Designing Courses for High Quality Learning: An Engineering Approach

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Oregon State University

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April 28, 2014

"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; Former Dean, Provost and President of the University of Michigan

Global Calls for Reform

K-12 Engineering

Research-based Transformation

Discipline-Based Education Research (DBER)

Understanding and Improving Learning in Undergraduate Science and Engineering

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

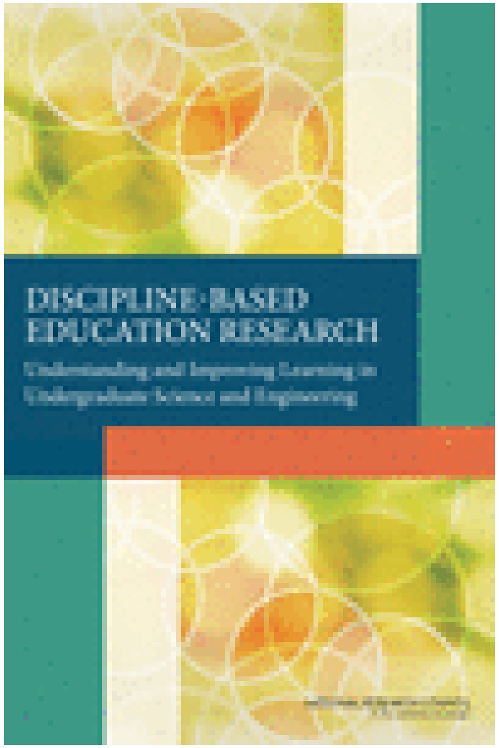
Study Charge

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

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

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

Discipline-Based Education Research (DBER) Report Update



LAST WORD OPINION BY SUSAN SINGER & KARL SMITH

Follow the Evidence

Discipline-based education research dispels myths about learning and yields results – if only educators would use it.

Last year, the National Research Council released the report *Discipline-Based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering*. That consensus study, on which we served as committee members, brought together experts in physics, chemistry, biology, the geosciences, astronomy, and engineering, as well as higher education researchers, learning scientists, and cognitive scientists to focus on how students learn in particular scientific and engineering disciplines. Our key conclusion: Findings from the growing field of discipline-based education research (DBER) have yet to spur widespread changes in the teaching of science and engineering.

For example, research-based instructional approaches to teaching that actively engage students in their own learning, such as group projects, have been shown to be more effective than traditional lectures. Yet science and engineering faculty still cling to familiar practice. While there's no magic solution for adopting evidence-based teaching practices, finding out what is known about undergraduate learning in engineering and science—and identifying impediments to implementation in the classroom—can point the way.

First, many students have incorrect understanding about fundamental concepts—particularly phenomena that are not directly observable, such as those involving very large or small scales of time and space. Understanding how educators can help students change these misconceptions is in the early stages, but DBER has uncovered some effective instructional techniques. One promising approach is to use "bridging analogies" that link students' correct knowledge with the situation about which they harbor false beliefs. For instance, a student may not believe that a table can exert a force on a book resting on its surface but accepts the notion if a spring is placed under the same book. Linking these two ideas, with perhaps an intermediate of a book resting on a foam block, can move the student toward a correct understanding of forces.

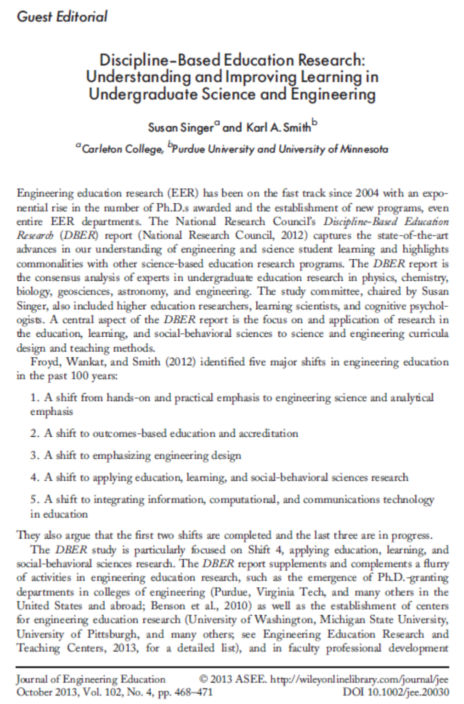
Students also are challenged by important aspects of engineering and science that can seem easy or obvious to experts. When tackling a problem, for instance, students tend to focus on the superficial rather than on its deep structure. Instructors may have an "expert blind spot" and not recognize how different the student's approach is from their own, which can impede effective instruction. Several strategies appear to improve problem-solving skills, such as providing support and prompts—known as "scaffolding"—as students work their way through problems. Another common issue for students in all disciplines is difficulty in extracting information from graphs, models, and simulations. Using multiple representations in instruction is one way to move students toward expertise.

STUDENTS ARE CHALLENGED BY KEY ASPECTS OF ENGINEERING AND SCIENCE THAT CAN SEEM EASY OR OBVIOUS TO EXPERTS.

The report recommends future DBER research that explores similarities and differences in learning among various student populations, and longitudinal studies that shed additional light on how students acquire and retain an understanding (or misunderstanding) of concepts. However, we also need strategies that translate the findings of DBER and related research into practice. That includes finding ways around barriers, such as the faculty reward system, the relative value placed on teaching versus research, lack of support for faculty learning to use research-based practices, problems with student evaluations, and workload concerns.

The report urges universities, disciplinary organizations, and professional societies to support faculty efforts to use evidence-based teaching strategies in their classrooms. It also recommends collaboration to prepare future faculty members who understand research findings on learning and teaching and who value effective teaching as part of their career aspirations. By implementing these recommendations, engineering and science educators will make a major first step toward using DBER to improve their practice—and learning outcomes.

Susan Singer, the Laurence McKinley Gould Professor of the Natural Sciences at Carleton College, chaired the National Research Council committee that prepared the consensus study. Karl Smith, the Cooperative Learning Professor of Purdue University's School of Engineering Education and emeritus professor of civil engineering at the University of Minnesota, represented engineering on the committee. To view the report, visit http://www.nap.edu/



Guest Editorial

Discipline-Based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering

Susan Singer[a] and Karl A. Smith[b]

[a]Carleton College, [b]Purdue University and University of Minnesota

Engineering education research (EER) has been on the fast track since 2004 with an exponential rise in the number of Ph.D.s awarded and the establishment of new programs, even entire EER departments. The National Research Council's *Discipline-Based Education Research* (*DBER*) report (National Research Council, 2012) captures the state-of-the-art advances in our understanding of engineering and science student learning and highlights commonalities with other science-based education research programs. The *DBER* report is the consensus analysis of experts in undergraduate education research in physics, chemistry, biology, geosciences, astronomy, and engineering. The study committee, chaired by Susan Singer, also included higher education researchers, learning scientists, and cognitive psychologists. A central aspect of the *DBER* report is the focus on and application of research in the education, learning, and social-behavioral sciences to science and engineering curricula design and teaching methods.

Froyd, Wankat, and Smith (2012) identified five major shifts in engineering education in the past 100 years:

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 social-behavioral sciences research
5. A shift to integrating information, computational, and communications technology in education

They also argue that the first two shifts are completed and the last three are in progress.

The *DBER* study is particularly focused on Shift 4, applying education, learning, and social-behavioral sciences research. The *DBER* report supplements and complements a flurry of activities in engineering education research, such as the emergence of Ph.D.-granting departments in colleges of engineering (Purdue, Virginia Tech, and many others in the United States and abroad; Benson et al., 2010) as well as the establishment of centers for engineering education research (University of Washington, Michigan State University, University of Pittsburgh, and many others; see Engineering Education Research and Teaching Centers, 2013, for a detailed list), and in faculty professional development

Journal of Engineering Education © 2013 ASEE. http://wileyonlinelibrary.com/journal/jee
October 2013, Vol. 102, No. 4, pp. 468–471 DOI 10.1002/jee.20030

ASEE *Prism Summer 2013*

National Research Council
Summer 2012 – http://www.nap.edu/catalog.php?record_id=13362

Journal of Engineering Education
Editorial – October, 2013

Practitioner Guide - In Preparation

Reflection and Dialogue

- Individually reflect on Designing Courses for High-Quality Learning. Think/Write for about 1 minute
  - Promising Approaches & Innovations
  - Ideas for encouraging adoption by colleagues
- Discuss with your neighbor for about 2 minutes
  - How to propagate and scale education innovations

Understanding Misunderstanding

A Private Universe – www.learner.org

Also see *Minds of Our Own* (Annenberg/CPB Math and Science Collection – www.learner.org)

1. Can we believe our eyes?
2. Lessons from thin air
3. Under construction

http://www.youtube.com/watch?v=Ng5qzH39nyg

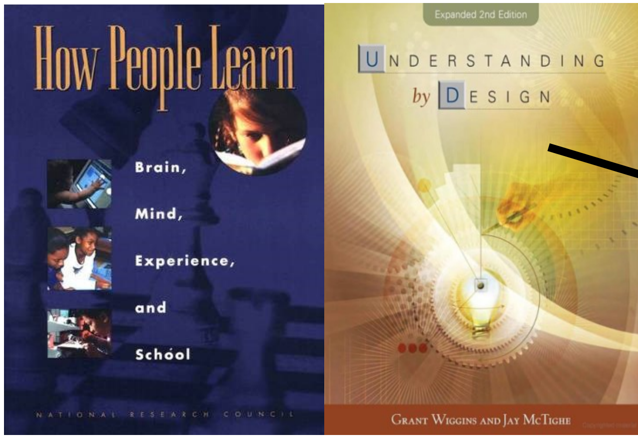
Seminar Layout

- Welcome & Overview
- Engineering Method
- How People Learn and Course Design Foundations
- Pedagogies of Engagement (PoE)
  - Cooperative Learning
- Design and Implementation (Tuesday Workshop)

Seminar/Workshop Objectives

- Participants will be able to :
  - Articulate an engineering approach to course design
  - Summarize research on *How People Learn (HPL)*
  - Describe key features of the *Understanding by Design* (UbD) process – Content (outcomes) – Assessment – Pedagogy
  - Explain key features of and rationale for Pedagogies of Engagement – Cooperative Learning
  - Identify connections between cooperative learning and desired outcomes of courses and programs
- Participants will begin applying key elements to the design on a course, class session or learning module

Design Foundations



Science of Instruction (UbD)

Science of Learning (HPL)

	No	**Yes**
Yes	Good Theory/ Poor Practice	Good Theory & Good Practice
No		Good Practice/ Poor Theory

Sources: Bransford, Brown & Cocking. 1999. *How people learn.* National Academy Press.
Wiggins, G. & McTighe, J. 2005. *Understanding by design, 2ed*. ASCD.

