

Studies at the Interface: Engineering Education Research and Engineering Education Innovation

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Virginia Polytechnic and State University
Engineering Education Seminar
April 29, 2011

Engineering Education Research & Innovation

Research

- Process Metallurgy
- Learning
- Design
- Engineering Education Research & Innovation

Innovation – Cooperative Learning

- Need identified ~1974
- Introduced ~1976
- FIE conference 1981
- JEE* paper 1981
- Research book 1991
- Practice handbook 1991
- Change* paper 1998
- Teamwork and project management* 2000
- JEE* paper 2005

National Academy of Engineering - Frontiers of Engineering Education Symposium -
December 13-16, 2010 - Slides PDF [[Smith-NAE-FOEE-HPL-UbD-12-10-v8.pdf](#)]

Process Metallurgy

- Dissolution Kinetics – liquid-solid interface
- Iron Ore Desliming – solid-solid interface
- Metal-oxide reduction roasting – gas-solid interface

Dissolution Kinetics

- Theory – Governing Equation for Mass Transport
- Research – rotating disk
- Practice – leaching of silver bearing metallic copper

$$(\nabla c \bullet \underline{v}) = D \nabla^2 c$$

$$v_y \frac{dc}{dy} = D \frac{d^2c}{dy^2}$$

Iron Ore Desliming

- Theory – DLVO [$V(h) = V_A(h) + V_R(h)$]
- Research – streaming potential
- Practice – recovery of iron from low-grade Fe_2O_3 ores (Selective removal of silicates)

Metal Oxide Reduction Roasting

- Theory – catalyzed gas-solid reactions
Boudouard Reaction [$\text{CO}_2 + \text{C} = 2\text{CO}$]
- Research method – thermogravimetric analysis
- Practice – extraction of Ti from FeTiO_3 , Al from Al_2O_3 – bearing minerals

First Teaching Experience

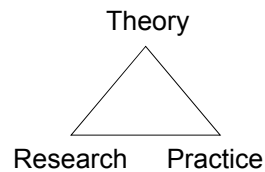
- Practice – Third-year course in metallurgical reactions – thermodynamics and kinetics



Lila M. Smith

Engineering Education

- Practice – Third-year course in metallurgical reactions – thermodynamics and kinetics
- Research – ?
- Theory – ?



University of Minnesota College of Education
Social, Psychological and Philosophical
Foundations of Education

- Statistics, Measurement, Research Methodology
- Assessment and Evaluation
- Learning and Cognitive Psychology
- Knowledge Acquisition, Artificial Intelligence, Expert Systems
- Social psychology of learning – student – student interaction

Acquisition of Expertise

Fitts P, & Posner MI. Human Performance. Belmont, CA: Brooks/Cole, 1967.

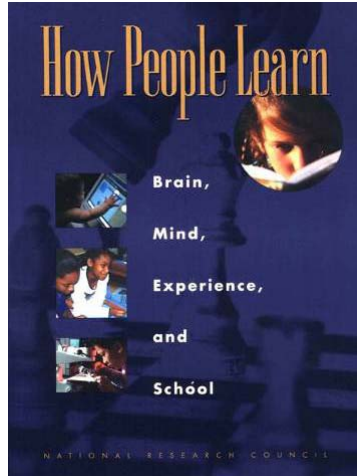
- Cognition: Learn from instruction or observation what knowledge and actions are appropriate
- Associative: Practice (with feedback) allowing smooth and accurate performance
- Automaticity: "Compilation" or performance and associative sequences so that they can be done without large amounts of cognitive resources

"The secret of expertise is that there is no secret. It takes at least 10 years of concentrated effort to develop expertise." Herbert Simon

Paradox of Expertise

- The very knowledge we wish to teach others (as well as the knowledge we wish to represent in computer programs) often turns out to be the knowledge we are least able to talk about.

Expertise Implies:

