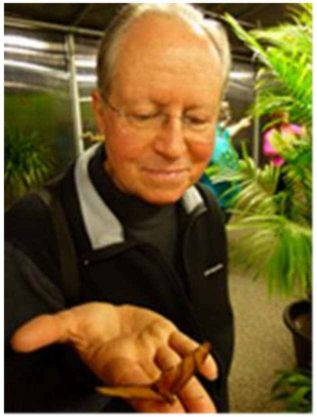
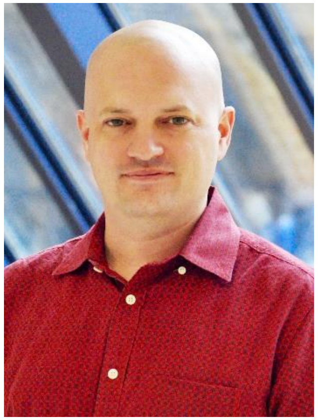
Engineering Education Research: Fundamentals Review and Research Questions





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Fundamentals of Engineering Education Research

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

IUCEE – December 19, 2020

Ruth A.Streveler
Purdue University

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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

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

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.

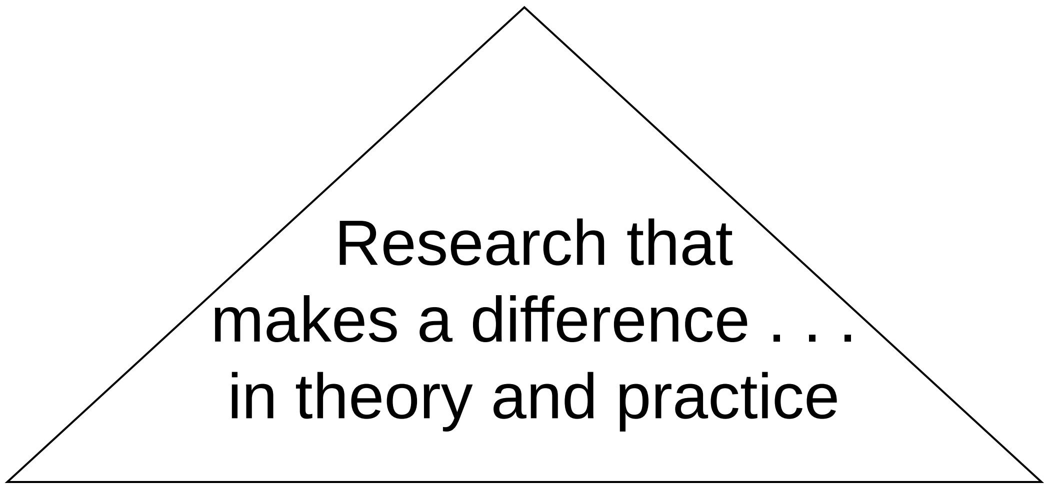
Some history about this workshop

- **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

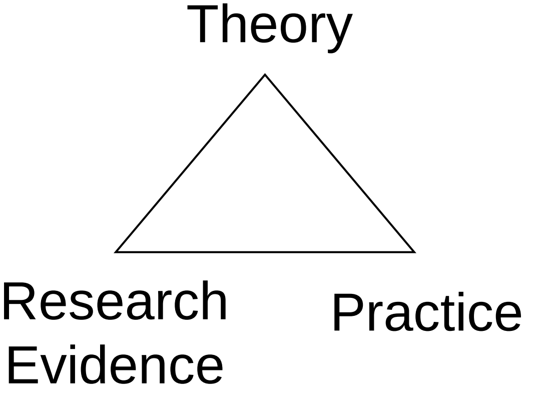
(appropriate design and methodology)

Practice

(implications for teaching)

Cooperative Learning

- Theory – Social Interdependence – Lewin – Deutsch – Johnson & Johnson
- Research – Randomized Design Field Experiments
- Practice – Formal Teams/Professor's Role



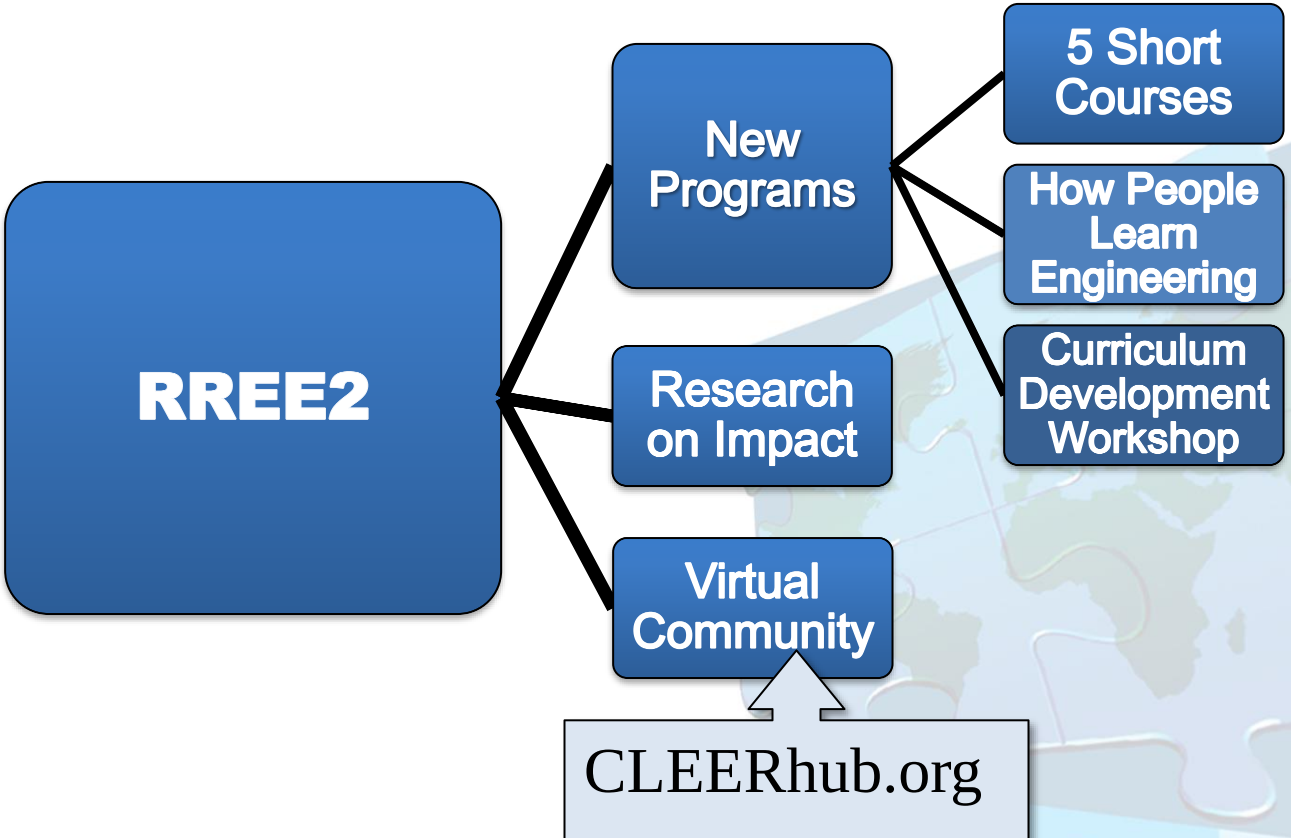
RREE

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



RIGOROUS RESEARCH *in* ENGINEERING EDUCATION

Centrality of Community of Practice (CoP)

- Streveler, R.A., Smith, K.A., and Miller, R.L. 2005. Enhancing Engineering Education Research Capacity through Building a Community of Practice.
- Streveler, R.A., Magana, A.J., Smith, K.A. and Douglas, T.C. 2010. CLEERHub.org: Creating a digital habitat for engineering education researchers. American Society for Engineering Education Annual Conference
- Pitterson, N., Allendoerfer, C., Streveler, R., Ortega-Alvarez, J., & Smith, K. (2020). The Importance of Community in Fostering Change: A Qualitative Case Study of the Rigorous Research in Engineering Education (RREE) Program. *Studies in Engineering Education*, *1*(1), 20–37. DOI: http://doi.org/10.21061/see.7 https://www.seejournal.org/articles/10.21061/see.7/

RREE2

Follow-up proposal (RREE2)

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

*Recorded and posted on https://stemedhub.org/groups/cleerhub

Today's objectives

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

Objective 1

Identify principal features of engineering education research

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…."**

☞ **In the Chat** - Individually, list the qualities, characteristics or standards <u>in your discipline</u>

☞ Compare your lists, <u>and as a group</u>, 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

1. Significant questions that can be investigated empirically

- Who would care about your results?