Engineering

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

The engineering method (design) is the use of state-of-the-art heuristics to create the best change in an uncertain situation within the available resources – Billy Koen, Mechanical Engineering Professor, UT-Austin, author *Discussion of the Method*, 2003, 2011

Understanding by Design (UbD) Process vs. Engineering Design Process

Understanding by Design

- Identify the desired results
- Determine acceptable evidence
- Plan learning experiences

Engineering Design

- Determine requirements specifications
- Develop or use established metrics to measure against outcomes
- Plan and develop process, system, etc. to implement

Think about it…

Why is it important to understand the parallels between these two processes?

Engineering Education: Advancing the Practice
Karl Smith

Research

- Process Metallurgy 1969 -1992
- Learning ~1974
- Design ~1995
- Engineering Education Research & Innovation ~ 2000
- STEM Education ~ 2010
- STEM Innovation – NSF I-Corps-L ~ 2013

Innovation – Cooperative Learning

- Need identified ~1974
- Introduced ~1976
- FIE conference 1981
- *JEE* paper 1981
- Research book 1991
- Practice handbook 1991…2006
- *Change* paper 1998
- *Teamwork and project management* 2000…2014
- *JEE* paper 2005
- Ed Psy Review paper 2007

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 & printed circuit-board waste

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

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

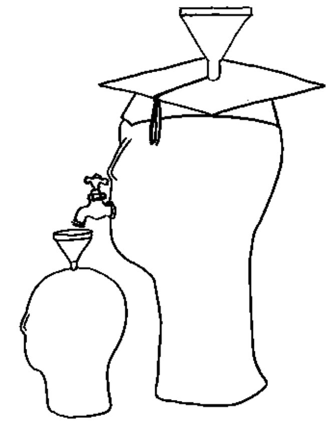
First Teaching Experience

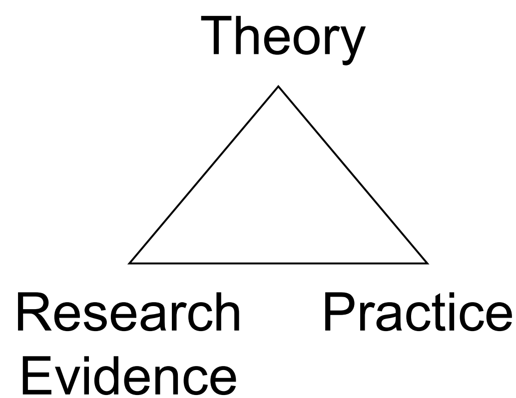
- Practice – Third-year course in metallurgical reactions – thermodynamics and kinetics

Lila M. Smith

Engineering Education

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



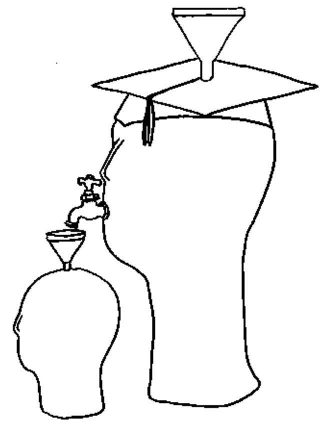


Pedago-pathologies

Amnesia

Fantasia

Inertia



Lee Shulman – MSU Med School – PBL Approach (late 60s – early 70s), President Emeritus of the Carnegie Foundation for the Advancement of College Teaching

Shulman, Lee S. 1999. Taking learning seriously. *Change, 31* (4), 11-17.

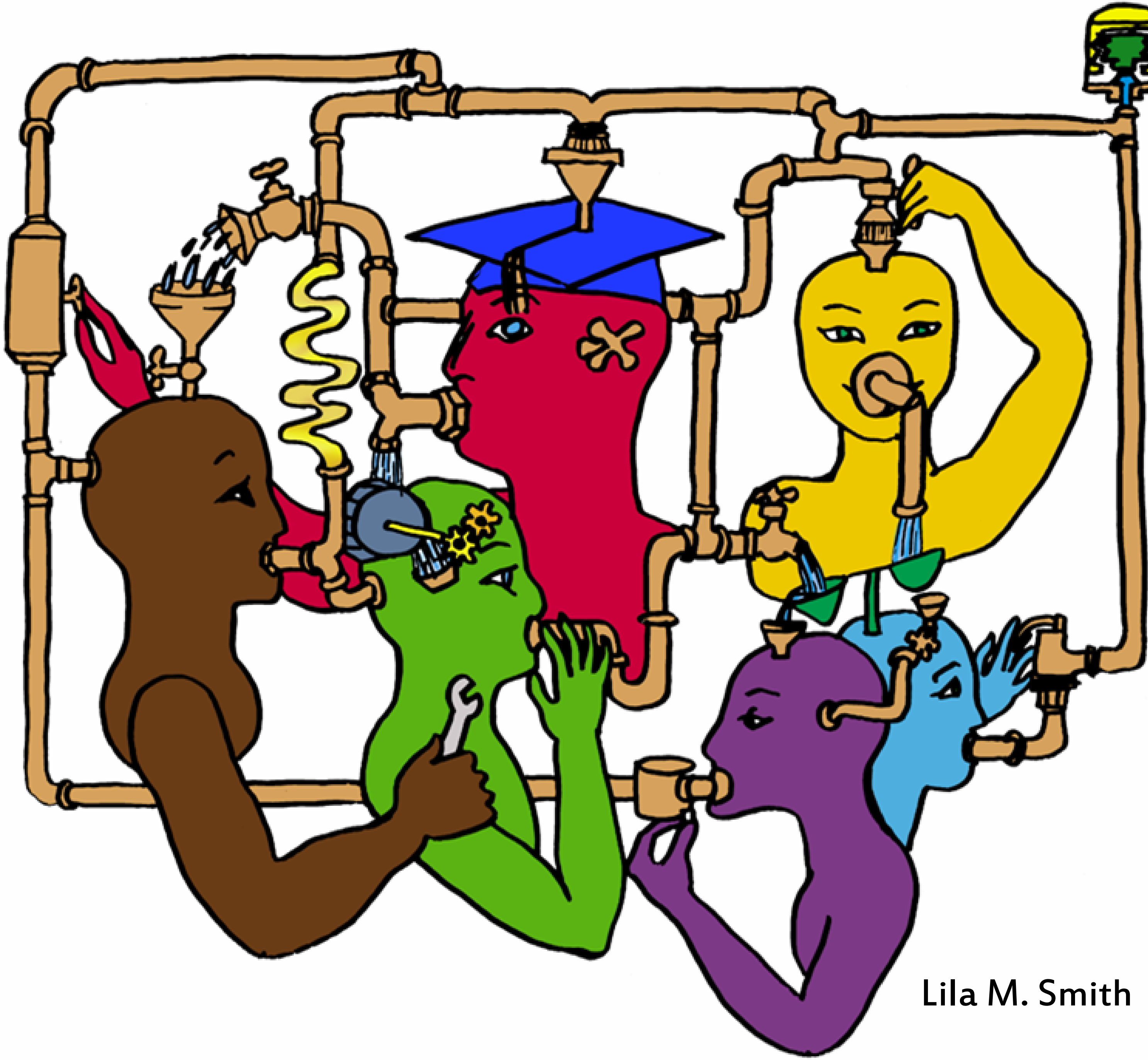
What do we do about these pathologies?

- **Activity** – Engage learners in meaningful and purposeful activities
- **Reflection** – Provide opportunities
- **Collaboration** – Design interaction
- **Passion** – Connect with things learners care about

Shulman, Lee S. 1999. Taking learning seriously. Change, 31 (4), 11-17.

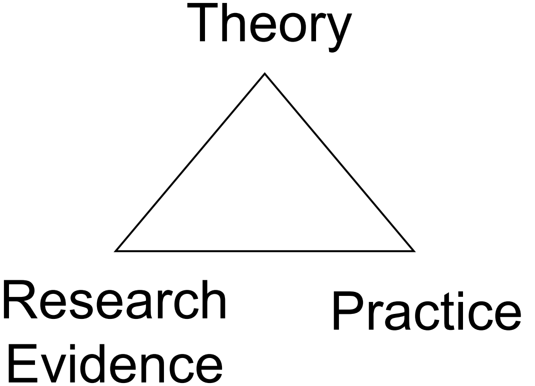
University of Minnesota College of Education Social, Psychological and Philosophical Foundations of Education

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


Lila M. Smith

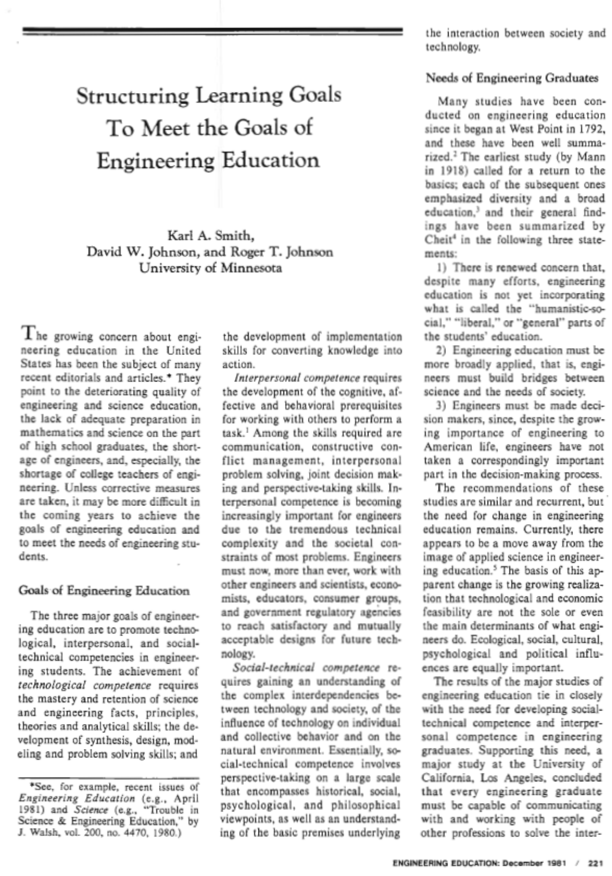
Cooperative Learning

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



Cooperative Learning Introduced to Engineering – 1981

- Smith, K.A., Johnson, D.W. and Johnson, R.T., 1981. The use of cooperative learning groups in engineering education. In L.P. Grayson and J.M. Biedenbach (Eds.), *Proceedings Eleventh Annual Frontiers in Education Conference*, Rapid City, SD, Washington: IEEE/ASEE, 26-32.



