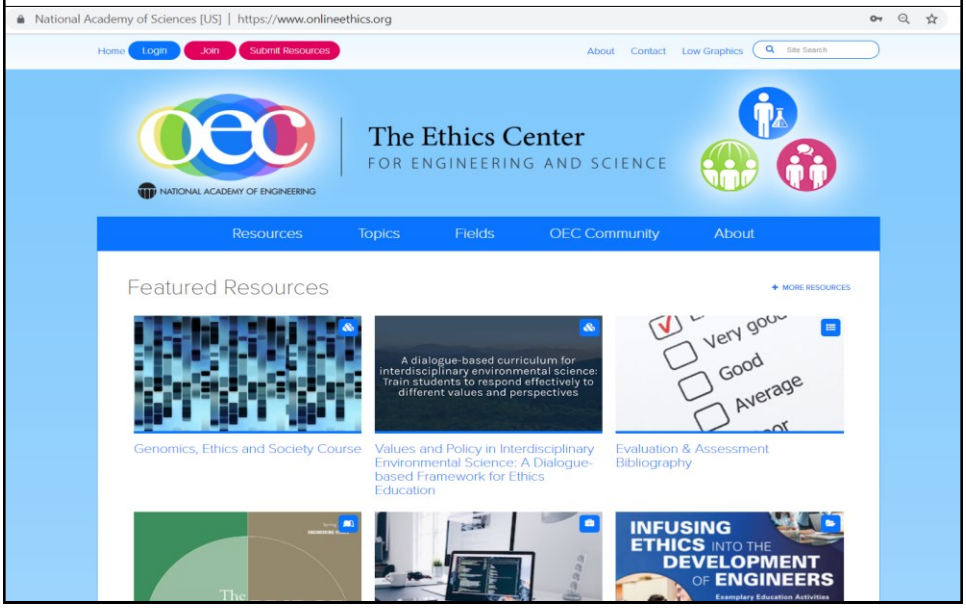




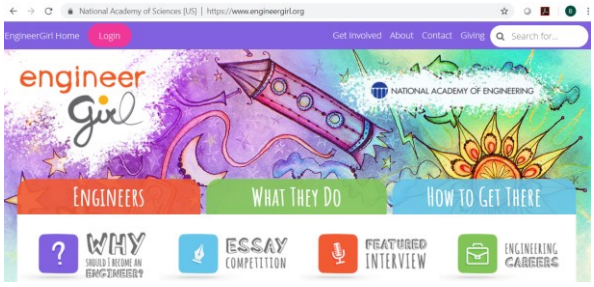

# Center for Engineering Ethics and Society

*Engineering for the needs of people and the planet*




# Grand Challenges for Engineering

# NAE K-12 Education Resources




EngineerGirl.org

- Aimed at middle school students, especially girls

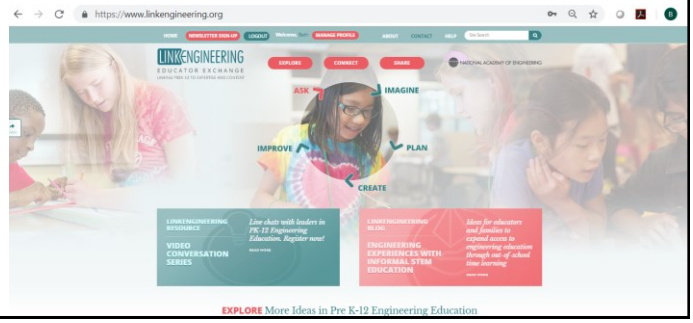
- Essay contest draws 100s of entries each year

- Ambassador program for high school girls to mentor younger girls in engineering projects (yearly)