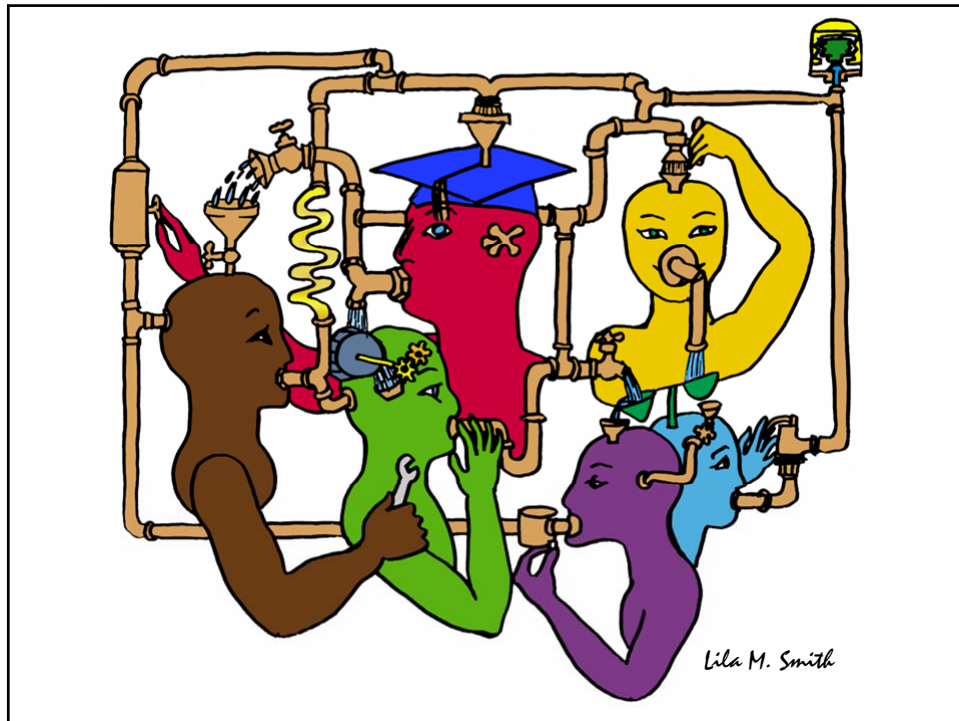


- a set of cognitive and metacognitive skills
- an organized body of knowledge that is deep and contextualized
- an ability to notice patterns of information in a new situation
- flexibility in retrieving and applying that knowledge to a new problem

Bransford, Brown & Cocking. 1999. *How people learn*. National Academy Press.

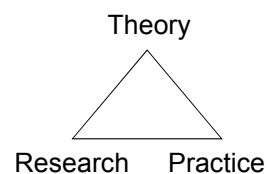
University of Minnesota College of Education
Social, Psychological and Philosophical
Foundations of Education

- Statistics, Measurement, Research Methodology
- Assessment and Evaluation
- Learning and Cognitive Psychology
- Knowledge Acquisition, Artificial Intelligence, Expert Systems
- **Social psychology of learning – student – student interaction**



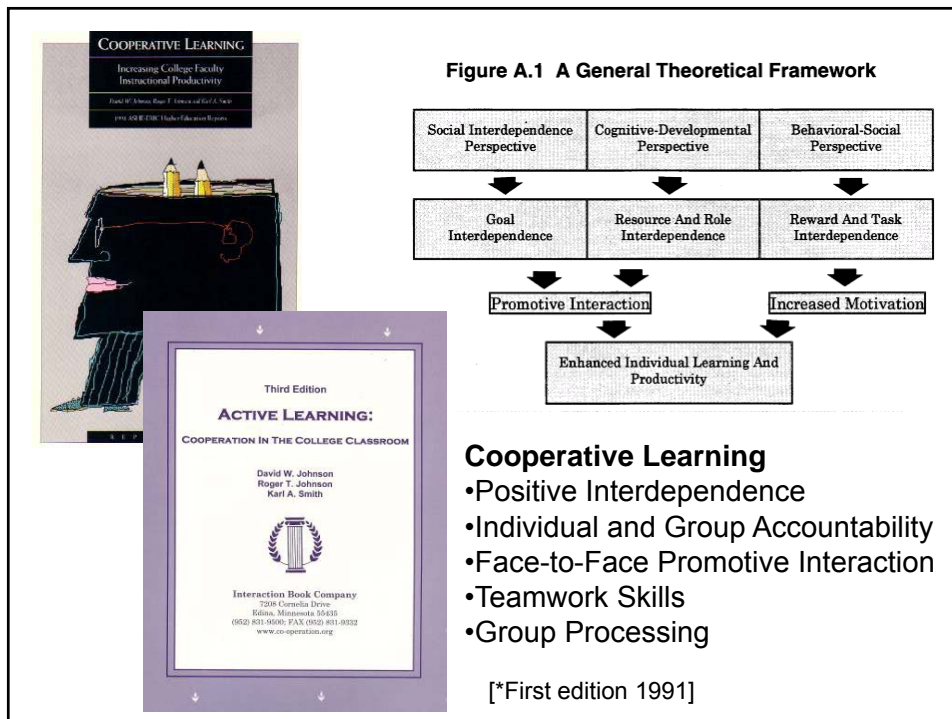
Cooperative Learning

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



Lewin's Contributions

- Founded field of social psychology
- Action Research
- Force-Field analysis
- $B = f(P, E)$
- Social Interdependence Theory
- “There is nothing so practical as a good theory”



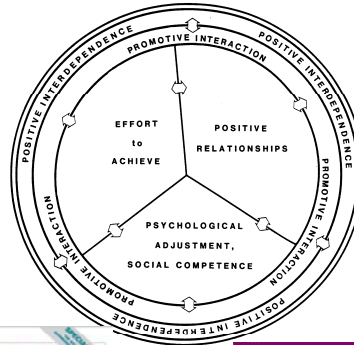
Cooperative Learning Research Support

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

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



January 2005



March 2007

Small-Group Learning: Meta-analysis

Springer, L., Stanne, M. E., & Donovan, S. 1999. Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis. *Review of Educational Research*, 69(1), 21-52.