Structuring Learning Goals To Meet the Goals of Engineering Education

Karl A. Smith,
David W. Johnson, and Roger T. Johnson
University of Minnesota

The growing concern about engineering education in the United States has been the subject of many recent editorials and articles.* They point to the deteriorating quality of engineering and science education, the lack of adequate preparation in mathematics and science on the part of high school graduates, the shortage of engineers, and, especially, the shortage of college teachers of engineering. Unless corrective measures are taken, it may be more difficult in the coming years to achieve the goals of engineering education and to meet the needs of engineering students.

Goals of Engineering Education

The three major goals of engineering education are to promote technological, interpersonal, and social-technical competencies in engineering students. The achievement of *technological competence* requires the mastery and retention of science and engineering facts, principles, theories and analytical skills; the development of synthesis, design, modeling and problem solving skills; and the development of implementation skills for converting knowledge into action.

Interpersonal competence requires the development of the cognitive, affective and behavioral prerequisites for working with others to perform a task.[1] Among the skills required are communication, constructive conflict management, interpersonal problem solving, joint decision making and perspective-taking skills. Interpersonal competence is becoming increasingly important for engineers due to the tremendous technical complexity and the societal constraints of most problems. Engineers must now, more than ever, work with other engineers and scientists, economists, educators, consumer groups, and government regulatory agencies to reach satisfactory and mutually acceptable designs for future technology.

Social-technical competence requires gaining an understanding of the complex interdependencies between technology and society, of the influence of technology on individual and collective behavior and on the natural environment. Essentially, social-technical competence involves perspective-taking on a large scale that encompasses historical, social, psychological, and philosophical viewpoints, as well as an understanding of the basic premises underlying the interaction between society and technology.

Needs of Engineering Graduates

Many studies have been conducted on engineering education since it began at West Point in 1792, and these have been well summarized.[2] The earliest study (by Mann in 1918) called for a return to the basics; each of the subsequent ones emphasized diversity and a broad education,[3] and their general findings have been summarized by Cheit[4] in the following three statements:

1) There is renewed concern that, despite many efforts, engineering education is not yet incorporating what is called the "humanistic-social," "liberal," or "general" parts of the students' education.

2) Engineering education must be more broadly applied, that is, engineers must build bridges between science and the needs of society.

3) Engineers must be made decision makers, since, despite the growing importance of engineering to American life, engineers have not taken a correspondingly important part in the decision-making process.

The recommendations of these studies are similar and recurrent, but the need for change in engineering education remains. Currently, there appears to be a move away from the image of applied science in engineering education.[5] The basis of this apparent change is the growing realization that technological and economic feasibility are not the sole or even the main determinants of what engineers do. Ecological, social, cultural, psychological and political influences are equally important.

The results of the major studies of engineering education tie in closely with the need for developing social-technical competence and interpersonal competence in engineering graduates. Supporting this need, a major study at the University of California, Los Angeles, concluded that every engineering graduate must be capable of communicating with and working with people of other professions to solve the inter-

*See, for example, recent issues of *Engineering Education* (e.g., April 1981) and *Science* (e.g., "Trouble in Science & Engineering Education," by J. Walsh, vol. 200, no. 4470, 1980.)

JEE December 1981

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.ucla.edu/index.php

Undergraduate Teaching Faculty, 2011*

Methods Used in "All" or "Most"	STEM women	STEM men	All other women	All other men
Cooperative learning	60%	41%	72%	53%
Group projects	36%	27%	38%	29%
Grading on a curve	17%	31%	10%	16%
Student inquiry	43%	33%	54%	47%
Extensive lecturing	50%	70%	29%	44%

*Undergraduate Teaching Faculty. National Norms for the 2010-2011 HERI Faculty Survey, www.heri.ucla.edu/index.php

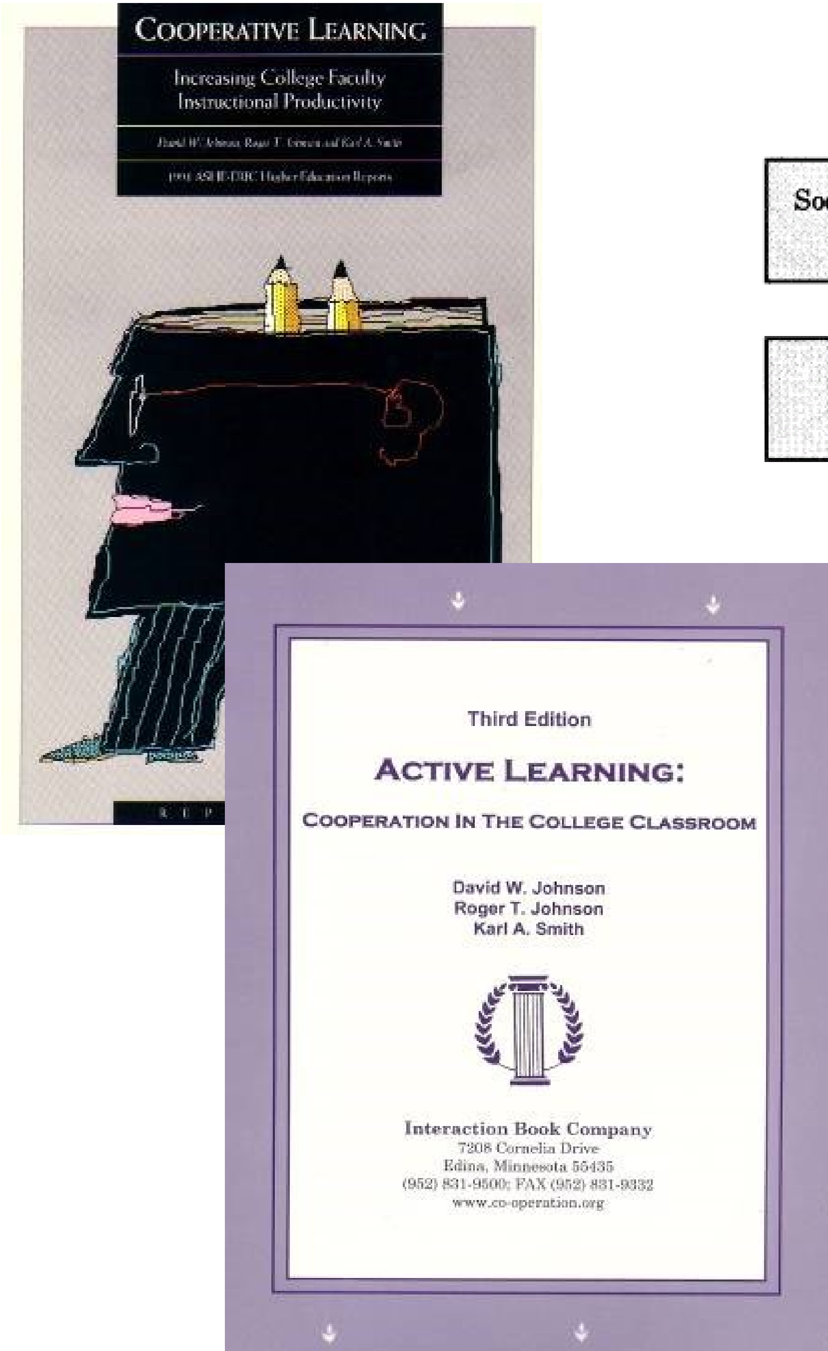
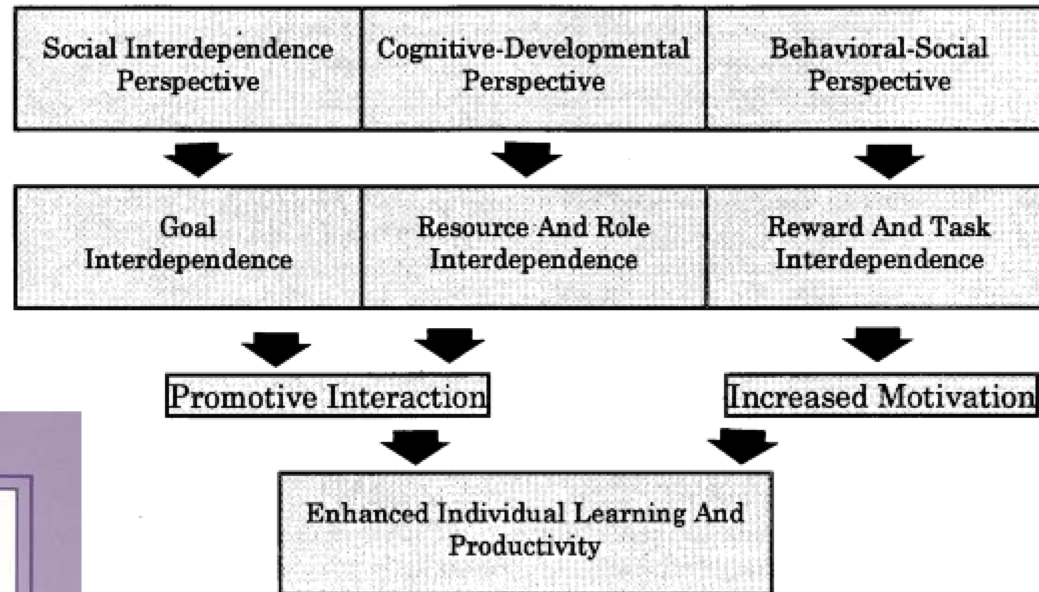