- What data will you need to gather to answer your question?

2. Link research to relevant theory

- Learning theories
  - Cognitive
  - Social-Cognitive
  - Novice – expert differences
  - Instructional psychology
  - Psychometrics
- Motivational theories
- Moral and ethical development
- Social context of education

3. Methods for direct investigation (examples)

Quantitative methods

- Tests
- Surveys & questionnaires (defined response)
- Faculty or peer ratings

Qualitative methods

- Focus groups
- Interviews
- Observations

4. Reasoning

What makes a convincing argument

- Builds on what others have done before (literature)
- Theoretical foundation – make sense of results within existing frameworks of learning and teaching
- Methodology is explicit and appropriate
  - Instruments are reliable and valid
- Strength of observed relationships
- Elimination of alternative explanations
  - Study design
  - Confounding variables

5. Replicate and generalize – use the results

Setting the results in a larger context

- **MUST know the literature**
- **Strict *replication* is rare in educational research**
  - ***Transferable* with extension - to new topic, setting, learners, etc.**

6. Disclose

- Scholarly journals
- Conference presentations

- Peer-review is the core issue
  - One of the few quality controls we have

Cooperative Learning Research Support

Johnson, D.W., Johnson, R.T., & Smith, K.A. 1998. Cooperative learning returns to college: What evidence is there that it works? *Change*, *30* (4), 26-35.*

- Over 300 Experimental Studies
- First study conducted in 1924
- High Generalizability
- Multiple Outcomes

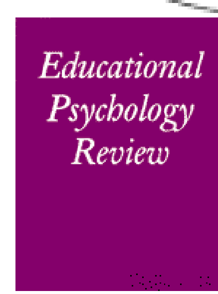
Outcomes of Cooperative Learning

Outcomes

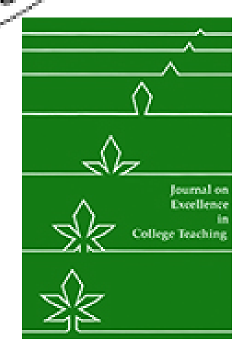
1. Achievement and retention
2. Critical thinking and higher-level reasoning
3. Differentiated views of others
4. Accurate understanding of others' perspectives
5. Liking for classmates and teacher
6. Liking for subject areas
7. Teamwork skills

*[CLReturnstoCollege.pdf]

January 2005



March 2007



25 (3&4) 2014

Objective 2

Frame and situate research questions and methodologies

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.
https://stemedhub.org/collections/post/254/download/Conceptual_Frameworks_Revised_2010.pdf

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.

Research Methodologies

Quantitative methods (Positivist/postpositivist)

- Tests
- Surveys & questionnaires (defined response)
- Faculty or peer ratings

Qualitative methods (Interpretivist)

- Focus groups
- Interviews
- Observations

Epistemological perspective	Post-positivist	Interpretivist (constructivism, social constructionism, hermeneutics, phenomenology, symbolic interactionism)	Critical/ emancipatory	Postmodern/poststructural
View on reality	Single falsifiable reality	Multiple subjective realities	Multiple subjective and political realities	Multiple fragmented realities
Purpose	To find relationships among variables, to define cause-and effect	To describe a situation, experience, or phenomenon	To produce a socio-political critique	To deconstruct existing 'grand narratives'
Methods	Methods and variables defined in advance, hypothesis driven	Methods and approaches emerge and are to be adjusted during study	Methods and approaches designed to capture inequities	Methods and approaches generated during the study
The role of researcher	Researcher is detached	Researcher and participants are partners	Researcher and participants are activists	Researchers and participants have various changing roles
Outcome or research product	Context-free generalizations	Situated descriptions	Critical essays, policy changes	Reconceptualized descriptions of the phenomenon

QUALITATIVE RESEARCH BASICS: A GUIDE FOR ENGINEERING EDUCATORS, page 9.

What is your experience?

- Silently reflect on your experience with engineering education research
- 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

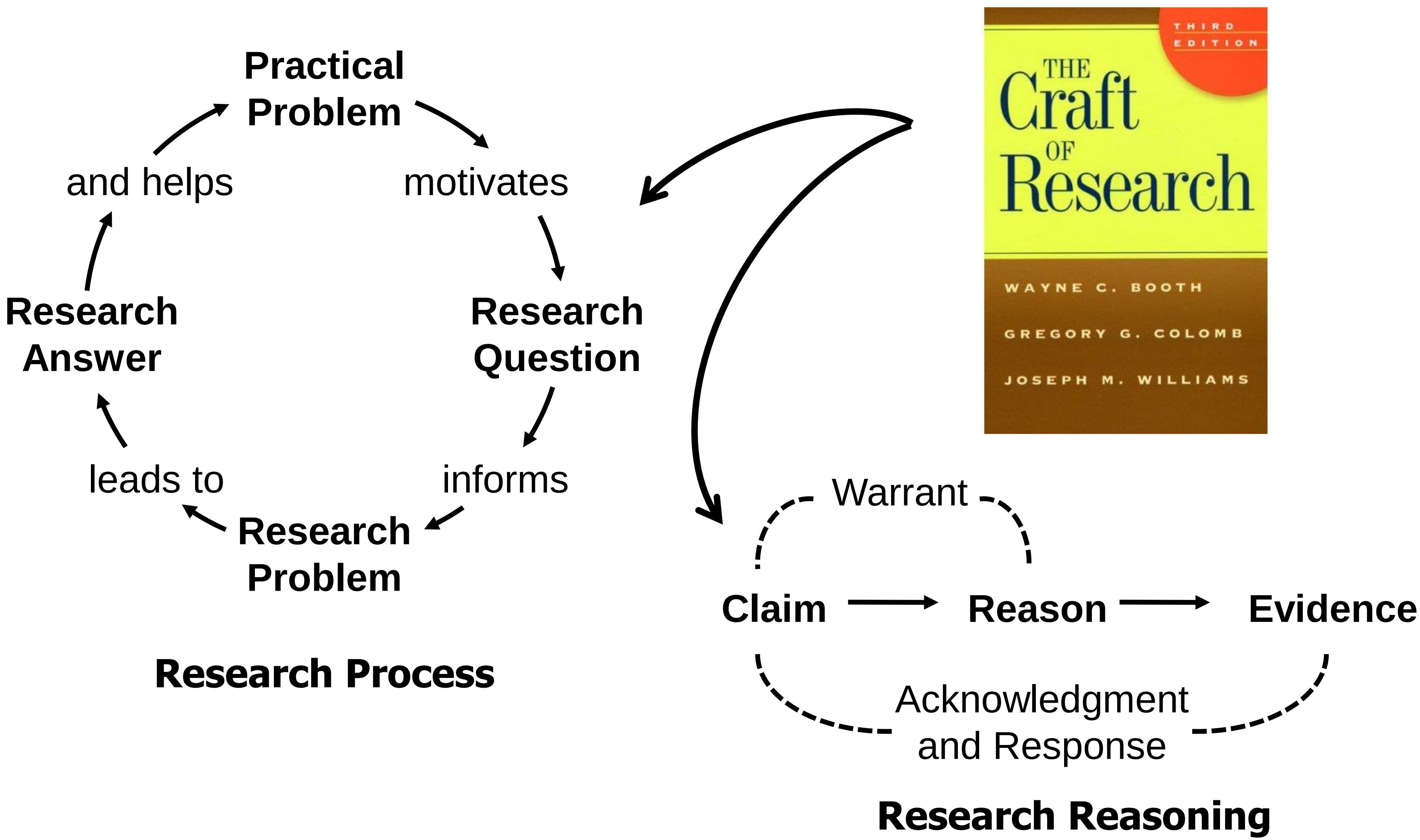
Objective 3

Gain familiarity with several print and online resources

Books, journals, online resources

- The Craft of Research
- Scientific Research in Education
- Disciplined-Based Education Research
- Engineering Education Community Resource
- Journal of Engineering Education (JEE)
- Science Citation Index
- Some other journals

The research process and reasoning



Discipline-Based Education Research (DBER)

Understanding and Improving Learning in Undergraduate Science and Engineering

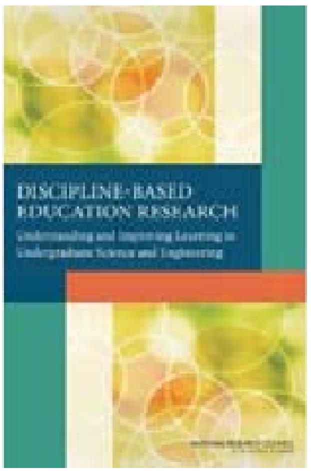
http://www.nap.edu/catalog.php?record_id=13362

Global Calls for Reform

K-12 Engineering

Research-based Transformation

Discipline-Based Education Research (DBER)



National Research Council
2012

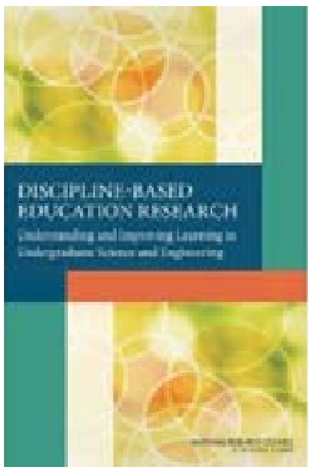
- Discipline-based education research (DBER) is a **small but growing field of inquiry**.
- **Conducting DBER** and **using DBER** findings are **distinct but interdependent** pursuits.
- DBER is **inherently interdisciplinary.**
- Individual fields of DBER have made **notable inroads** in terms of establishing their fields **but still face challenges in doing so.**
- **Blending** a scientific/engineering discipline with education research poses **unique professional challenges for DBER scholars.**
- There are **many pathways to becoming a discipline-based education researcher**.