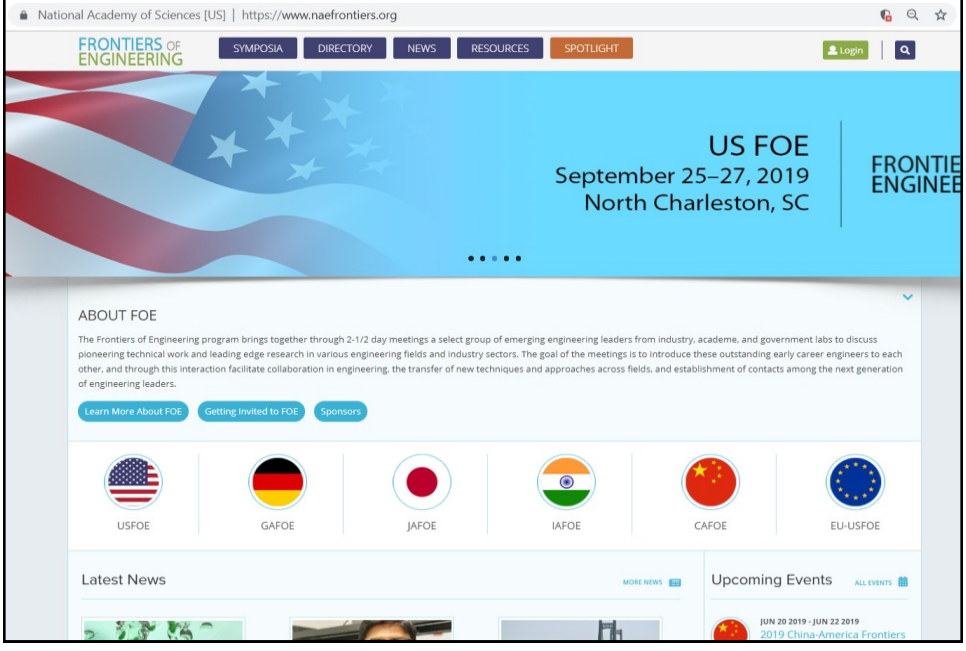
**LinkEngineering.org**

- Online community of practice for PK-12 educators

- Partnership with TeachEngineering.org, a digital library with ~1700 resources




# Frontiers of Engineering



# Update on EAGER: Impact of the Emerging EER&I Community

EER&I Networking Session – ASEE 2019

Audeen Fentiman

On behalf of the collaborators

29

# Collaborators on NSF #1736469

(9/1/2017 – 8/31/2019)

- Purdue University
  - Donna Riley, PI; Robin Adams, Audeen Fentiman, Karl Smith
- Virginia Tech
  - Jenni Case, Jeremi London
- Arizona State University
  - Ann McKenna, Nadia Kellam

30

# Goals

- Identify the EER&I faculty network
- Identify examples of EER&I impact
- Organize and host a summit of EER&I leaders and change researchers to develop a systematic process for documenting the impact of EER&I
- Pilot the process at the three participating schools (and others)
- Compile and disseminate best practices

31

# EER&I Impact Summit and Results

- September 24 & 25, 2018, in West Lafayette, IN
- 30 participants
- Topics covered
  - Identifying and connecting the broader EER&I community
  - Gathering and presenting evidence of EER&I impact
  - Communicating impact to various audiences
  - Piloting a few systematic processes for documenting impact of EER&I
- Results
  - 5 pages of potential impacts (bulleted lists)
  - Detailed plans for presenting quantitative and qualitative evidence of impact
  - 8 pilot programs to document impact at various institutions

32

## Panel Session at ASEE 2019

- Monday, June 17, 2019 – 90 minutes
- Format
  - 3-min presentation on each of 8 pilots
  - Small groups of attendees plan efforts to document impact at their schools
  - Groups report out
- Results
  - ___ people attended
  - Summary of lessons learned by presenters
  - Summary of plans shared by participants

33

## What's Next

- Seek one-year, no cost extension
- Share summary of impact metrics with the EER&I network
- Share impact documents with EER&I network as they are completed
- Write final report and disseminate results
- Explore whether we need a national database or standard, but flexible, tool to help EER&I programs characterize their impact

34

UF Herbert Wertheim College of Engineering
UNIVERSITY of FLORIDA

#8
UF IS NUMBER 8 AMONG PUBLIC UNIVERSITIES
U.S. NEWS & WORLD REPORT
2019

# NEW DEPARTMENT OF ENGINEERING EDUCATION

The field of Engineering is unique due to its wide breadth of subject areas that incorporate an extensive study of fundamentals as well as a vast body of experiential learning.

Here at the University of Florida's Herbert Wertheim College of Engineering, we are proud to fully establish the **Department of Engineering Education** starting fall 2019.

Faculty in the department will teach general engineering courses, including a first-year design class, courses for a graduate certificate in Engineering Education, and conduct fundamental and applied research in Engineering Education.

*Visit us at Booth #317 for a department "Birth" Day cake cutting at 5:15 p.m. on Monday, June 17.*

**JOIN THE TRANSFORMATION.** UF is hiring faculty members across all disciplines.

UF Herbert Wertheim College of Engineering
UNIVERSITY of FLORIDA

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U.S. NEWS & WORLD REPORT
2019

NEW DEPARTMENT OF ENGINEERING EDUCATION

JOIN THE TRANSFORMATION. UF is hiring faculty members across all disciplines.