Figure A.1 A General Theoretical Framework



Cooperative Learning

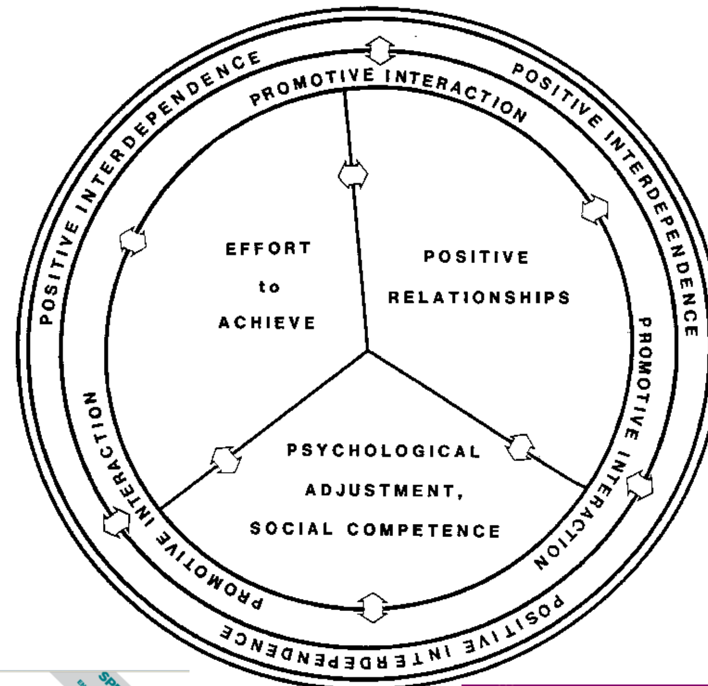
- •Positive Interdependence
- •Individual and Group Accountability
- •Face-to-Face Promotive Interaction
- •Teamwork Skills
- •Group Processing

[*First edition 1991]

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.

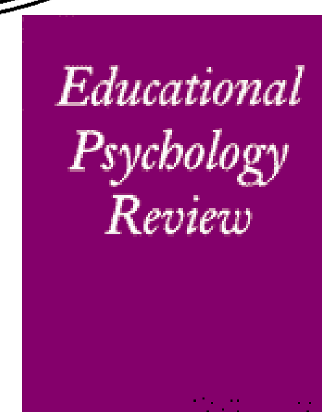
- Over 300 Experimental Studies
- First study conducted in 1924
- High Generalizability
- Multiple Outcomes



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

Student Engagement Research Evidence

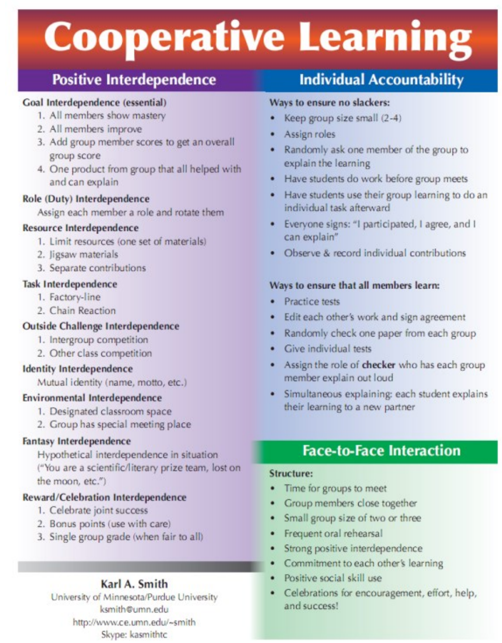
- Perhaps the strongest conclusion that can be made is the least surprising. Simply put, the greater the student's involvement or engagement in academic work or in the academic experience of college, the greater his or her level of knowledge acquisition and general cognitive development …(Pascarella and Terenzini, 2005).
- Active and collaborative instruction coupled with various means to encourage student engagement invariably lead to better student learning outcomes irrespective of academic discipline (Kuh et al., 2005, 2007).

See Smith, et.al, 2005 and Fairweather, 2008, Linking Evidence and Promising Practices in Science, Technology, Engineering, and Mathematics (STEM) Undergraduate Education - http://www7.nationalacademies.org/bose/Fairweather_CommissionedPaper.pdf

Cooperative Learning is instruction that involves people working in teams to accomplish a common goal, under conditions that involve both *positive interdependence* (all members must cooperate to complete the task) and *individual and group accountability* (each member is accountable for the complete final outcome).

Key Concepts

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



Cooperative Learning

Positive Interdependence

Goal Interdependence (essential)
1. All members show mastery
2. All members improve
3. Add group member scores to get an overall group score
4. One product from group that all helped with and can explain

Role (Duty) Interdependence
Assign each member a role and rotate them

Resource Interdependence
1. Limit resources (one set of materials)
2. Jigsaw materials
3. Separate contributions

Task Interdependence
1. Factory-line
2. Chain Reaction

Outside Challenge Interdependence
1. Intergroup competition
2. Other class competition

Identity Interdependence
Mutual identity (name, motto, etc.)

Environmental Interdependence
1. Designated classroom space
2. Group has special meeting place

Fantasy Interdependence
Hypothetical interdependence in situation ("You are a scientific/literary prize team, lost on the moon, etc.")

Reward/Celebration Interdependence
1. Celebrate joint success
2. Bonus points (use with care)
3. Single group grade (when fair to all)

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Skype: kasmithtc

Individual Accountability

Ways to ensure no slackers:
- Keep group size small (2-4)
- Assign roles
- Randomly ask one member of the group to explain the learning
- Have students do work before group meets
- Have students use their group learning to do an individual task afterward
- Everyone signs: "I participated, I agree, and I can explain"
- Observe & record individual contributions

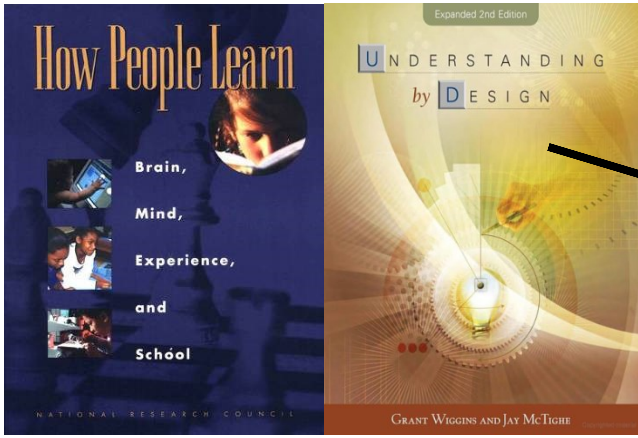
Ways to ensure that all members learn:
- Practice tests
- Edit each other's work and sign agreement
- Randomly check one paper from each group
- Give individual tests
- Assign the role of **checker** who has each group member explain out loud
- Simultaneous explaining: each student explains their learning to a new partner

Face-to-Face Interaction

Structure:
- Time for groups to meet
- Group members close together
- Small group size of two or three
- Frequent oral rehearsal
- Strong positive interdependence
- Commitment to each other's learning
- Positive social skill use
- Celebrations for encouragement, effort, help, and success!

http://www.ce.umn.edu/~smith/docs/Smith-CL%20Handout%2008.pdf

Design Foundations



Science of Learning (HPL) ↓ / Science of Instruction (UbD) →	No	Yes
Yes	Good Theory/ Poor Practice	Good Theory & Good Practice
No		Good Practice/ Poor Theory

Sources: Bransford, Brown & Cocking. 1999. *How people learn.* National Academy Press.
Wiggins, G. & McTighe, J. 2005. *Understanding by design, 2ed*. ASCD.