Small-group (predominantly cooperative) learning in postsecondary science, mathematics, engineering, and technology (SMET). 383 reports from 1980 or later, 39 of which met the rigorous inclusion criteria for meta-analysis.

The main effect of small-group learning on achievement, persistence, and attitudes among undergraduates in SMET was significant and positive. Mean effect sizes for achievement, persistence, and attitudes were 0.51, 0.46, and 0.55, respectively.

Key Concepts

- Positive Interdependence
- Individual and Group Accountability
- Face-to-Face Promotive Interaction
- Teamwork Skills
- Group Processing

[illegible]

EDUCATION

Eric Mazur

Click here. Students continually discuss concepts among themselves and with the instructor during class. Discussions are spurred by multiple-choice conceptual questions that students answer using a clicker device. See supporting online text for examples of such "clicker questions."

from the ones I handed out? I decided to ignore the students' complaints.

A physics professor describes his evolution from lecturing to dynamically engaging students during class and improving how they learn.

action, which states that the force of object A on object B is in an interaction between two objects is equal in magnitude to the force of B on A—it is sometimes known as "action is reaction." One day, when the course had progressed to more complicated material, I decided to test my students' understanding of this principle. I asked them to explain the principle, but by asking them a set of basic conceptual questions (1, 2). One of the questions, for example, requires students to compare the forces that a heavy truck and a light car exert on one another when they collide. I expected that the students would have no trouble tackling this question. To my surprise, however, only a minority a minute after the test began, one student asked, "How should I answer these questions?" According to what you taught me or according to the law I usually think about these things?" To my dismay, students had great difficulty with the conceptual questions. That was when it began to dawn on me that

In hindsight, the reason for my students' poor performance is simple. The traditional approach to teaching reduces education to a transfer of information. Before the industrial revolution, when books were not yet mass commodities, the lecture method was the only way to transfer information from one generation to the next. However, education is so

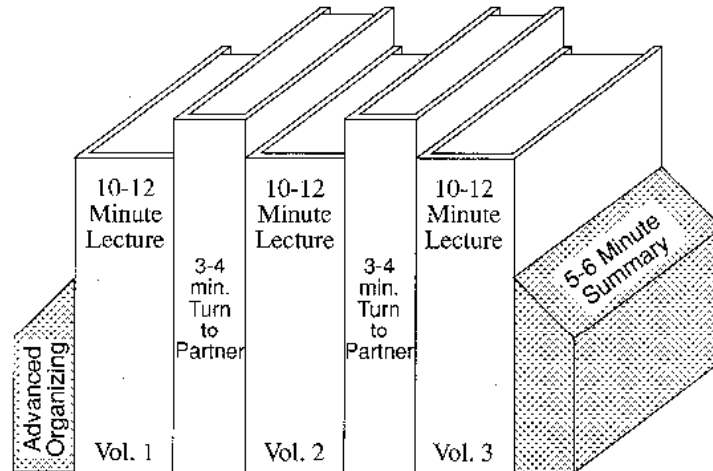
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2 JANUARY 2009 VOL 323 SCIENCE www.sciencemag.org

January 2, 2009—Science, Vol. 323 – www.sciencemag.org

Calls for evidence-based promising practices

Book Ends on a Class Session



Thinking Together: Collaborative Learning in the Sciences – Harvard University – Derek Bok Center – www.fas.harvard.edu/~bok_cen/

Problem-Based Cooperative Learning

At M.I.T., Large Lectures Are Going the Way of the Blackboard



Just Hibel for The New York Times
The Massachusetts Institute of Technology has changed the way it offers some introductory classes. Prof. Gabriela Scobie at a class on electricity and magnetism.

By SARA RIMER
Published: January 12, 2009

CAMBRIDGE, Mass. — For as long as anyone can remember, introductory physics at the Massachusetts Institute of Technology was taught in a vast windowless amphitheater known by its number,

COMMENTS (00)
E-MAIL
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SINGLE PAGE

January 13, 2009—New York Times – <http://www.nytimes.com/2009/01/13/us/13physics.html?em>

[illegible]

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About the SCALE-UP Project...



This research was supported, in part, by the U.S. Department of Education's Fund for the Improvement of Post-Secondary Education (FIPSE), the National Science Foundation, Hewlett-Packard, Apple Computer, and Force Scientific. Opinions expressed are those of the authors and not necessarily those of our sponsors.