IMPACT • ACCESS • INCLUSION

# Nebraska's DBER Initiative

Lance C. Pérez, PhD
Omar H. Heins Professor of Electrical and Computer Engineering
Dean

COLLEGE OF ENGINEERING

## History

IMPACT • ACCESS • INCLUSION

- Ten years ago, UNL started a DBER initiative in the sciences
- Hired DBER Faculty into T/TT positions in our science departments
- These faculty have
  - Established successful research programs
  - Impacted the teaching practice and curriculum of their units
  - Been accepted by their units as peers

## 3 Years Ago in the College of Engineering

IMPACT • ACCESS • INCLUSION

- We had many faculty engaged in SOTL, but engagement was uneven and lack coherence.
- A few faculty had evolved into DBER faculty, largely by engaging with faculty outside the College and the University.
- They struggled with a lack of infrastructure to support their research programs (e.g., IRB, data collection and analyses, graduate students and programs)

COLLEGE OF ENGINEERING

## Engineering DBER Initiative

IMPACT • ACCESS • INCLUSION

- We opted for a distributed DBER model where we hire DBER faculty into our existing engineering academic units
  - Practical reasons
  - Philosophical reasons
- We started by hiring a senior faculty member as a tenured full professor.
- We are in midst of a cluster hire of junior DBER faculty distributed across the college.
- Engineering DBER faculty are integrated into the larger campus DBER community.

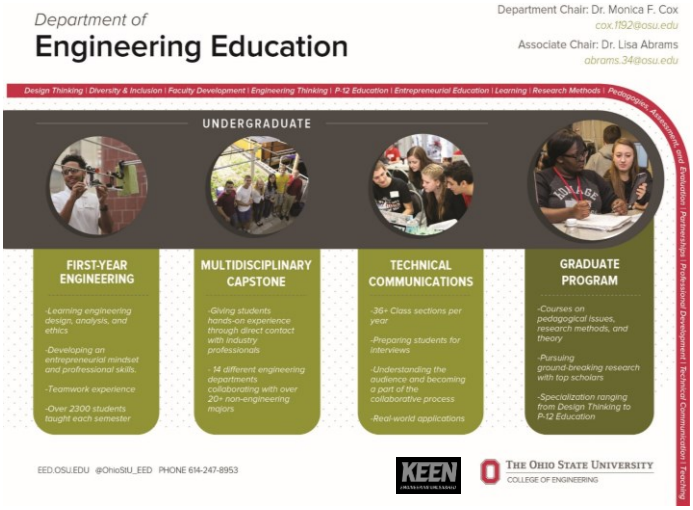
COLLEGE OF ENGINEERING

IMPACT • ACCESS • INCLUSION

lcperez@unl.edu

College of Engineering
114 Othmer Hall, P.O. Box 880642, Lincoln, NE 68588-0642
100 Peter Kiewit Institute, 1110 South 67th Street, Omaha, NE 68182-0176
402-472-5259 | engineering.unl.edu

UNIVERSITY OF NEBRASKA - LINCOLN



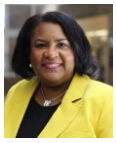

**VALUES**

- Collaborative work
- Student-centered approach
- Diversity
- Safe environment that allows for measured risk taking
- Transparency
- Excellence

THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Department of Engineering Education

## EED New Faculty Hires (2016 – 2019)



**Dr. Monica F. Cox**
Professor
Inaugural
Department Chair

**Dr. Lisa Abrams**
Professor of Practice
Associate Chair

- **Tenure track** (6)
  - 3 Assistant
  - 1 Associate
  - 2 Full

**Clinical** (3)
- 1 Professor
- 2 Assistant

**Research** (1)
- 1 Assistant (pending)

**Dr. Julie P. Martin**
Associate Professor

**Dr. David A. Delaine**
Assistant Professor

**Dr. Emily Dringenberg**
Assistant Professor

**Dr. Jeff Froyd**
Professor

**Dr. Krista Kecskemety**
Assistant Professor of Practice

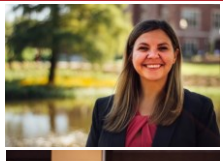
**Dr. Rachel Kajfez**
Assistant Professor

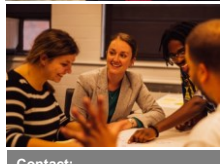
**Dr. Xiaofeng "Denver" Tang**
Assistant Professor of Practice

THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Department of Engineering Education

## Ph.D. Program in Engineering Education (Launched Fall 2018)





**Contact:**
**Graduate Program Coordinator**
**Ana Casado**
**casado.1@osu.edu**

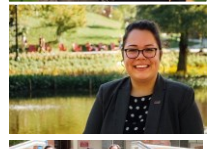
### Program Goals for Student Learning:

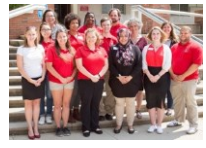
1. Identify, discuss and address critical issues facing engineering education in alignment with stakeholder needs.
2. Design, conduct and critique research in engineering education.
3. Demonstrate, value and apply engineering expertise.
4. Create, teach and assess courses and curricula.
5. Identify, demonstrate and value appropriate personal and professional skills, mindsets and traits.