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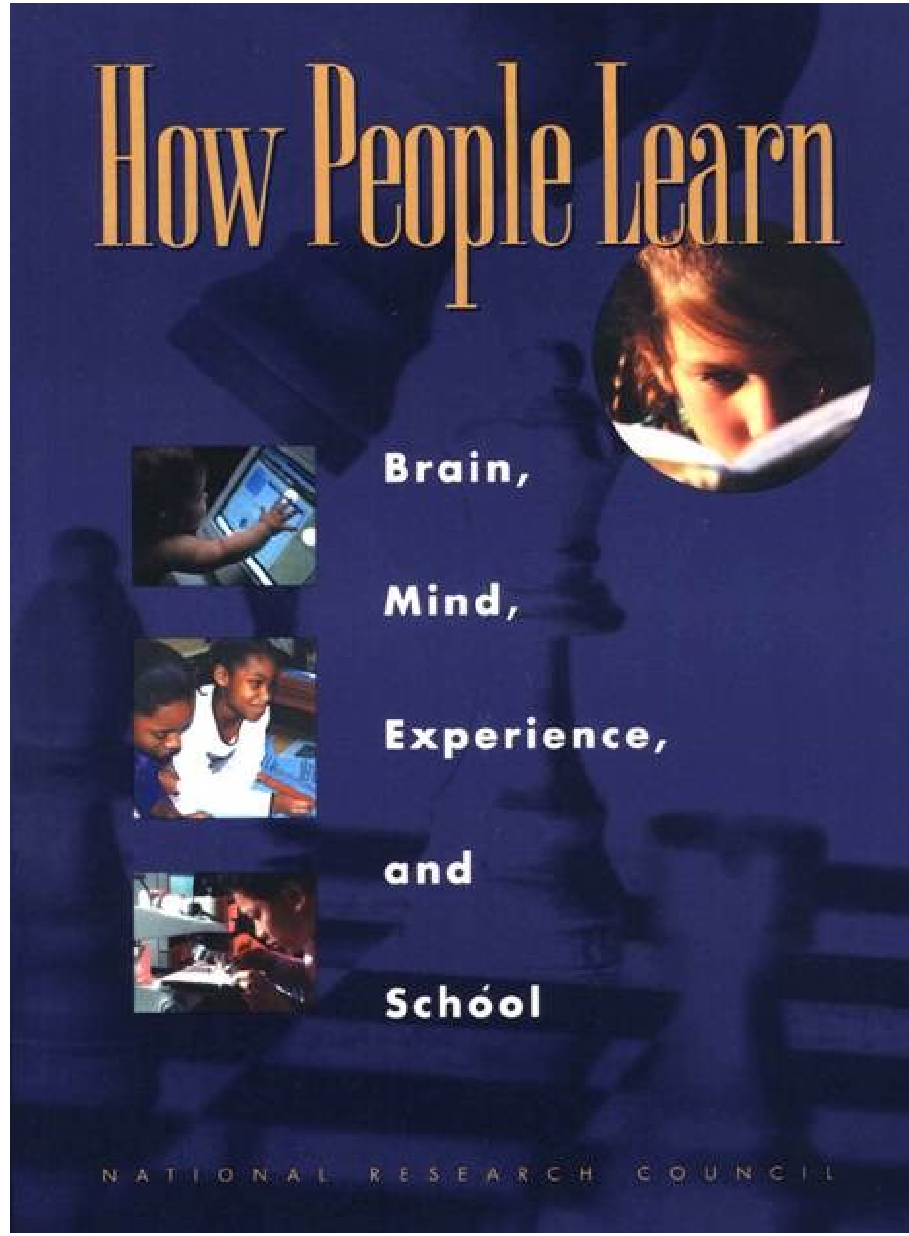
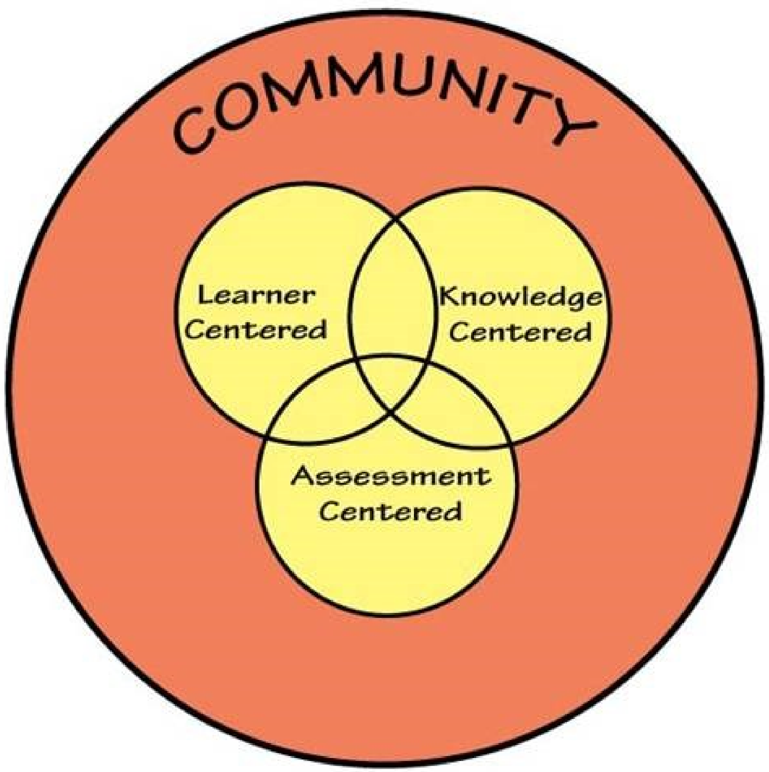


http://www.nap.edu/openbook.php?record_id=6160

How People Learn (HPL)

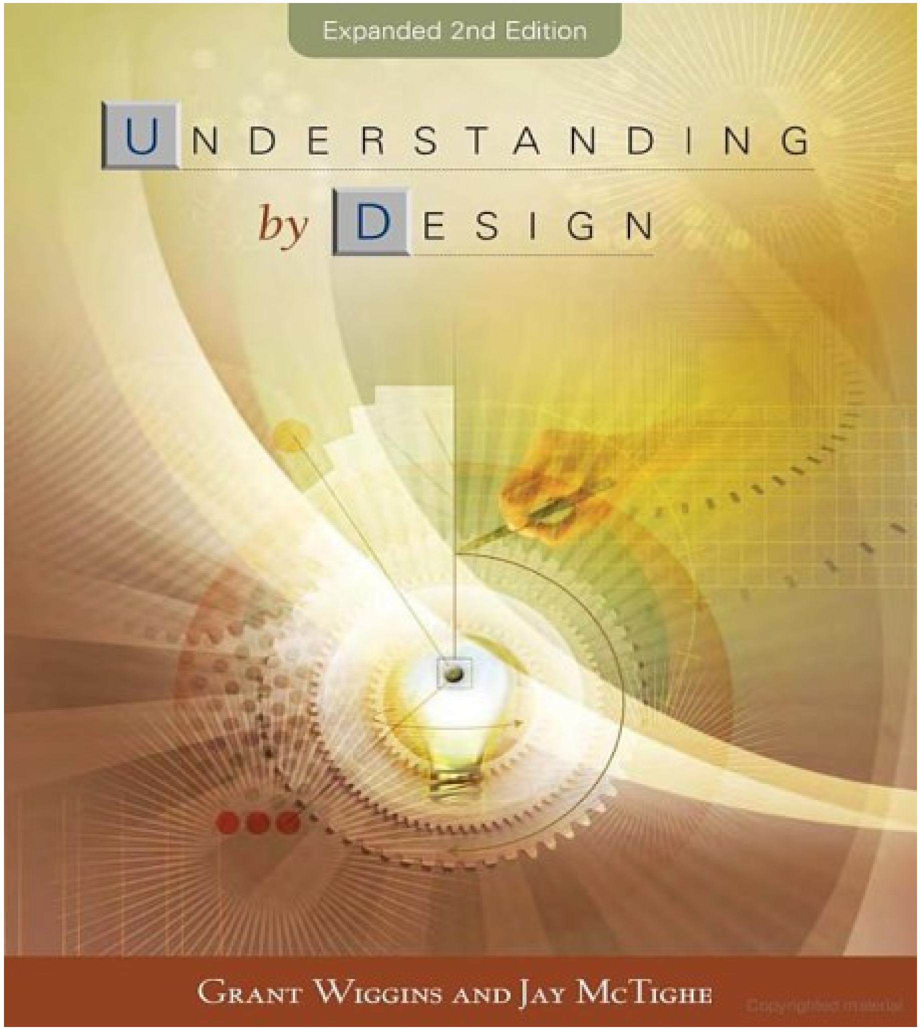
HPL Framework



- Expertise Implies (Ch. 2):
  - 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.

Understanding by Design (UbD)



http://books.google.com/books?id=N2EfKlyUN4QC&printsec=frontcover&source=gbs_v2_summary_r&cad=0#v=onepage&q=&f=false

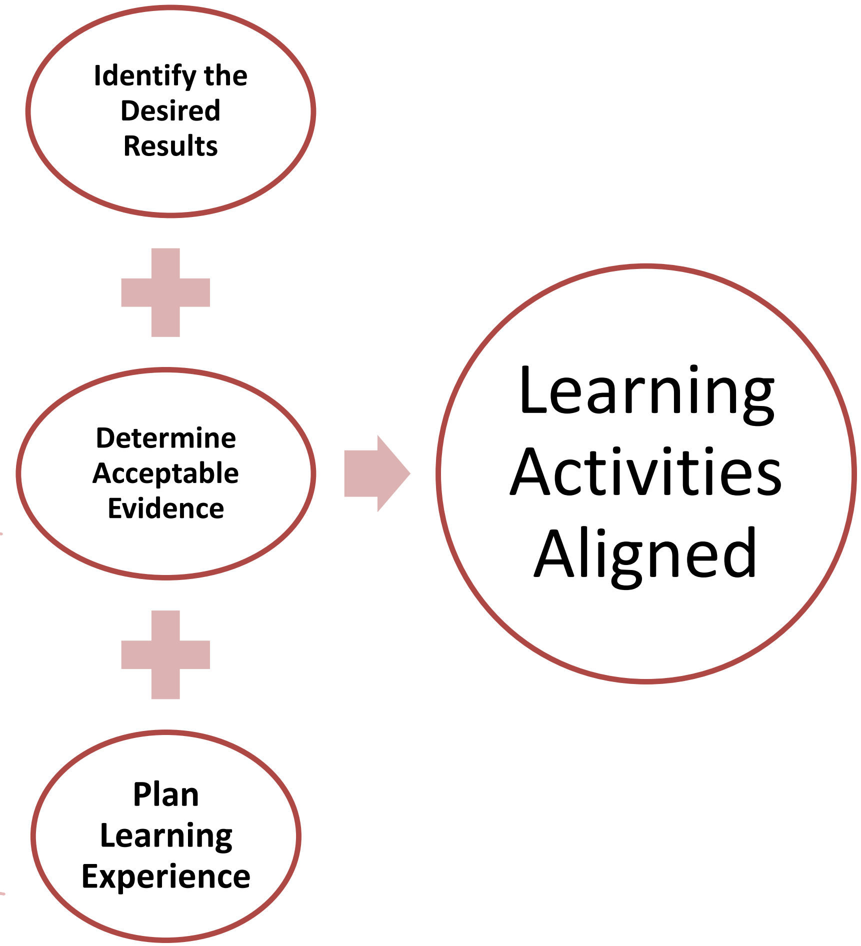
41

Understanding by Design Process

What should learners know, understand and be able to do?

How will we know if the learners have achieved the desired results?
What will be accepted as evidence of learner's understanding and proficiency?

What activities will equip learners with the needed knowledge and skills?
What materials and resources will be useful?