PURDUE ENGINEERING EDUCATION

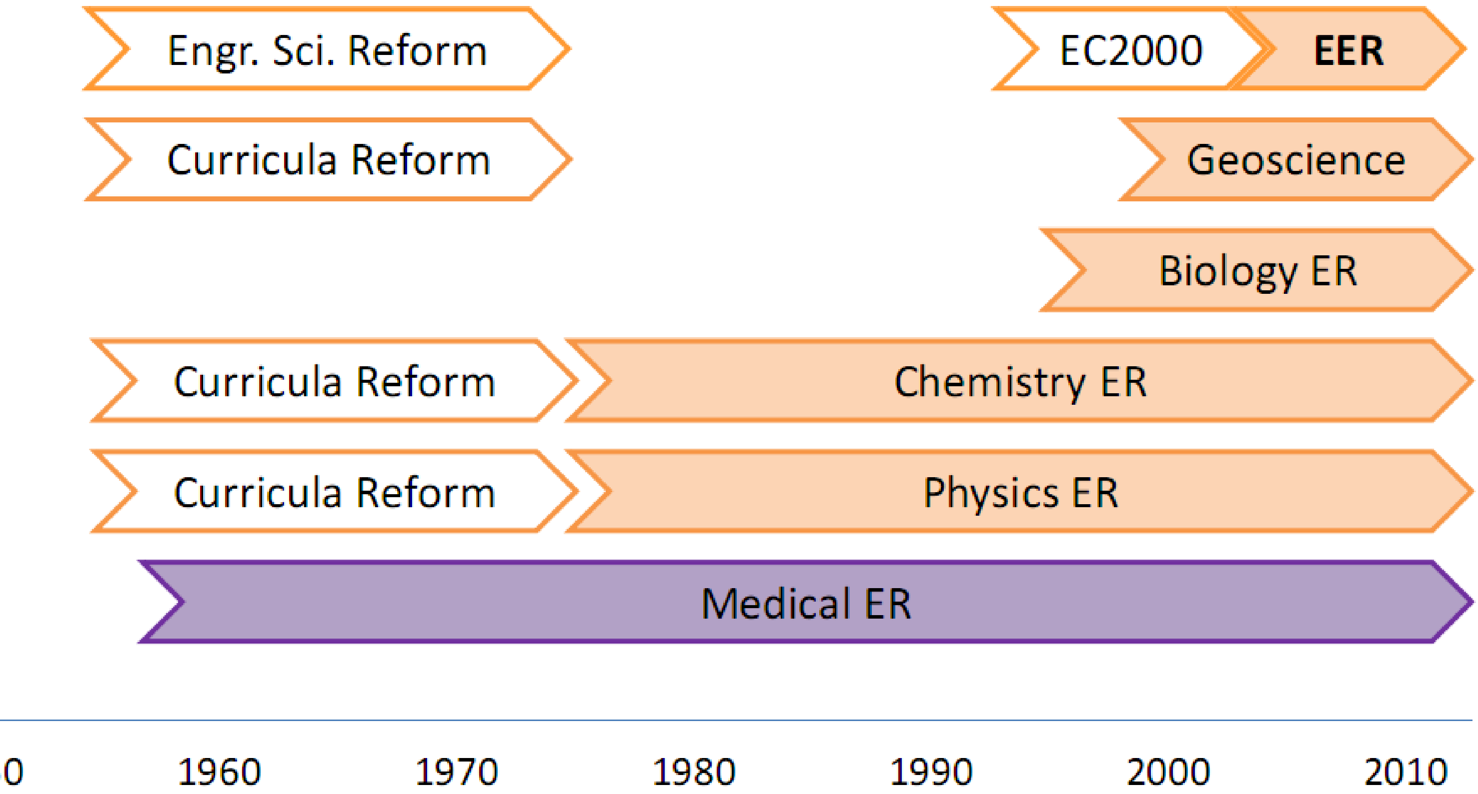
http://www.nap.edu/catalog.php?record_id=13362

Discipline-Based Education Research Timeline

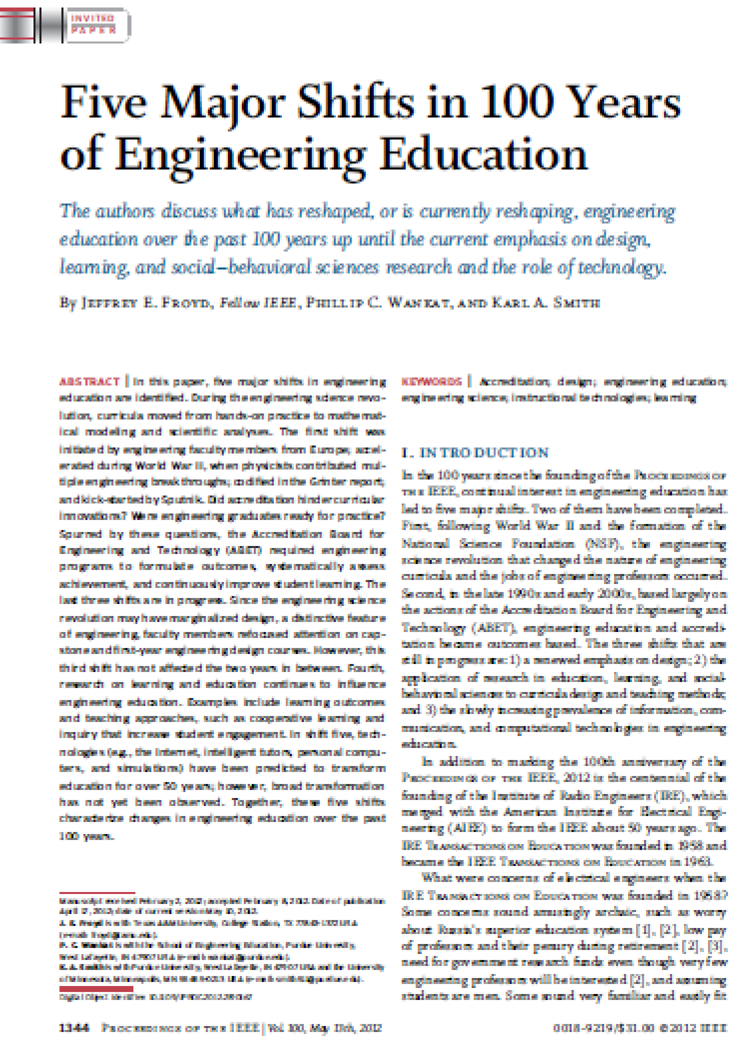
DBER Departments and Graduate Programs



National Research Council 2012



DBER is **located** in the relevant disciplinary school, e.g. medicine, physics.



INVITED PAPER

Five Major Shifts in 100 Years of Engineering Education

The authors discuss what has reshaped, or is currently reshaping, engineering education over the past 100 years up until the current emphasis on design, learning, and social–behavioral sciences research and the role of technology.

