

Evidence-Based Practices for Innovative Education

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Faculty Development Days

Bismarck State College

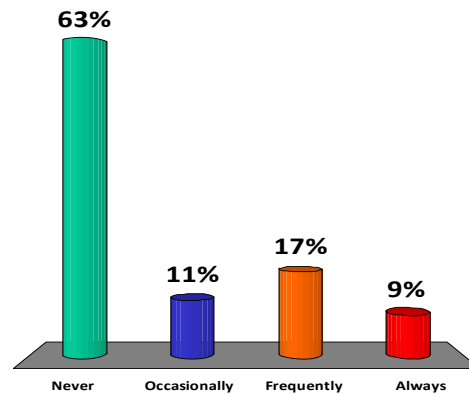
August 15, 2012

Overview

- Keynote – Evidence-Based Practices for Innovative Education
 - Welcome & Overview
 - Cooperative Learning Basics
 - Course Design Foundations
- Workshop – Design and Implementation of Active and Cooperative Learning
 - Informal Cooperative Learning
 - Book Ends on a Class Session
 - Formal Cooperative Learning
 - Problem-Based Cooperative Learning

Clicker Usage

1. Never
2. Occasionally
3. Frequently
4. Always



3

Participant Learning Goals (Objectives)

- Describe key features of the Understanding by Design and How People Learn
- Describe key features of Cooperative Learning
- Explain rationale for Pedagogies of Engagement, especially Cooperative Learning & Challenge Based Learning
- Apply cooperative learning to classroom practice
- Identify connections between cooperative learning and desired outcomes of courses and programs

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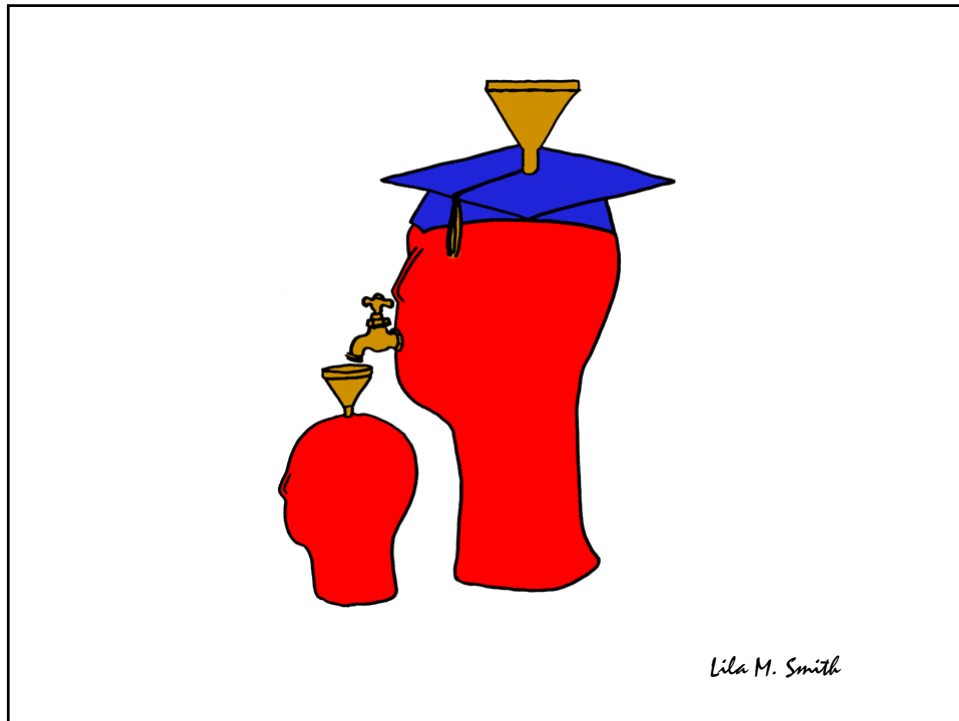
Reflection and Dialogue