Understanding by Design (UbD) Process vs. Engineering Design Process

Understanding by Design
- Identify the desired results
- Determine acceptable evidence
- Plan learning experiences

Engineering Design
- Determine requirements specifications
- Develop or use established metrics to measure against outcomes
- Plan and develop process, system, etc. to implement

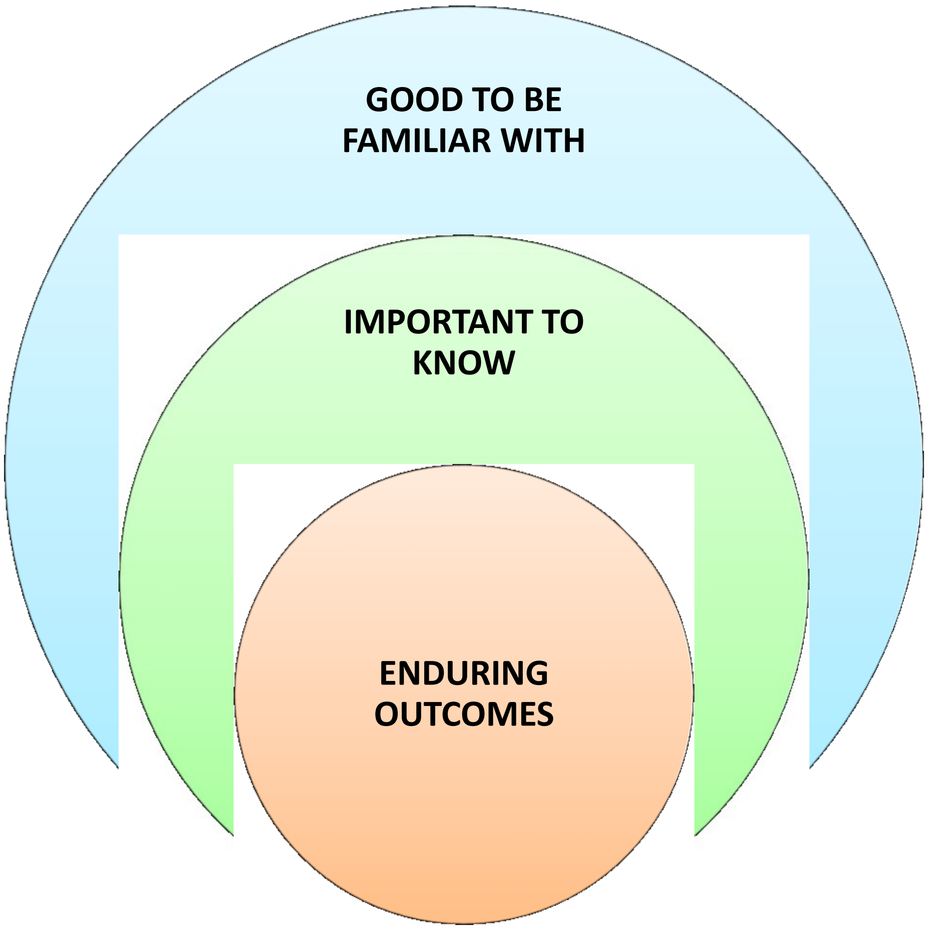
Think about it…

Why is it important to understand the parallels between these two processes?

HOW PEOPLE LEARN

UNDERSTAND BIG IDEAS

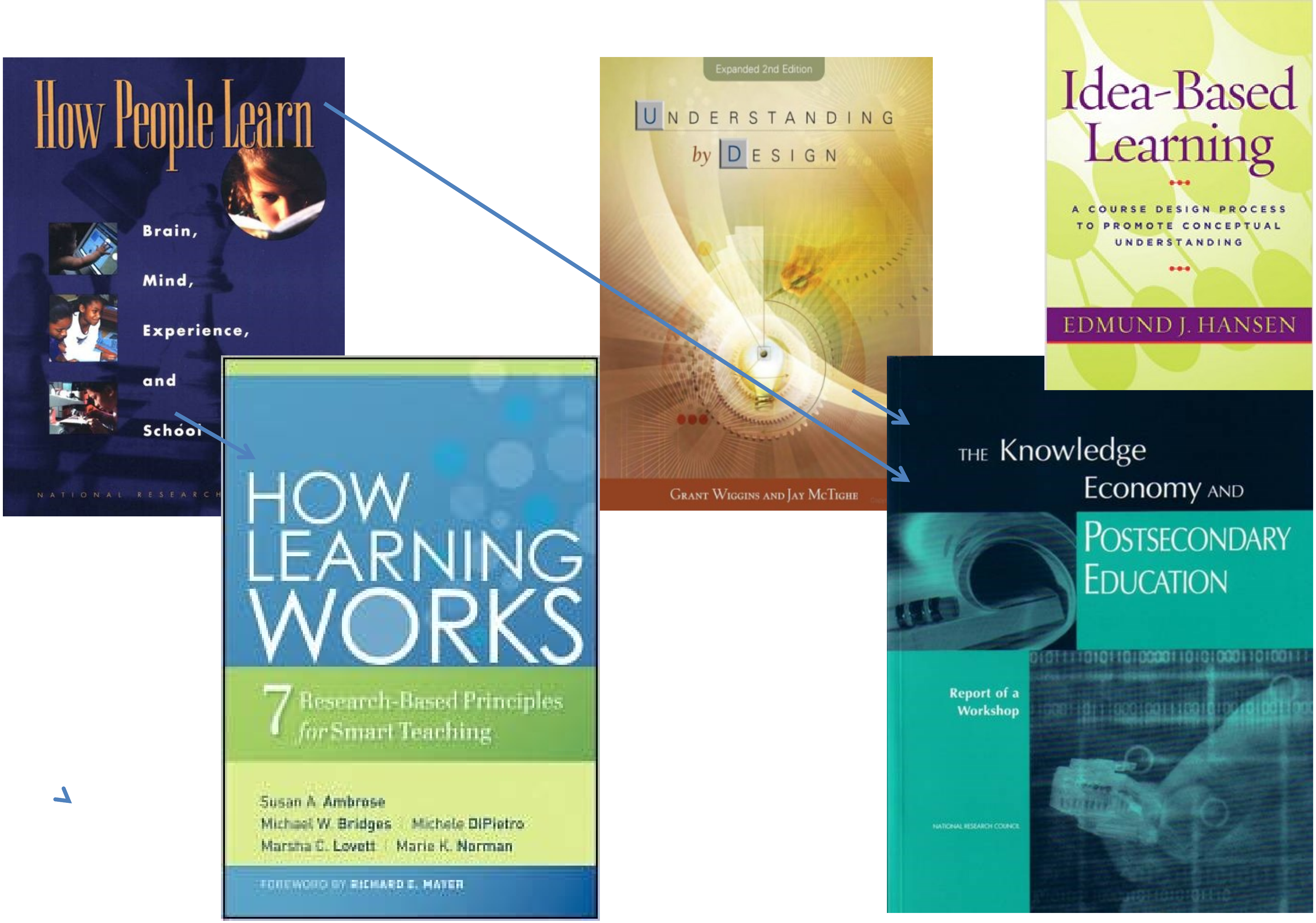
Concept: Curricular Priorities



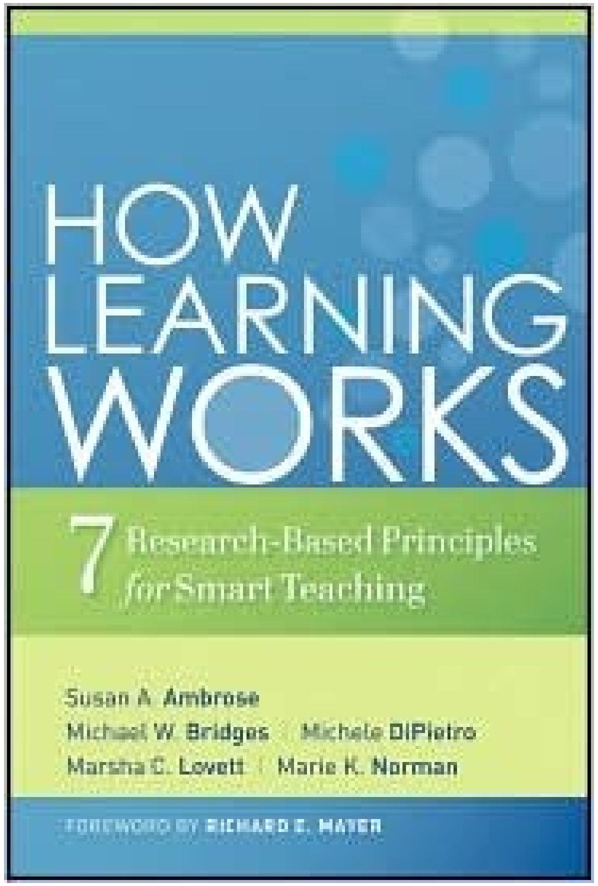
-Understanding by Design,
Wiggins and McTighe (1998)

Things to Consider:

- Are the topics **enduring and transferable** big ideas having value beyond the classroom?
- Are the topics big ideas and **core processes** at the heart of the discipline?
- Are the topics **abstract, counterintuitive, often misunderstood, or easily misunderstood** ideas requiring uncoverage?
- Are the topics big ideas **embedded in facts, skills and activities**?