By Jeffrey E. Froyd, *Fellow IEEE*, Phillip C. Wankat, and Karl A. Smith

ABSTRACT | In this paper, five major shifts in engineering education are identified. During the engineering science revolution, curricula moved from hands-on practice to mathematical modeling and scientific analyses. The first shift was initiated by engineering faculty members from Europe, accelerated during World War II, when physicists contributed multiple engineering breakthroughs, codified in the Grinter report, and kick-started by Sputnik. Did accreditation hinder curricular innovations? Were engineering graduates ready for practice? Spurred by these questions, the Accreditation Board for Engineering and Technology (ABET) required engineering programs to formulate outcomes, systematically assess achievement, and continuously improve student learning. The last three shifts are in progress. Since the engineering science revolution may have marginalized design, a distinctive feature of engineering, faculty members refocused attention on capstone and first-year engineering design courses. However, this third shift has not affected the two years in between. Fourth, research on learning and education continues to influence engineering education. Examples include learning outcomes and teaching approaches, such as cooperative learning and inquiry that increase student engagement. In shift five, technologies (e.g., the Internet, intelligent tutors, personal computers, and simulations) have been predicted to transform education for over 50 years; however, broad transformation has not yet been observed. Together, these five shifts characterize changes in engineering education over the past 100 years.

KEYWORDS | Accreditation; design; engineering education; engineering science; instructional technologies; learning

I. INTRODUCTION

In the 100 years since the founding of the Proceedings of the IEEE, continual interest in engineering education has led to five major shifts. Two of them have been completed. First, following World War II and the formation of the National Science Foundation (NSF), the engineering science revolution that changed the nature of engineering curricula and the jobs of engineering professors occurred. Second, in the late 1990s and early 2000s, based largely on the actions of the Accreditation Board for Engineering and Technology (ABET), engineering education and accreditation became outcomes based. The three shifts that are still in progress are: 1) a renewed emphasis on design; 2) the application of research in education, learning, and social-behavioral sciences to curricula design and teaching methods; and 3) the slowly increasing prevalence of information, communication, and computational technologies in engineering education.

In addition to marking the 100th anniversary of the Proceedings of the IEEE, 2012 is the centennial of the founding of the Institute of Radio Engineers (IRE), which merged with the American Institute for Electrical Engineering (AIEE) to form the IEEE about 50 years ago. The IRE Transactions on Education was founded in 1958 and became the IEEE Transactions on Education in 1963.

What were concerns of electrical engineers when the IRE Transactions on Education was founded in 1958? Some concerns sound amazingly archaic, such as worry about Russia's superior education system [1], [2], low pay of professors and their penury during retirement [2], [3], need for government research funds even though very few engineering professors will be interested [2], and assuming students are men. Some sound very familiar and easily fit

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1. a shift from hands-on and practical emphasis to engineering science and analytical emphasis;
2. a shift to outcomes-based education and accreditation;
3. a shift to emphasizing engineering design;
4. a shift to applying education, learning, and socialbehavioral sciences research;
5. a shift to integrating information, computational, and communications technology in education.

http://ieeexplore.ieee.org/xpl/articleDetails.jsp?reload=true&tp=&arnumber=6185632

Workshop Resources

- **Fundamentals of Engineering Education Research**
  - Slides [Texas_State-San_Marcos-EER-Workshop-Smith-Oct-6-2017-v2.pdf]
  - Collaboratory for Engineering Education Research (CLEERhub) Research Monographs - https://stemedhub.org/groups/cleerhub
    - A Guidebook On Conceptual Frameworks For Research In Engineering Education
    - Qualitative Research Basics: A Guide for Engineering Educators [RREE-Qualitative_Research_Basics-Chism-Douglas-Hilson-2008.pdf]
    - Planning, Implementing, and Reporting Quantitative Research in Education: A User's Guide [RREE_quantitative_research_guide.pdf]
  - National Academy Press Reports
    - Scientific Research in Education
    - Discipline-Based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering
    - Reaching Students: What Research Says About Effective Instruction in Undergraduate Science and Engineering
  - Other Reports
    - ASEE - Innovation with Impact: Creating a Culture for Scholarly and Systematic Innovation in Engineering Education
    - IEEE - Five Major Shifts in 100 Years of Engineering Education

Objective 4

Become aware of global communities and their networks

131
centers & groups

48
graduate programs

75
conferences & workshops

60
journals

...and more

engineering education community resource

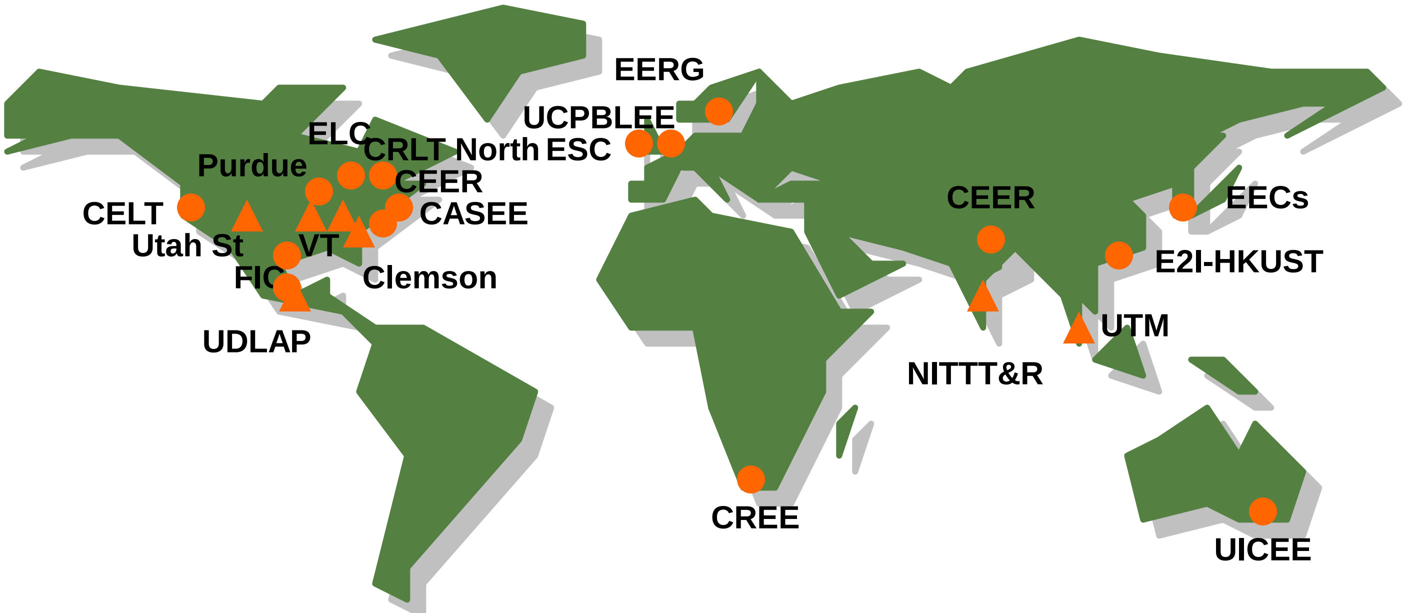
http://bit.ly/engredu

An <u>emerging</u> global community

- Groups, centers, departments
- Engineering education societies
- Forums for dissemination

What follows is a **sample** — it is NOT an exhaustive list!