The primary goal of the **Student-Centered Activities for Large Enrollment Undergraduate Programs (SCALE-UP)** Project is to establish a highly collaborative, hands-on, computer-rich, interactive learning environment for large-enrollment courses.

Educational research indicates that students should collaborate on interesting topics and be deeply involved with the material as they are studying. We promote active learning in ensembles (classrooms of 80 students or more). (Of course, smaller classes can also benefit.) We believe the SCALE-UP Project has the potential to radically change the way large classes are taught at colleges and universities. The social interactions between students and with their teachers appears to be the "active ingredient" that make the approach work. As more and more instruction is handled virtually via technology, the relationship-building capability of brick and mortar institutions becomes even more important. The pedagogical methods and classroom management techniques we design and disseminate are general enough to be used in a wide variety of classes at many different types of colleges.

Classes is spent primarily on "in-class" and "hands-onable". Essentially these are hands-on activities, simulations, or learning questions and problems. There are also some hypothesis-driven labs where students have to write detailed reports. (The experiments are more sophisticated than most, but shows what the best students are capable of doing.) Students sit in three groups of three students at a 7' x 7' foot diameter round table. Instructor circulate and work with teams and individuals, engaging them in Socratic-style dialogues. Each table has at least three networked laptops. The setting is very much like a banquet hall, with lively conversations mostly at the table. Many other colleges and universities are adopting/adapting the SCALE-UP format and pedagogy. Engineering schools are especially pleased with the course design, which fit in well with the requirements for ABET accreditation.

Materials developed for this course were incorporated into what became the leading introductory physics textbooks used by more than 1/2 of all science, math, and engineering students in the country.

Impact

Details

Rigorous studies of learning have been conducted in parallel with the curriculum development effort. Besides hundreds of hours of classroom video and audio recordings, we also have conducted numerous interviews and focus groups, conducted many conceptual learning assessments (using nationally recognized instruments in a pre-test/post-test protocol), and collected portfolios of student work. We have data comparing nearly 10,000 traditional and SCALE-UP students. Our findings can be summarized as the following:

- Ability to solve problems is improved
- Conceptual understanding is improved
- Attitudes are improved
- Failure rates are drastically reduced, especially for women and minorities
- "At risk" students do better in later engineering statics classes

More than 50 colleges and universities across the US have adopted the SCALE-UP approach to their own institutions. In all cases, the basic idea remains the same: get the students working together to examine something interesting. That gives the instructor the room about the room, asking questions and stirring up debate. Classes in physics, chemistry, math, engineering, and even literature have been taught this way. If you want more information, please contact Dr. Robert Beichner.

http://www.ncsu.edu/PER/scaleup.html

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UNIVERSITY OF MINNESOTA
Driven to Discover™

News Release

UMNews

Home > News Releases > U of M dedicates new Science Teaching and Student Services building

News Release

U of M dedicates new Science Teaching and Student Services building

Building to serve as new hub for student life, including technology-rich "laboratories of the mind" and One Stop Student Services

Photo: Daniel Walker, University News Service, wwalker@umn.edu, 612-625-6555

MINNEAPOLIS (ST PAUL, MN) —University of Minnesota technology and student today dedicated the new Science Teaching and Student Services (STSS) building, located at the gateway to the university's East Bank campus in Minneapolis.

The 115,000-square-foot STSS, which replaces the demolished Science Classroom Building, will be home not only to new "laboratories of the mind" and "active learning" classrooms but also to numerous student services offices, including One Stop Student Services, retention services and career services.

"This really is the kind of education at our Twin Cities campus," said university President Robert Dornhoefer. "We're grateful to the people of Minnesota for making this investment in their University."

The building, which was funded in large part by state bonding funds, has the stones and offers a wide view of the West Bank and downtown Minneapolis over the Mississippi River. It has 10 active learning classrooms, which provide for technology-driven and collaborative interaction among students and faculty. There are also five multimedia classrooms and two large lecture halls.

"Active learning classrooms are the classrooms of the future and have proven results in improving educational achievement for students," said university Provost Thomas Sullivan. "There is a critical need for more degrees in science, technology, engineering and mathematics fields to meet expected job growth. This new facility supports our efforts to educate the scientists and engineers who make the discoveries of tomorrow."