- Bransford, Vye and Bateman – Creating High Quality Learning Environments

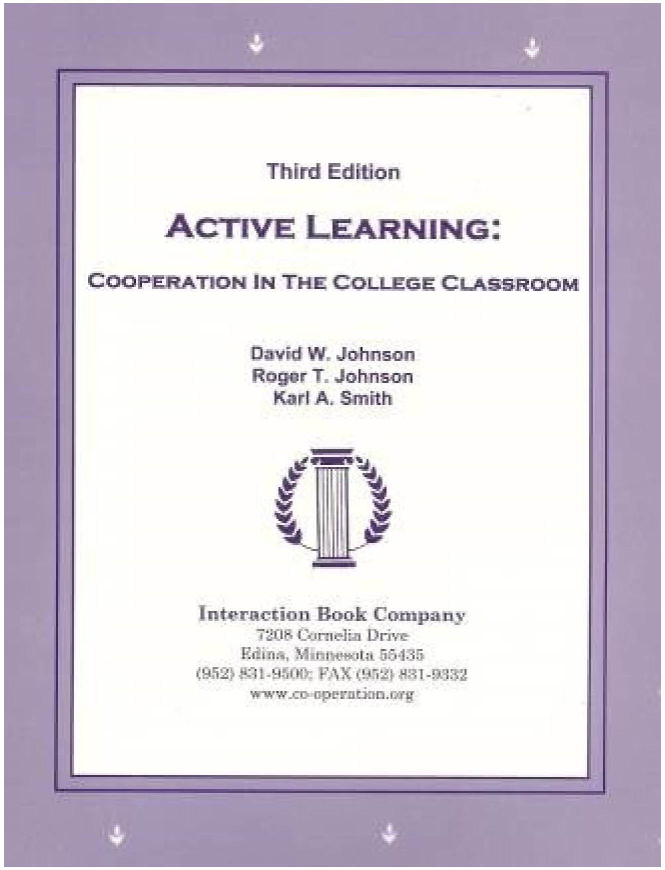


1. Students prior knowledge can help or hinder learning
2. How student organize knowledge influences how they learn and apply what they know
3. Students' motivation determines, directs, and sustains what they do to learn
4. To develop mastery, students must acquire component skills, practice integrating them, and know when to apply what they have learned
5. Goal-directed practice coupled with targeted feedback enhances the quality of students' learning
6. Students' current level of development interacts with the social, emotional, and intellectual climate of the course to impact learning
7. To become self-directed learners, students must learn to monitor and adjust their approach to learning

Pedagogies of Engagement (PoE)

Active Learning: Cooperation in the College Classroom

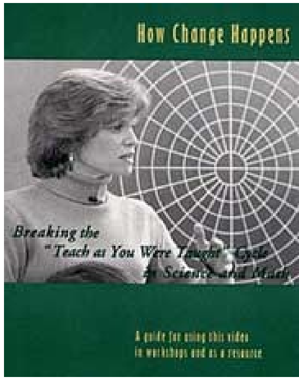
- **Informal** Cooperative Learning Groups
- **Formal** Cooperative Learning Groups
- Cooperative **Base** Groups

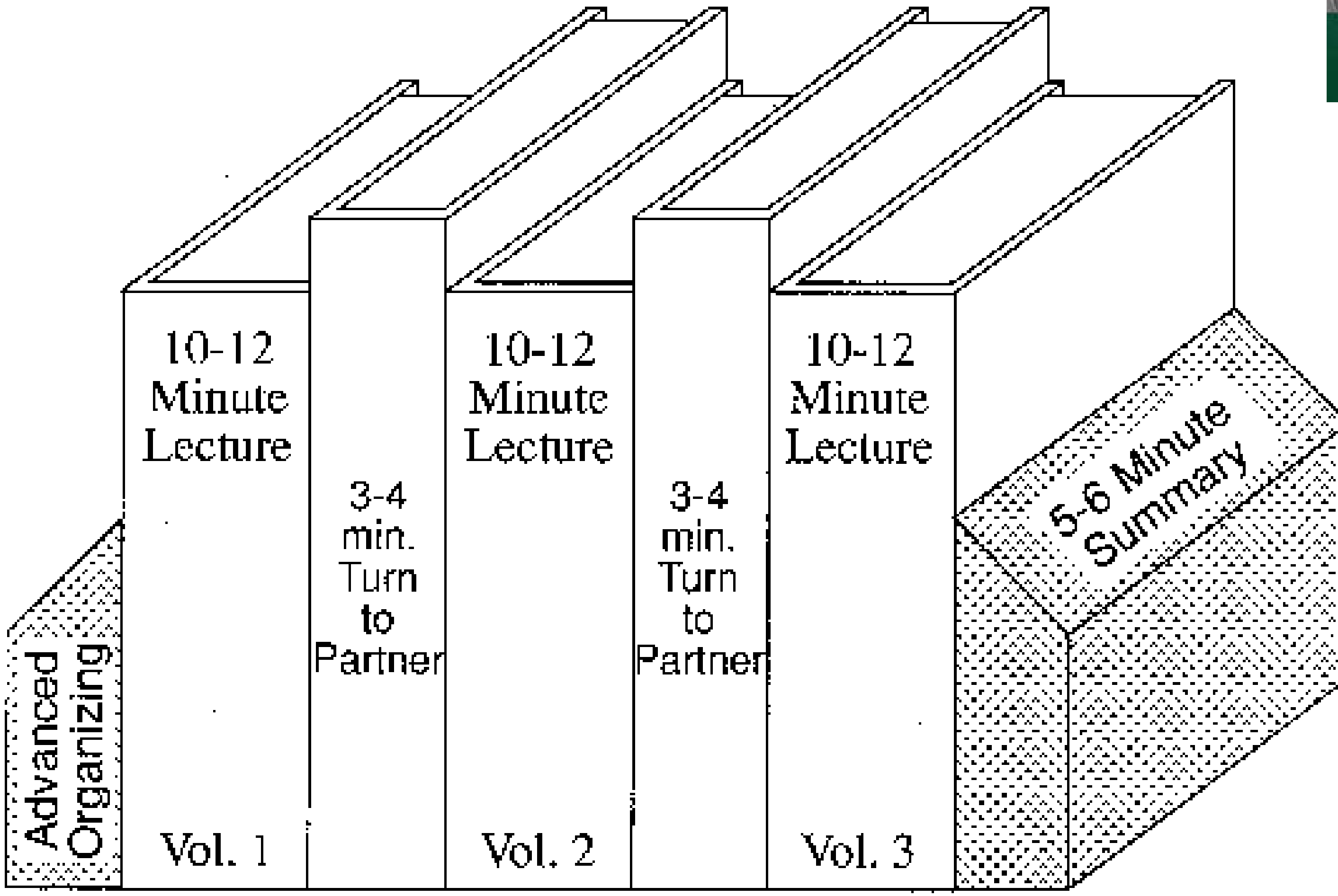


Notes: Cooperative Learning Handout (CL College-912.doc)

www.ce.umn.edu/~smith/docs/CL%20College-912.doc

Book Ends on a Class Session





Smith, K.A. 2000. Going deeper: Formal small-group learning in large classes. Energizing large classes: From small groups to learning communities. *New Directions for Teaching and Learning*, 2000, 81, 25-46. [NDTL81Ch3GoingDeeper.pdf]

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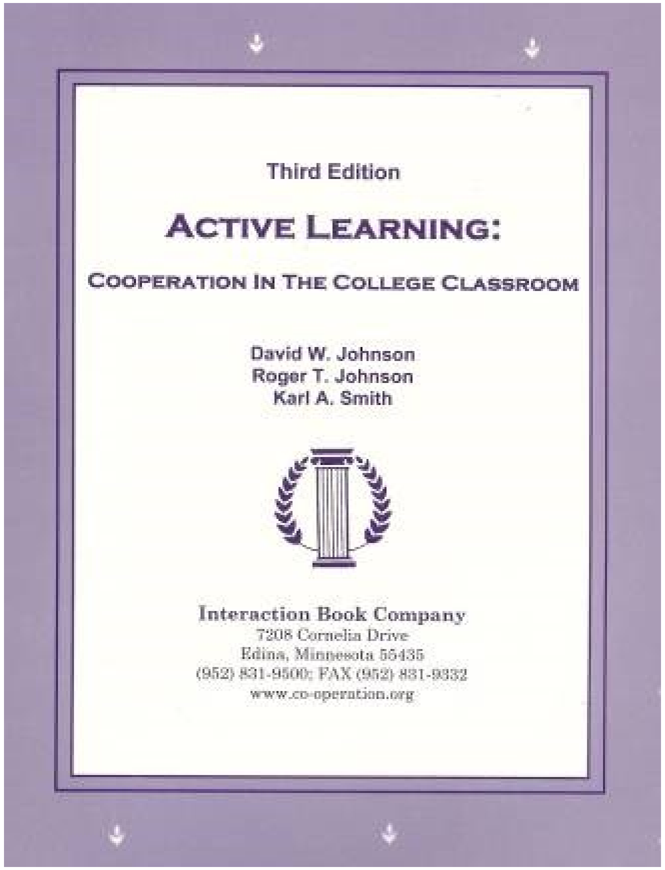


SCALE-UP

Student-Centered Active Learning Environment with Upside-down Pedagogies

How would you like to teach (or learn) in a classroom like this one at MIT?

The purpose of this website is to share designs for state-of-the-art learning studios, teaching methods, and instructional materials that are based on more than a decade of discipline-based education research.

For a quick introduction, visit our Frequently-Asked-Questions page, or take a look at this 5 minute video or view a some of these short video clips created by adopters:

Minnesota, McGill, Iowa, Virginia Tech, Old Dominion, Northern Michigan, Oklahoma, Windward High School

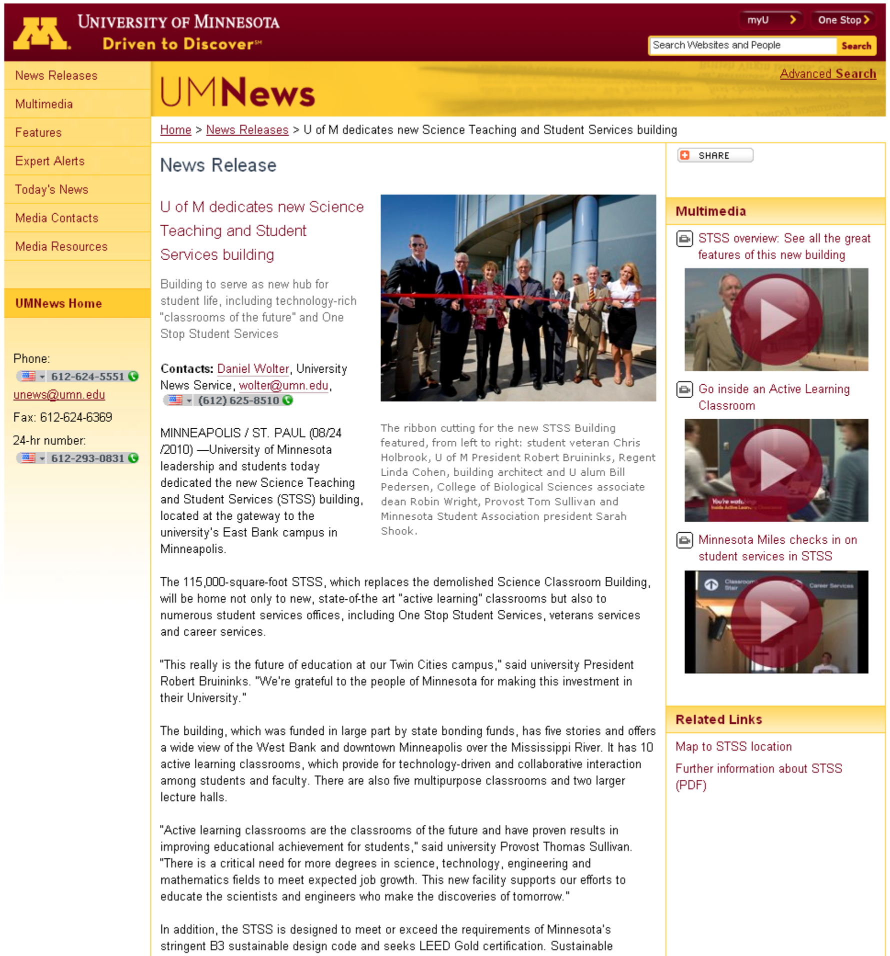
As a visitor to the site, you can view classroom designs and find contact information for scores of colleges and a growing number of high schools that are offering highly interactive, collaborative, guided-inquiry-based instruction.