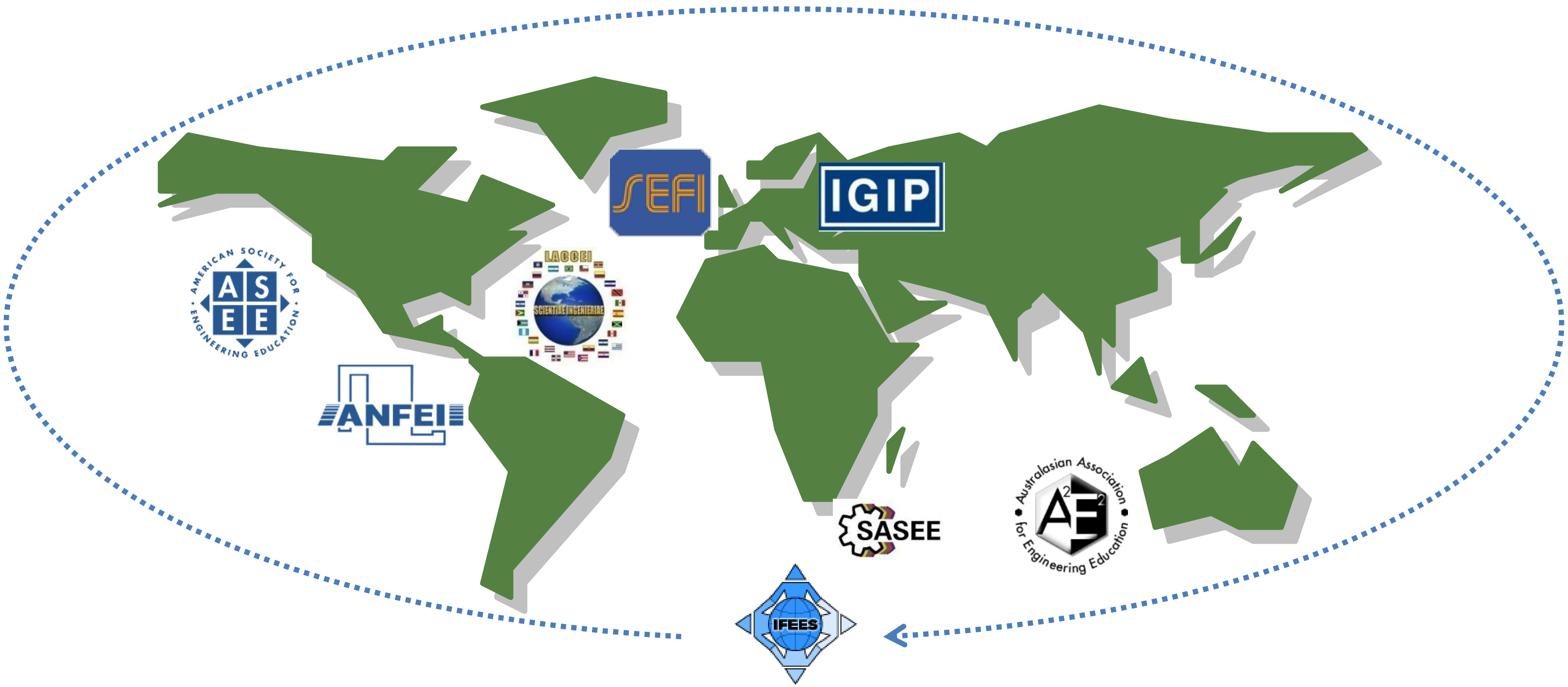
Groups, centers, departments…



● **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, EECs, Engineering Education Centers in Korea.

▲ **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

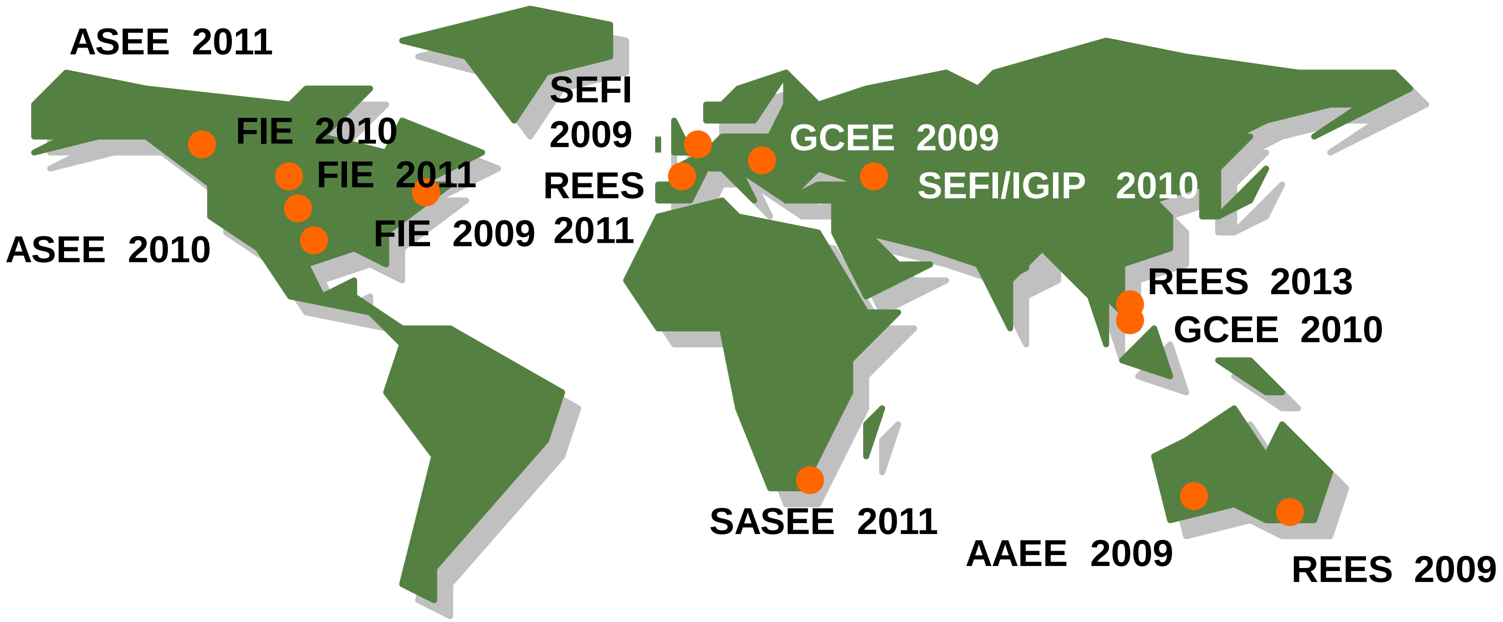
Engineering education societies…



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,

Becoming an Engineering Education Researcher—Adams, Fleming & Smith

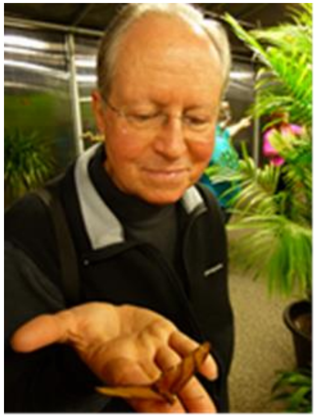
1. Find and follow your dream.
2. Find and build community.
3. Do your homework. Become familiar with engineering education research.
4. Remember what it is like to be a student—be open to learning and the associated rewards and challenges.
5. Find balance. You will feel like you have multiple identities.
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.

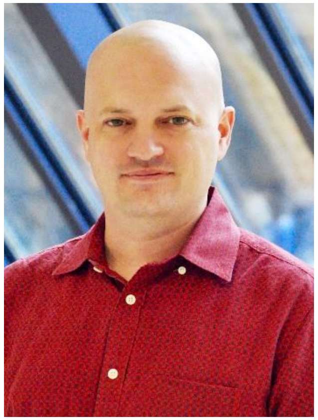
Adams, R., L. Fleming, and K. Smith. 2007. Becoming an engineering education researcher: Three researchers stories and their intersections, extensions, and lessons. Proceedings, International Conference on Research in Engineering Education; http://www.ce.umn.edu/%7Esmith/docs/Adams-Fleming-Smith-Becoming_an_engineering_education_researcher-ICREE2007.pdf

What Are Your Plans?

- Silently reflect on your interests and plans for applying and/or supporting engineering education research, or becoming an engineering education researcher.
- Jot down
  - What do you plan to do next?
  - What are your longer range plans?
- Share with an IUCEE EER participant

Engineering Education Research: Fundamentals Review and Research Questions





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Case Study

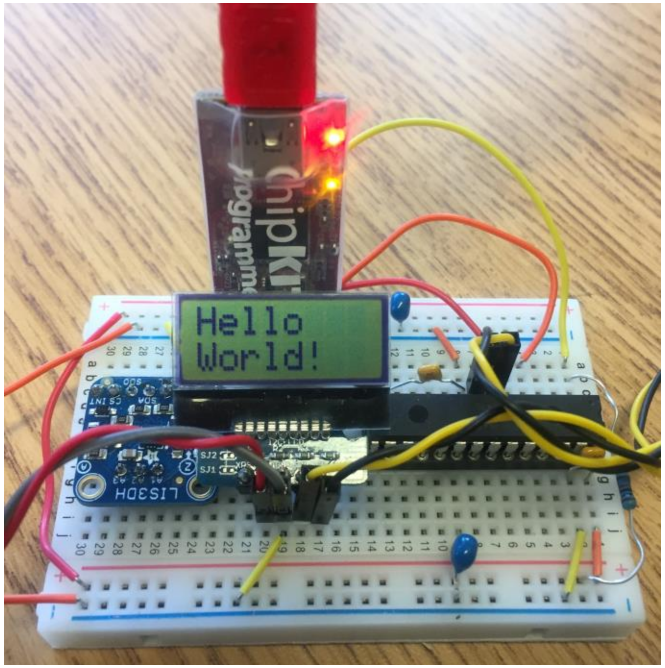
University of Minnesota (UMN)
Electrical and Computer Engineering (ECE)

- 50 Faculty
- 500 Undergraduates
  - Course Sizes: 150 to 20 Students
- 500 Graduate Students
  - Labs are run by TAs

Course Background

- **EE 2361 – Introduction to Microcontrollers**
  - Second Programming Course
  - "Bare metal" Programming
  - Memory and Instructions
  - Interrupts
  - Peripherals
    - Serial Interfaces, Timers, etc.