In addition, the STSS is designed to meet or exceed the requirements of Minnesota's stringent LEED sustainable design code and meets LEED Gold certification. Sustainable

You're watching:
Inside Active Learning Classrooms

00:00

<http://mediamill.cla.umn.edu/mediamill/embed/78755>

http://www1.umn.edu/news/news-releases/2010/UR_CONTENT_248261.html

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UNIVERSITY OF DELAWARE

PROBLEM-BASED LEARNING

[UD PBL articles and books](#)

[UD PBL in the news](#)

[Sample PBL problems](#)

[UD PBL courses and syllabi](#)

[PBL Clearinghouse](#)

[PBL Conferences and Other PBL sites](#)

[Institute for Transforming Undergraduate Education](#)

[Other related UD sites](#)

"How can I get my students to think?" is a question asked by many faculty, regardless of their disciplines. Problem-based learning (PBL) is an instructional method that challenges students to "learn to learn," working cooperatively in groups to seek solutions to real world problems. These problems are used to engage students' curiosity and initiate learning the subject matter. PBL prepares students to think critically and analytically, and to find and use appropriate learning resources. -- *Barbara Duch*

PBL2002:
A Pathway to Better Learning

Recipient of 1999 Hesburgh Certificate of Excellence

Please direct comments, suggestions, or requests to ud-pbl@udel.edu.
"http://www.udel.edu/pbl/"
Last updated March 13, 2004.
© Univ. of Delaware, 1999.

<http://www.udel.edu/pbl/>

Cooperative Learning Adopted

The American College Teacher:

National Norms for 2007-2008

Methods Used in "All" or "Most"	All – 2005	All – 2008	Assistant - 2008
Cooperative Learning	48	59	66
Group Projects	33	36	61
Grading on a curve	19	17	14
Term/research papers	35	44	47

<http://www.heri.ucfa.edu/index.php>

Emphasis on Innovation

- NSF TUES (CCLI) PI Meeting
 - TUES (Transforming Undergraduate Education in STEM)
 - Myles Boylan presentation
 - Carl Wieman presentation – White House – Office of Science and Technology Policy
 - <http://ccliconference.org/meetings/2011-tues-conference/>
- NAE FOEE
 - <http://www.nae.edu/Activities/Projects20676/CASEE/26338/35816/FOEE.aspx>

The Federal Environment for STEM Education Programs: Implications for TUES

& Some of your suggestions

Myles Boylan

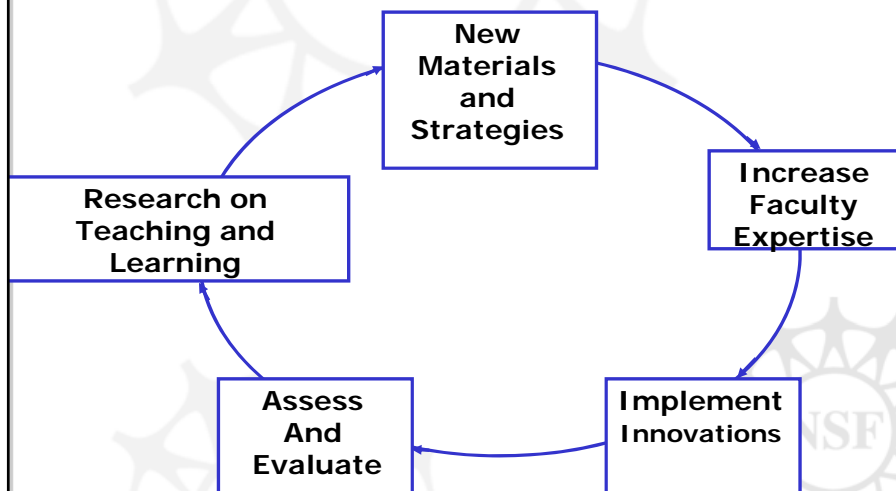
Division of Undergraduate Education

National Science Foundation

CCLI PI Meeting January 28, 2011

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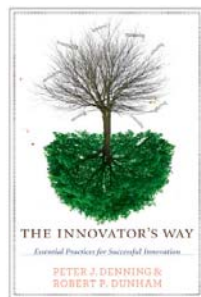
Cyclic Model for Creating Knowledge and Improving Practices in STEM Education



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Measuring Impact in STEM Ed; Are they thinking like experts?

Carl Wieman
Assoc. Director for Science
White House Office of Science and
Technology Policy



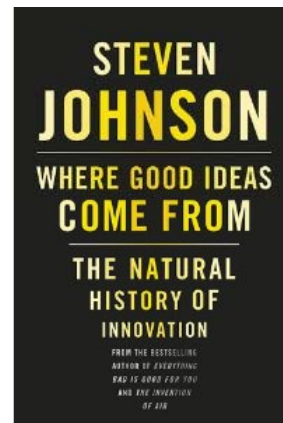
Engines *of* Innovation

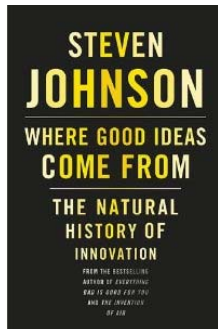
THE
ENTREPRENEURIAL
UNIVERSITY
IN THE
TWENTY-FIRST
CENTURY