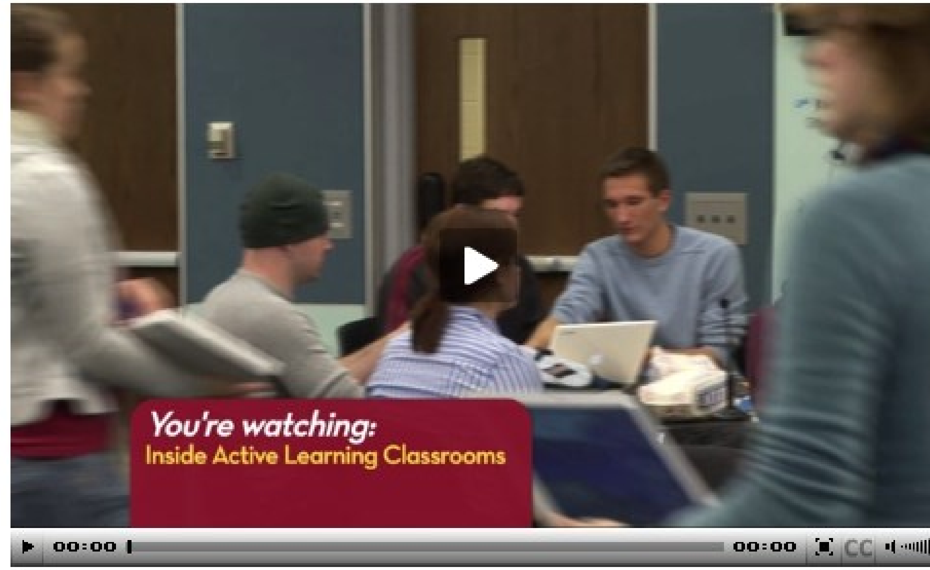
Registered site members have access to many more details and classroom materials being developed and tested by faculty from around the world.

Visitors may click here to go to pages describing the work of many of the institutions adopting SCALE-UP.

Registered site members, click here to log in. (There is additional detailed information available only to those who have registered.)

http://scaleup.ncsu.edu/





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

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

http://www.youtube.com/watch?v=IfT_hoiuY8w

http://youtu.be/IfT_hoiuY8w

Inside an Active Learning Classroom

- STSS in University of Minnesota

http://vimeo.com/andyub/activeclassroom



"I love this space! It makes me feel appreciated as a student, and I feel intellectually invigorated when I work and learn in it."

University of Delaware

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UD Home | A-Z | Find It | Maps | People | My UD

PBL@UD

Institute for Transforming Undergraduate Education

Problem-Based Learning at University of Delaware

Why PBL? | Our Workshops | Resources | Leaders & Fellows | Partners | In the News

The Motivation to Learn Begins with a Problem

In a problem-based learning (PBL) model, students engage complex, challenging problems and collaboratively work toward their resolution. PBL is about students connecting disciplinary knowledge to real-world problems—the motivation to solve a problem becomes the motivation to learn.

PBL@UD

For more than ten years, the Leaders and Fellows of the Institute for Transforming Undergraduate Education (ITUE) have encouraged the adoption of student-centered and active classroom pedagogies—and in particular—the use of PBL in the undergraduate classroom. On- and off-campus workshops are held for faculty and students to enhance their understanding of PBL.

Recipient of a Hesburgh Certificate of Excellence

The Theodore M. Hesburgh Award was created to acknowledge and reward successful, innovative faculty development programs that enhance undergraduate teaching. ITUE is a recipient of the Hesburgh Certificate of Excellence for its work in implementing problem-based learning in the classroom.

What we offer

PBL Clearinghouse

Find great problems for your

In this peer-reviewed online resource, educators have the opportunity to submit and publish their own problems and articles on problem-based learning.

Learn more

PBL Training at a lower cost: Attend our January 4-6 Workshop for an Introduction to PBL!

This workshop will demonstrate problem-based learning (PBL) and model ways that PBL can be used effectively in all disciplines. We will begin with a problem, and participants will work in teams to experience first hand what this instructional approach entails. We will then move to the main focus of this program: writing effective problem-based materials. Participants will leave the session with new or revised problems for use in their courses.

Learn more

PBL@UD • info@pbl.udel.edu

University of Delaware

http://www.udel.edu/inst/

PoE Video Examples

- Early examples (80s & early 90s)
  - Smith
  - Derek Bok Center - Harvard
  - STEMTEC
- Mid 90s
  - Felder - NCSU
  - U Wisconsin – Chem Concepts
  - Jones - Purdue
- Recent
  - Mazur – Peer Instruction
  - University of Minnesota – Active Learning (SCALE-UP)

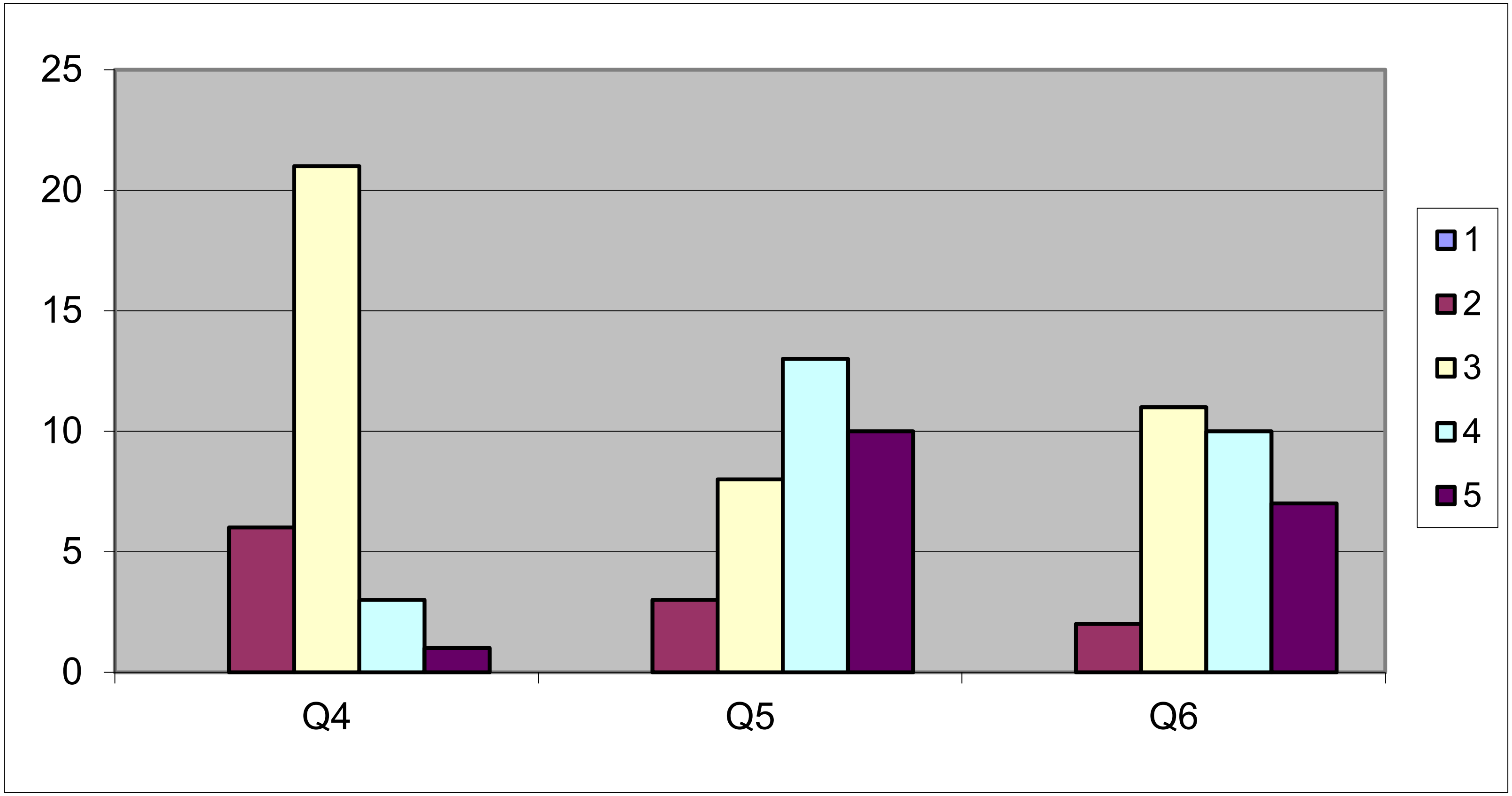
Session Summary (Minute Paper)

Reflect on the session:

1. Most interesting, valuable, useful thing you learned.
2. Things that helped you learn.
3. Question, comments, suggestions.

4. Pace: Too slow 1 . . . . 5 Too fast
5. Relevance: Little 1 . . . 5 Lots
6. Instructional Format: Ugh 1 . . . 5 Ah

OSU – Seminar (4-28-14)



Q4 – Pace: Too slow 1 . . . . 5 Too fast (3.0)
Q5 – Relevance: Little 1 . . . 5 Lots (3.9)
Q6 – Format: Ugh 1 . . . 5 Ah (3.7)