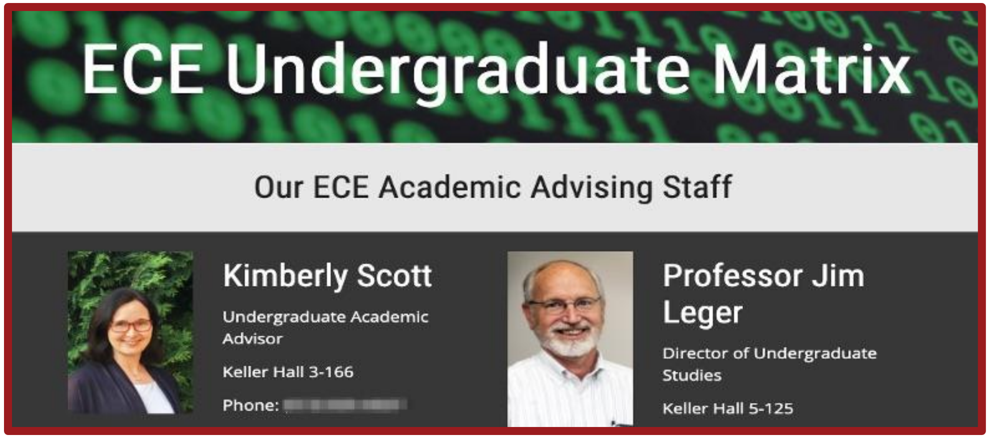
  - **~50/120 students per section**

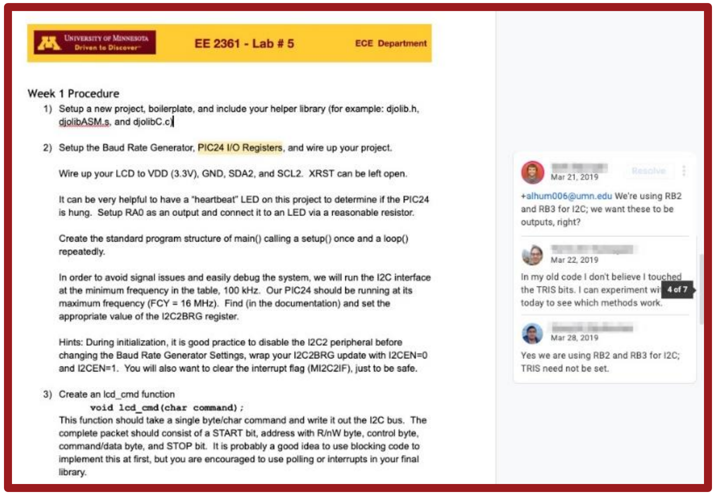


Integrated Advising and TA Feedback

All undergraduate students, meet at least once per term with Academic advising Staff

- Discuss courses
- Degree program progress
- Areas of concern





University of Minnesota Driven to Discover | EE 2361 - Lab # 5 | ECE Department

Week 1 Procedure

1) Setup a new project, boilerplate, and include your helper library (for example: djolib.h, djolibASM.s, and djolibC.c)

2) Setup the Baud Rate Generator, PIC24 I/O Registers, and wire up your project.

Wire up your LCD to VDD (3.3V), GND, SDA2, and SCL2. XRST can be left open.

It can be very helpful to have a "heartbeat" LED on this project to determine if the PIC24 is hung. Setup RA0 as an output and connect it to an LED via a reasonable resistor.

Create the standard program structure of main() calling a setup() once and a loop() repeatedly.

In order to avoid signal issues and easily debug the system, we will run the I2C interface at the minimum frequency in the table, 100 kHz. Our PIC24 should be running at its maximum frequency (FCY = 16 MHz). Find (in the documentation) and set the appropriate value of the I2C2BRG register.

Hints: During initialization, it is good practice to disable the I2C2 peripheral before changing the Baud Rate Generator Settings, wrap your I2C2BRG update with I2CEN=0 and I2CEN=1. You will also want to clear the interrupt flag (MI2C2IF), just to be safe.

3) Create an lcd_cmd function

```
void lcd_cmd(char command);
```

This function should take a single byte/char command and write it out the I2C bus. The complete packet should consist of a START bit, address with R/nW byte, control byte, command/data byte, and STOP bit. It is probably a good idea to use blocking code to implement this at first, but you are encouraged to use polling or interrupts in your final library.

Resolve

Mar 21, 2019

+alhum006@umn.edu We're using RB2 and RB3 for I2C; we want these to be outputs, right?

Mar 22, 2019

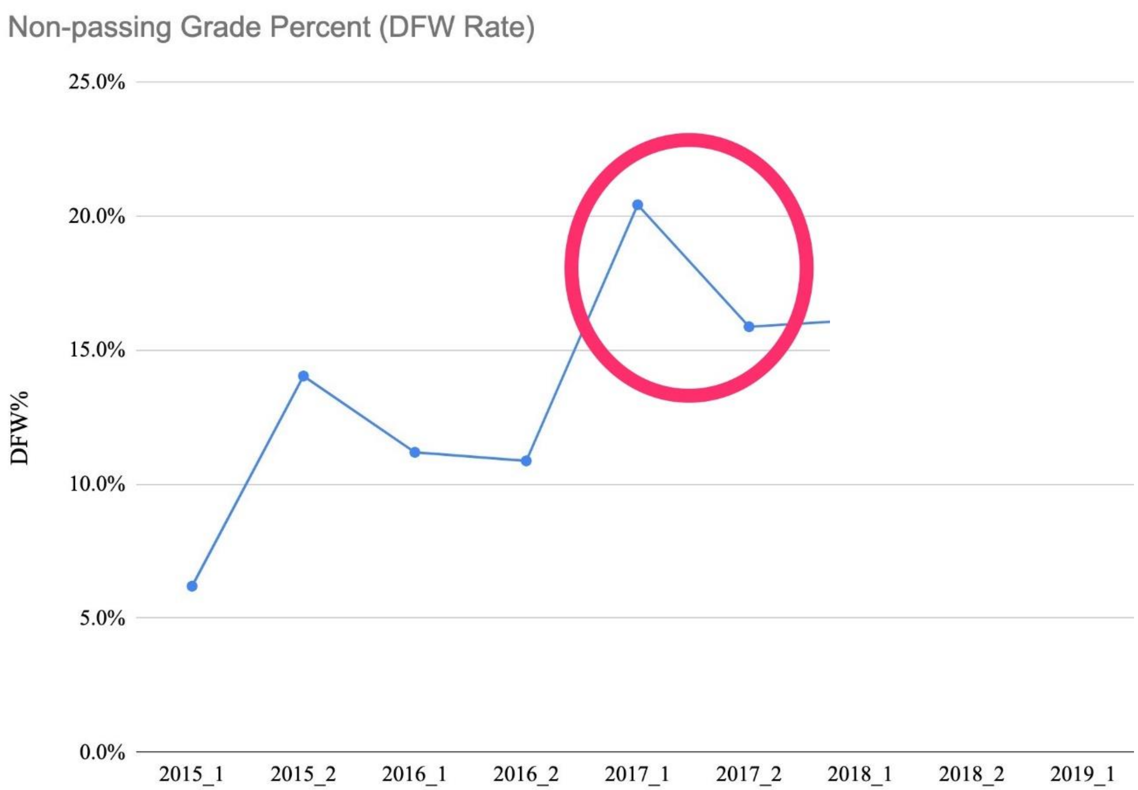
In my old code I don't believe I touched the TRIS bits. I can experiment wi 4 of 7 today to see which methods work.

Mar 28, 2019

Yes we are using RB2 and RB3 for I2C; TRIS need not be set.