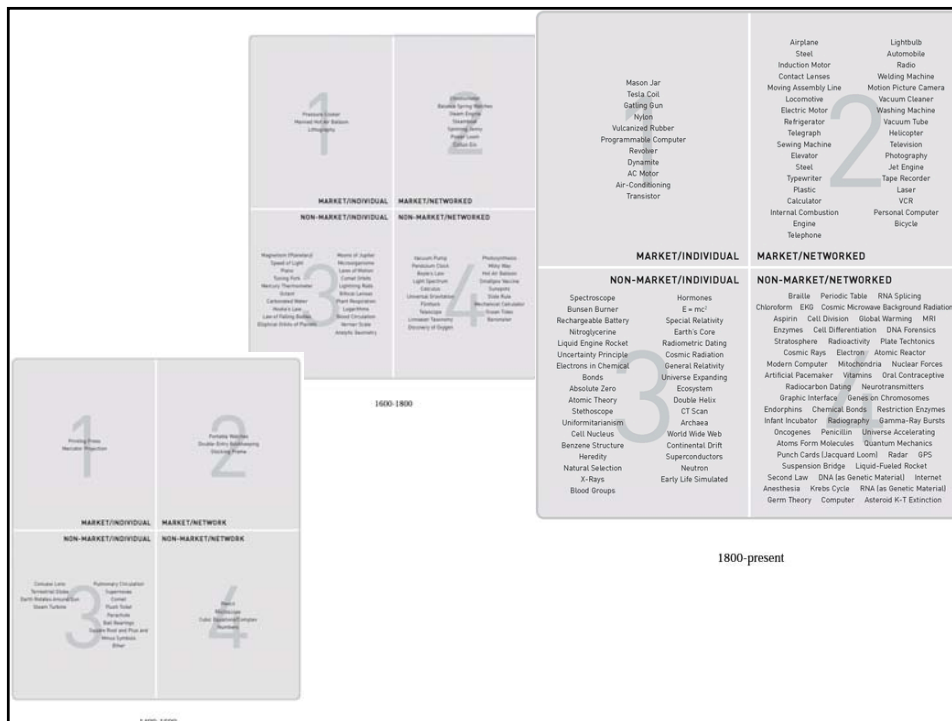
Holden Thorp &
Buck Goldstein

Innovation is the adoption
of a new practice in a community
- Denning & Dunham (2010)

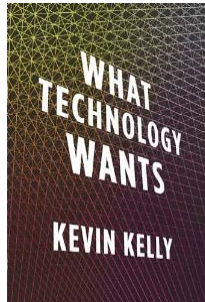




1. What is the distribution of innovations?
2. Did it change over time? If so, how?
3. Where does **your** innovation fit?



Technology



Three definitions of technology (Arthur, 2009)

1. A means to fulfill a human purpose
2. An assemblage of practices and components
3. The entire collection of devices and engineering practices available to a culture

Definitions

- Technology – OED
 - τεχνολογία
 - systematic treatment of art, craft
- Engineering – OED
 - The action of the verb [ENGINEER](#); the work done by, or the profession of, an engineer.
- Smith – OED
 - One who works in iron or other metal
 - Original sense – craftsman, skilled worker in metal, wood or other material

Engineering in Popular Media

- "Houston, we've got a problem." Apollo 13
- MacGyver?
- Myth Busters?
- Petroski

Engineering

A scientist discovers that which exists. An engineer creates that which never was - Theodore von Kármán (1881-1963)

The engineering method is the use of heuristics to cause the best change in a poorly understood situation within the available resources – Billy Koen

The engineering method is design under constraints – Wm. Wulf, Past President, National Academy of Engineering

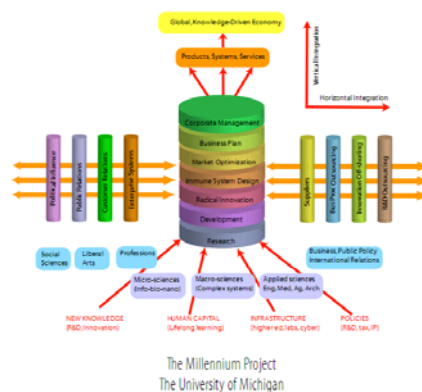
It could well be that faculty members of the twenty-first century college or university will find it necessary to set aside their roles as teachers and instead become **designers** of learning experiences, processes, and environments.