### Coursework

- Foundations and the Field of Engineering Education
- Learning Theory, Pedagogy, and Assessment
- Research Design in Engineering Education
- Professional Development in Engineering Education
- Teaching Practicum I & II

**eed.osu.edu/eed-graduate-program**





THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Department of Engineering Education

## EED 2019 Advisory Board Roster

Term: September 1, 2017 – August 31, 2019

**Dr. Alex Bandar**
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Director
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The Ohio State University

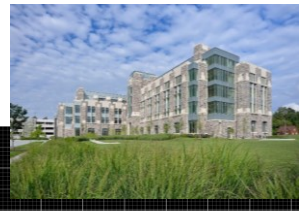
**Dr. Marie Paretti**
Professor
Engineering Education
Co-Founder and Director
Engineering Communication Center
Virginia Tech

VT | COLLEGE OF ENGINEERING ENGINEERING EDUCATION VIRGINIA TECH

# Virginia Tech
## Department of Engineering Education

## UPDATE – Beyond the figures

JENNI CASE
Department Head 2017 -



## What are we all about?

@vtenge

- We support students
  - First year engineering students making the transition to university – highly professional advising team
  - Graduate students on their research and career trajectories – strong culture of mentorship
- We teach
  - General introduction to engineering studies (2X2 credits, 2500+ students in sections of 75) – high quality at scale
  - Learning through international engagement (180 students) – nationally recognized program, largest at VT
  - Field of engineering education research, scholarship and practice (6 graduate core courses) – recently updated
  - An introduction to spatial visualization (230 students) – informed by cutting edge research
  - A suite of courses leading to a minor in Innovation – scope for development
  - New course for all engineering grad students – mentoring, diversity – pilot in 2019/20
- We develop and share new knowledge - Through research, scholarship, practice – strong portfolio of external funding
  - In conjunction with our grad students – significant opportunities for research assistant positions & co-authoring
  - In a broader national & international community of researchers – we are highly networked
  - In collaboration with practitioners and in our own courses - fast growing suite of collaborations
- We support each other in our career development – highly collaborative culture supported by DH leadership

# PURDUE ENGINEERING EDUCATION ONLINE

**EER&I Networking Session – ASEE 2019**

Audeen Fentiman

# GRADUATE CERTIFICATE – NOW ONLINE

- 10 credit hours
- 4 courses
  - Content, Assessment and Pedagogy – 3 hours
  - Engineering Education Methods – 3 hours
  - Mentored Teaching – 1 hour
  - Succeeding as an Engineering Professor – 3 hours
- All courses available each year – 2 per semester
- Enrollment cap – 20 students per section

# GRADUATE CERTIFICATE

- Philosophy for teaching online
  - Same learning outcomes as on-campus classes
  - Same assignments – with detailed faculty feedback
  - Extensive student-student and student-faculty interaction
  - Quality of experience equal to on-campus
- Different courses taking different approaches
  - Asynchronous or hybrid synchronous/asynchronous
  - Students participate in class discussions as individuals or as teams
  - Materials made available to students in different ways

# GRADUATE CERTIFICATE – AUDIENCES

- Engineering and STEM Ph.D. students at Purdue
- Engineering and STEM Ph.D. students at other universities
- Current Engineering or other STEM faculty
- Practicing engineers and scientists seeking a second career in academia

# NON-THESIS MS ENE – ONLINE SOON

- Most core courses now available online (last one ready Spring 2020)
- Request for online non-thesis MS ENE in the system
- Some electives taken elsewhere can be transferred to Purdue (pre-approval suggested)
- Some online courses can be counted toward Ph.D.

# PUTTING COURSES ONLINE

- Opportunity to rethink how the course is taught
- Each faculty member taking slightly different approach
- Many lessons learned
- Expect to share results in the future

## Participant Networking Activity (~35 min)

- **Introductions with Guided Format**
- **Ad Hoc Conversations in Groups of 2-3**
  - Your Name & Organization
  - Status of EER&I Center or PhD Program/Interest in EER&I
  - 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
- **Move to a new group when you're ready**

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

- **Reflect on your interests and plans for engineering education research & innovation**
- **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&I Networks – REEN, SEFI,
  - ASEE Engineering Education Research and Innovation website - https://www.asee.org/public#innovation

# Thank you!

An e-copy of this presentation will be posted to: https://karlsmithmn.org/engineering-education-research-and-innovation/

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