- Teaching Assistants:
- Initial Training
- Weekly meetings
- End of Term “Lesson’s Learned”
- Continuous Improvements

2018 – (1) Identification and Discussion



DFW - D, F, or Withdraw Rate

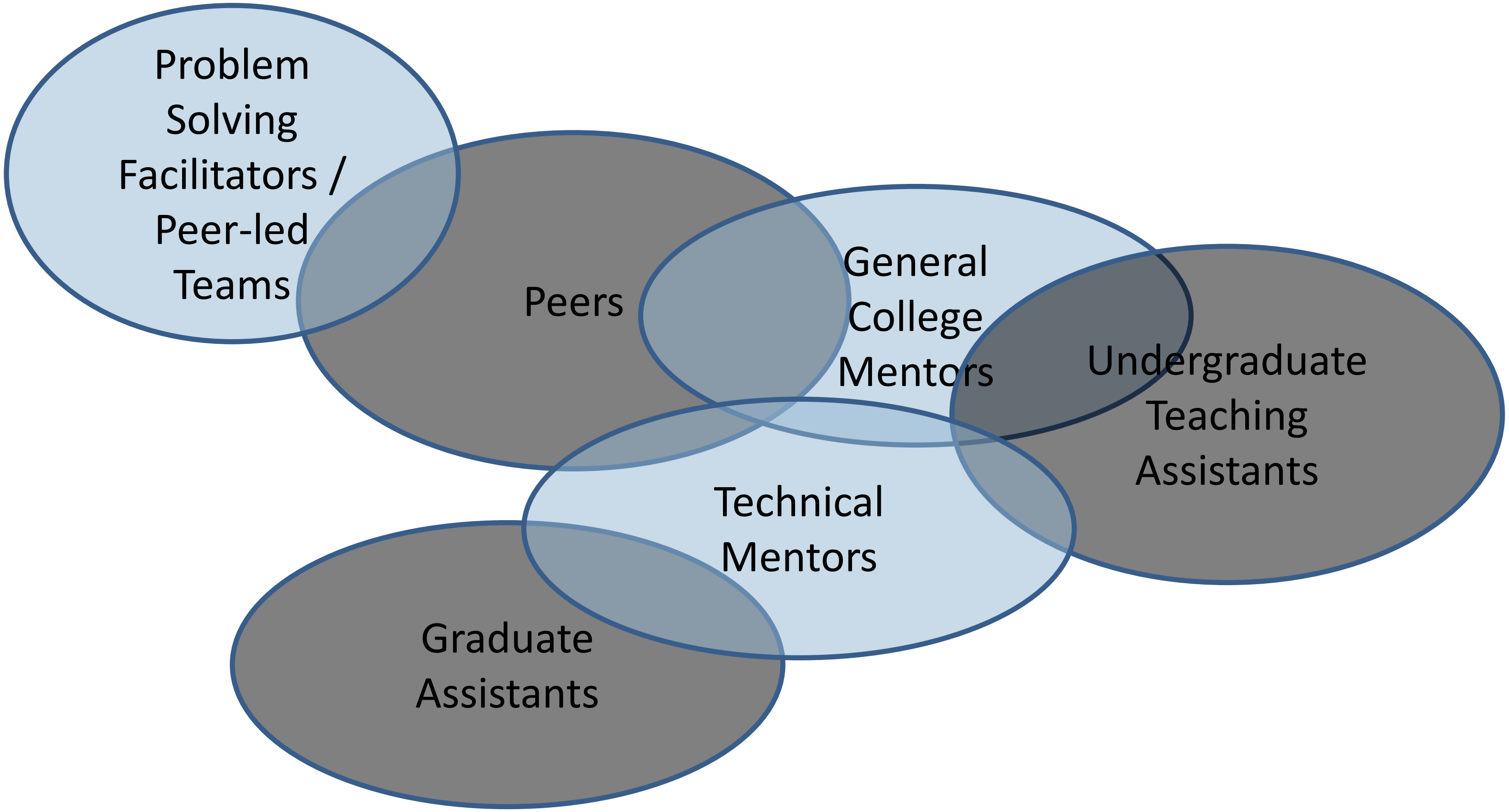
Red Flags:

- TAs
- Advisors

ECE Graduate survey, EE2361:

- Hardest
  - "scary course"
- Most Valuable

2018 – (2) Link to Existing Work / Theory



Search Terms : Peer, mentor, advising, freshmen, first-year, sophomore, assistants, programming, microcontrollers, undergraduate teaching assistant

2018 – Development

Two stand out papers:

E. Roberts, J. Lilly, and B. Rollins, "Using Undergraduates As Teaching Assistants in Introductory Programming Courses: An Update on the Stanford Experience," SIGCSE '95

I. Pivkina, "Peer learning assistants in undergraduate computer science courses," FIE '16

PLA Key Traits:

- Don't grade
- Previously taken the course
- Driven to help peers

2019 – Implementation

Table 1: Comparison of TAs and PLAs

Teaching Assistant (TA)	Peer Learning Assistant (PLA)
Graduate student	Undergraduate student
Present pre-lab lecture	Re-touch confusing topics 1-on-1
Grade in-lab milestones	Help debug!
LMS maintenance	Hold office hours
Grade pre-lab and post-lab	Mentor and advise students

- Weekly meetings
- Open-ended communication

2019 – (3) Direct Investigation

Research Questions?

2019 – (3) Direct Investigation

Research Questions

Improve DFW rate

Improve perception of course

Assessment Methods?

2019 – (3) Direct Investigation

Research Questions:

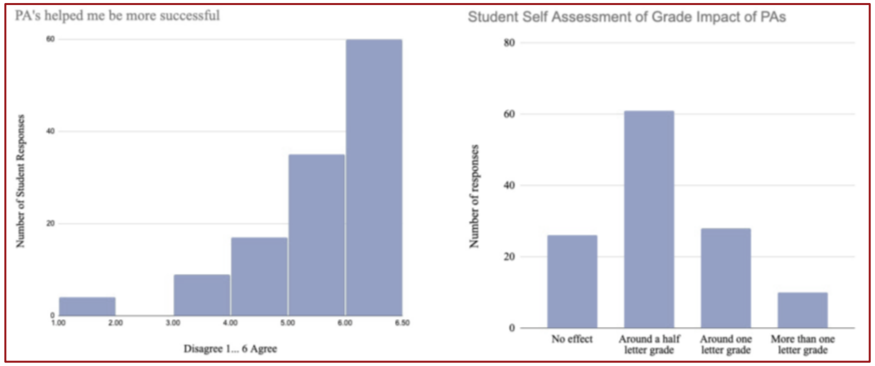
1. Does the addition of PLAs reduce no pass rates in the course?
2. Does the addition of PLAs improve student perceptions of the course?

Methods:

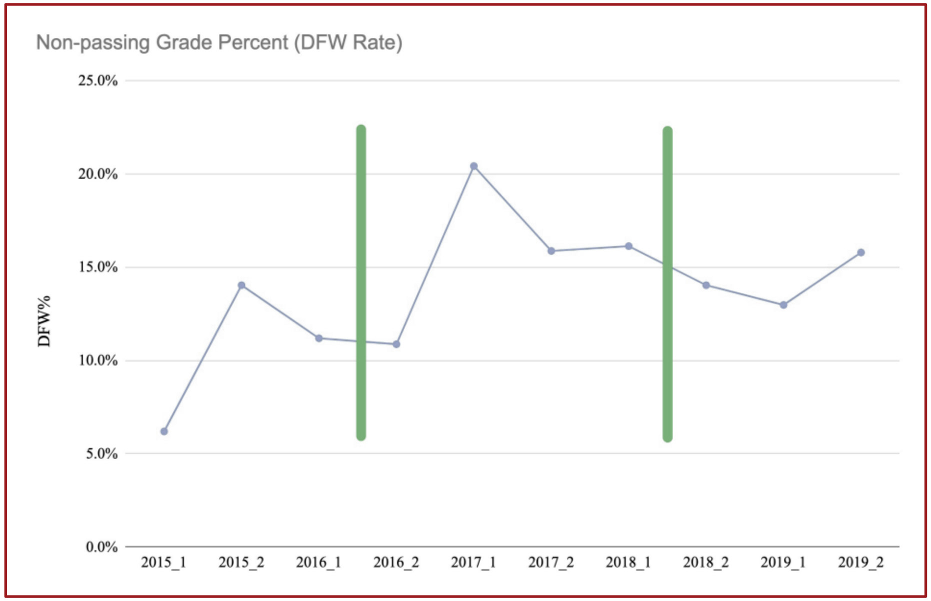
- SRTs – Student Rating of Teaching Eval (UofM Standard)
- Survey Students
- PA Survey
- Grade Tracking (may require Institutional Review Board)

2019 – (4) Results

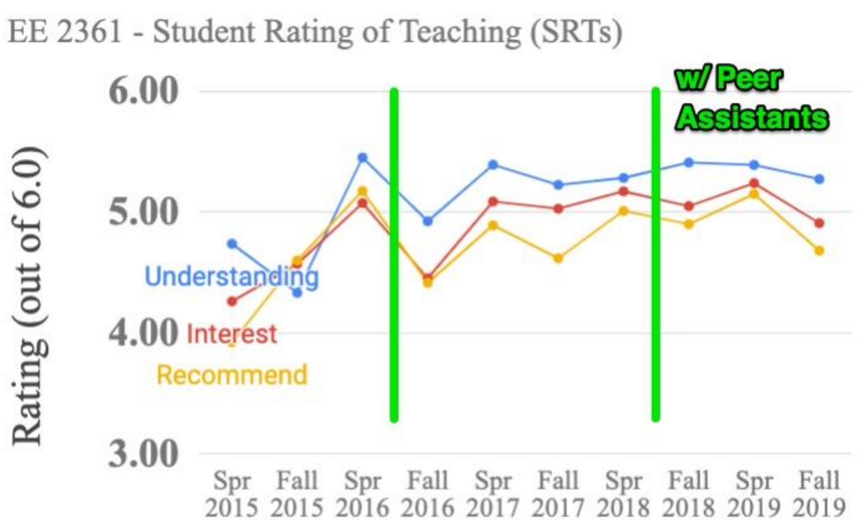
Student Perceptions were Excellent



No Pass Rates (mean down, not stat, sig.)