James Duderstadt, 1999 [Nuclear Engineering Professor; Dean, Provost and President of the University of Michigan]



Engineering for a Changing World

A Roadmap to the Future of
Engineering Practice, Research, and Education



...objectives for engineering practice, research, and education:

To adopt a systemic, research-based approach to innovation and continuous improvement of engineering education, recognizing the importance of diverse approaches—albeit characterized by quality and rigor—to serve the highly diverse technology needs of our society

<http://milproj.ummu.umich.edu/publications/EngFlex%20report/download/EngFlex%20Report.pdf>

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American Society for Engineering Education

The Innovation Cycle of Educational Practice and Research

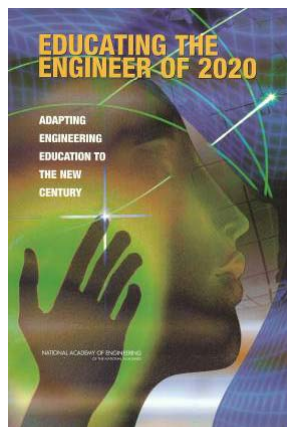
Adapted from Booth, Colomb, and Williams, 2008

Engineering education innovation is about designing effective learning environments. It requires, at the least, engineering and education expertise working in continual cycles of educational practice and research.

Innovation Cycle of Educational Practice and Research (Jamieson/Lohmann, 2009)

Jamieson, L.H. & Lohmann, J.L. 2009. Creating a Culture for Scholarly and Systematic Innovation in Engineering Education. ASEE. <http://www.asee.org/about-us/the-organization/advisory-committees/CCSSIE>

Engineering Education Research



Colleges and universities should endorse research in engineering education as a valued and rewarded activity for engineering faculty and should develop new standards for faculty qualifications.

Levels of Engineering Education Inquiry

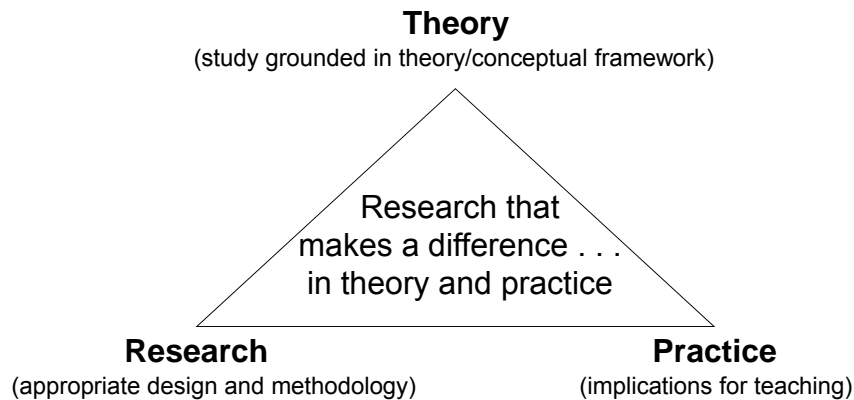
- **Level 0 Teacher**
 - Teach as taught (“distal pedagogy”)
- **Level 1 Effective Teacher**
 - Teach using accepted teaching theories and practices
- **Level 2 Scholarly Teacher**
 - Assesses performance and makes improvements
- **Level 3 Scholar of Teaching and Learning**
 - Engages in educational experimentation, shares results
- **Level 4 Engineering Education Researcher**
 - Conducts educational research, publishes archival papers

Source: Strevler, R., Borrego, M. and Smith, K.A. 2007. Moving from the “Scholarship of Teaching and Learning” to “Educational Research:” An Example from Engineering. *Improve the Academy*, Vol. 25, 139-149.

Some history about this workshop

- **Rigorous Research in Engineering Education (RREE1)**
 - One-week summer workshop, year-long research project
 - Funded by National Science Foundation (NSF), 2004-2006
 - About 150 engineering faculty participated
- **Goals**
 - Identify engineering faculty interested in conducting engineering education research
 - Develop faculty knowledge and skills for conducting engineering education research (especially in theory and research methodology)
 - Cultivate the development of a Community of Practice of faculty conducting engineering education research

RREE Approach



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

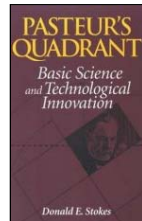


Guiding Principles for Scientific Research in Education

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

National Research Council, 2002

Research can be inspired by ...



**Understanding
(Basic)**

Yes

No

Use (Applied)

No

Yes

Pure basic research (Bohr)	Use-inspired basic research (Pasteur)
	Pure applied research (Edison)