Student Ratings Up (p<0.12)



2020 – (5) Analyze and Generalize

What did we learn?

What can we add to the literature?

▪

2020 – (5) Analyze and Generalize

What did we learn?

What can we add to the literature?

Demographics, What Demographics?

2020 – (5) Analyze and Generalize

The PLA program was more impactful to students with less programming experience.

How much improvement?

No effect, 0.5 Letter Grades, 1 Letter Grade, >1 Letter Grade

How long have you been programming?

0.5, 1, 2, >2 years

Table 4: Population Comparison of Perceived Grade Impact

	Grade Impact	n
Prog.Exp. <= 1 sem	0.85±0.41	10
Prog.Exp. >= 1 year	0.49±0.38	66
p-val	0.012	

*Self Reported, Perceived Impact (no actual grade data was analyzed)

2020 – (5) Analyze and Generalize

Same question, two formats:

How good do you feel you are at programming in general?

Just Beginning (1) … Expert (6)

How long have you been programming?

0.5, 1, 2, 2+ years

	Begin. (1-2) Response	Expert (5-6) Response
Count	13	28
Avg	0.65	0.55
StdDev	0.50	0.49
MeanShift	0.10	
Mean Shift as % StdDev	20.4%	
p-val	0.28	

	Time <=1 sem	Time >=1 year
Count	10	66
Mean	0.85	0.49
StdDev	0.41	0.38
MeanShift	0.36	
Mean Shift as % StdDev	90%	
p-val	0.012	

*Self Reported, Perceived Impact (no actual grade data was analyzed)

2020 – Publishing Summary

Research Questions:

1. Does the addition of PLAs reduce no pass rates in the course?
2. Does the addition of PLAs improve student perceptions of the course?
3. Does the PLA program improve the perceptions of less experienced programmers more than others?
4. Are PLAs more or less effective than TAs at helping students' learning?

Methods:

- SRTs
- Survey Students
- PA Survey

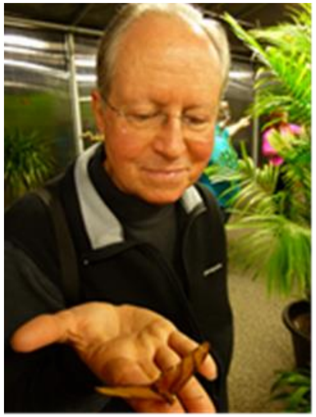
2020 – (6) Publication and Disclosure

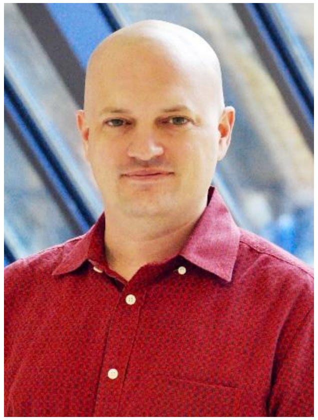
Venue?

Find the venue that is most friendly to <u>your</u> audience.

Thank you!

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





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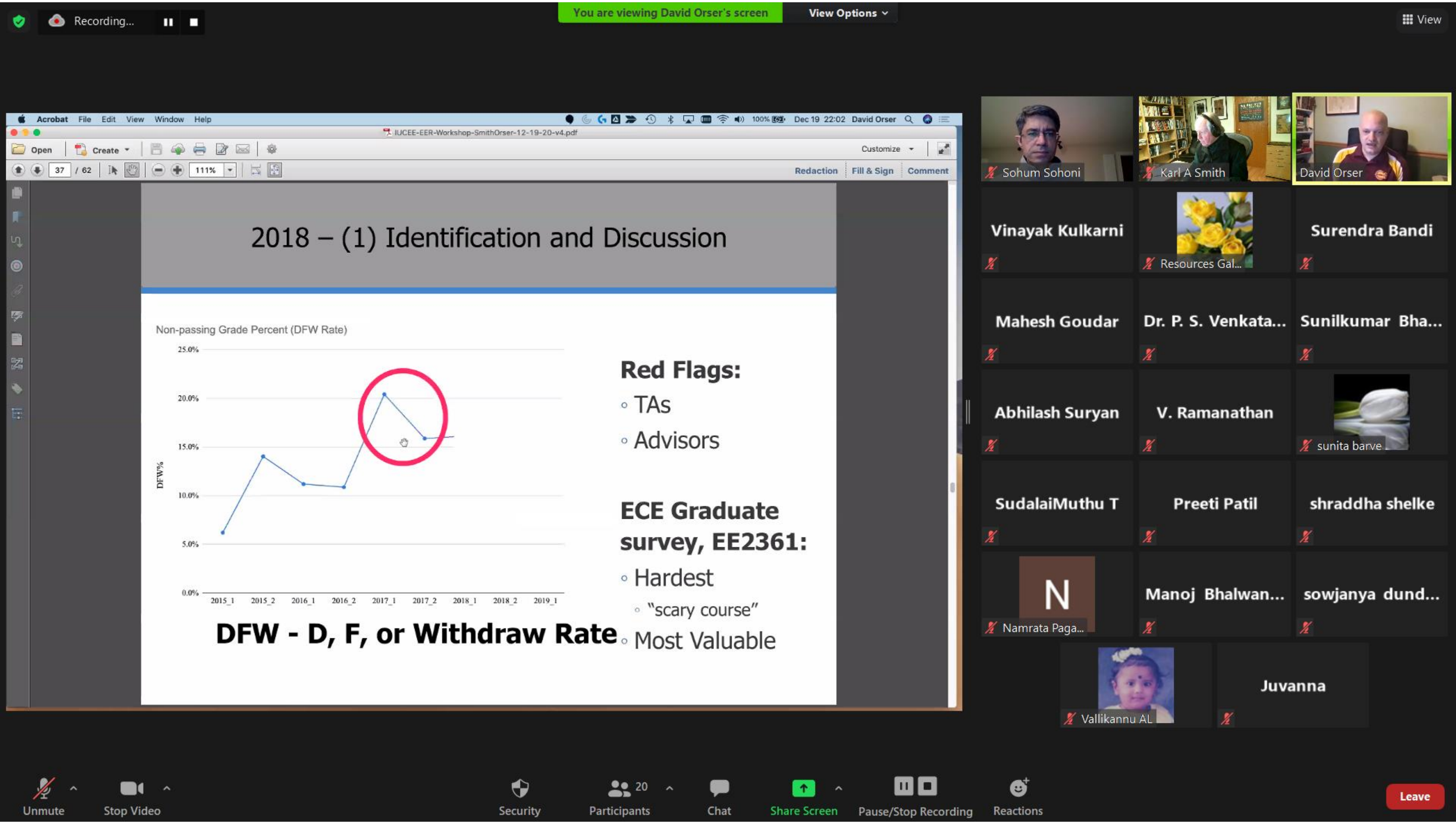
Recording...
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View Options
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IUCEE-EER-Workshop-SmithOrser-12-19-20-v4.pdf
2018 – (1) Identification and Discussion
Non-passing Grade Percent (DFW Rate)
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
DFW%
2015_1
2015_2
2016_1
2016_2
2017_1
2017_2
2018_1
2018_2
2019_1
DFW - D, F, or Withdraw Rate
Red Flags:
TAs
Advisors
ECE Graduate survey, EE2361:
Hardest
"scary course"
Most Valuable
Sohum Sohoni
Karl A Smith
David Orser
Vinayak Kulkarni
Resources Gal...
Surendra Bandi
Mahesh Goudar
Dr. P. S. Venkata...
Sunilkumar Bha...
Abhilash Suryan
V. Ramanathan
sunita barve
SudalaiMuthu T
Preeti Patil
shraddha shelke
Namrata Paga...
Manoj Bhalwan...
sowjanya dund...
Vallikannu AL
Juvanna
Unmute
Stop Video
Security
Participants
Chat
Share Screen
Pause/Stop Recording
Reactions
Leave