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

Research Process



RREE2

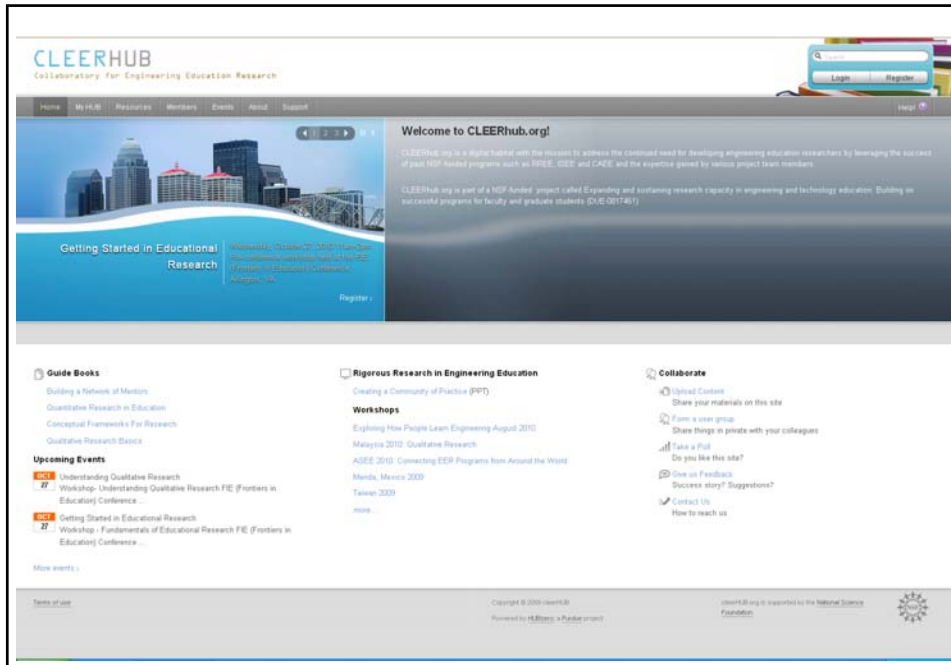
Follow-up proposal has been awarded (RREE2)

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

*To be recorded and posted on the CLEERhub.org

Status of RREE Project

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



http://cleerhub.org

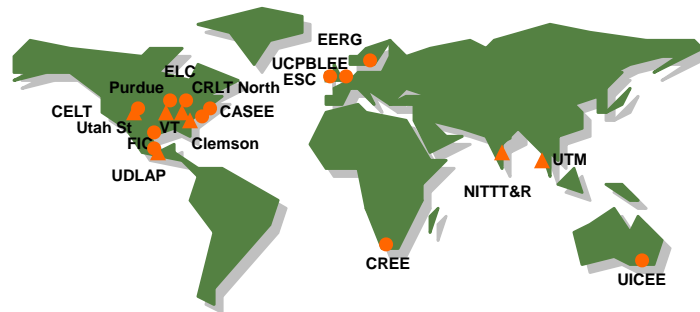
An emerging global community



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

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

Groups, centers, departments...



- **Engineering Teaching and Learning Centers** — Australia: UICEE, UNESCO International Centre for Engineering Education; Denmark: UCPBLEE, UNESCO Chair in Problem Based Learning in Engineering Education; 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.

- ▲ **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

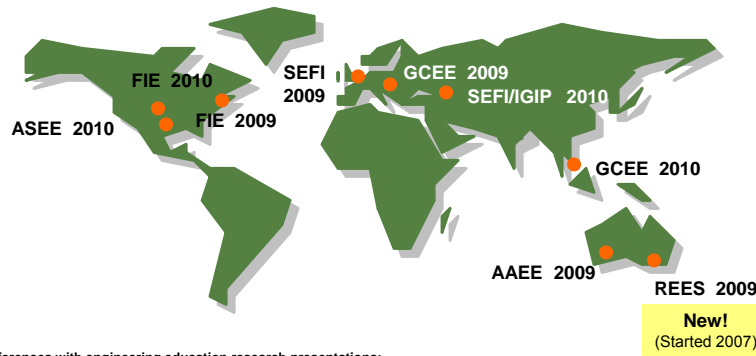
Engineering education societies...



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

Forums for dissemination...



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

sponsored by the
ASEE International Division

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

ASEE Annual Conference – June 22, 2010 – Session 2123

Facilitated By

Karl A. Smith
Purdue University and
University of Minnesota

Jack Lohmann
Georgia Tech

Hans Hoyer
ASEE

Ruth A. Streveler
Purdue University

Satish Udpa
Michigan State University

Stephanie Eng
ASEE

ASEE 2010 – EER PhD Program Briefings

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

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

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

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

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

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

MEETINGS	LOCATION	RESOURCES
Committee Meeting 1 June 28-29, 2010	Keck Center, Room 101 500 6th Street, NW Washington, DC	Agenda
Committee Meeting 2 October 18-19, 2010	Keck Center, Room 201 500 6th Street, NW Washington, DC (limited space)	Agenda
Committee Meeting 3 December 3-4, 2010	Beckman Center Irvine, CA	

COMMITTEE

Committee Membership

STAFF

Natalie Nelson Study Director

Heidi Schwesinger, Deputy Director, BOSE

Margaret Hilton, Senior Program Officer, BOSE

Rebecca Krone, Program Associate

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

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 - COLLABORATIVE RESEARCH: Expanding and sustaining research capacity in engineering and technology education: Building on successful programs for faculty and graduate students
- And Virginia Tech for hosting this seminar

Thank you!

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

Virginia Tech – Engineering Education Seminar – April 29, 2011



ksmith@umn.edu