- Individually reflect on your mental image of an innovative teacher. Write for about 1 minute.
 - Jot down words or phrases
 - Construct a figure or diagram
- Discuss with your neighbor for about 2 minutes
 - Describe your mental image and talk about similarities and differences
 - Select one Element, Image, Comment, Story, etc. that you would like to present to the whole group if you are randomly selected
- Whole group discussion

Teacher Mental Images About Teaching - Axelrod (1973)

Mental Image	Motto	Characteristics	Disciplines
Content	I teach what I know	Pour it in, Lecture	Science, Math
Instructor	I teach what I am	Modeling, Demonstration	Many
Student – Cognitive Development	I train minds	Active Learning, Discussion	English, Humanities
Student – Development of Whole Person	I work with students as people	Motivation, Self-esteem	Basic Skills Teachers

Axelrod, J. *The University Teacher as Artist*. San Francisco: Jossey-Bass, 1973.



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

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

- Research – rotating disk

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

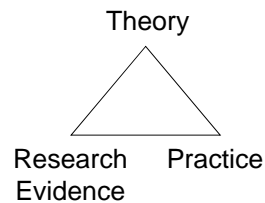
- Practice – leaching of silver bearing metallic copper

First Teaching Experience

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

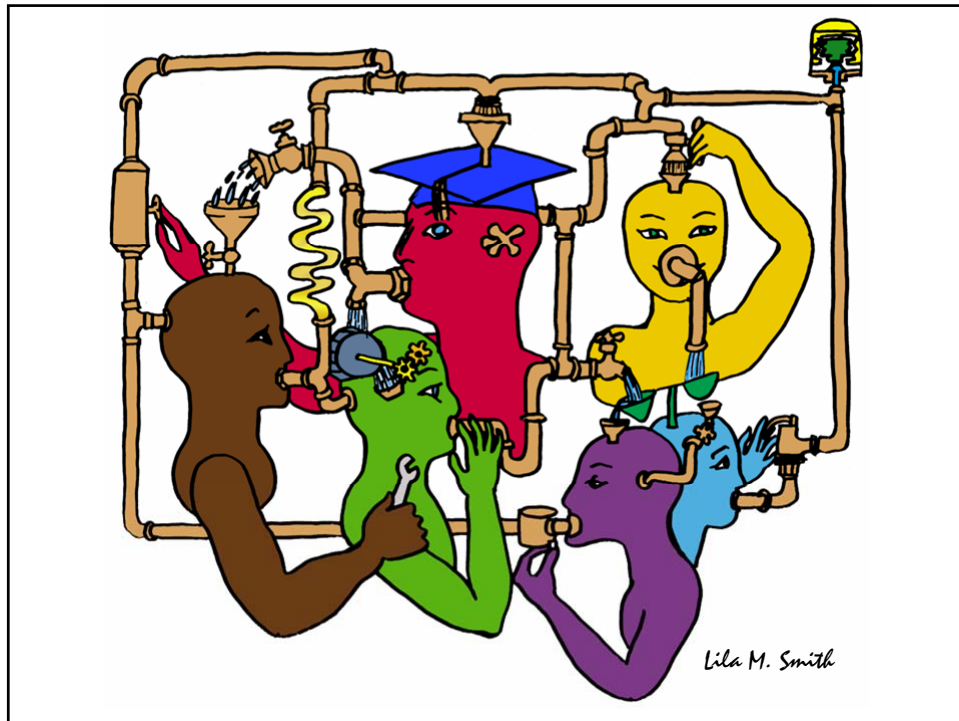
Engineering Education

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



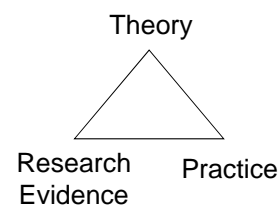
University of Minnesota College of Education Social, Psychological and Philosophical Foundations of Education

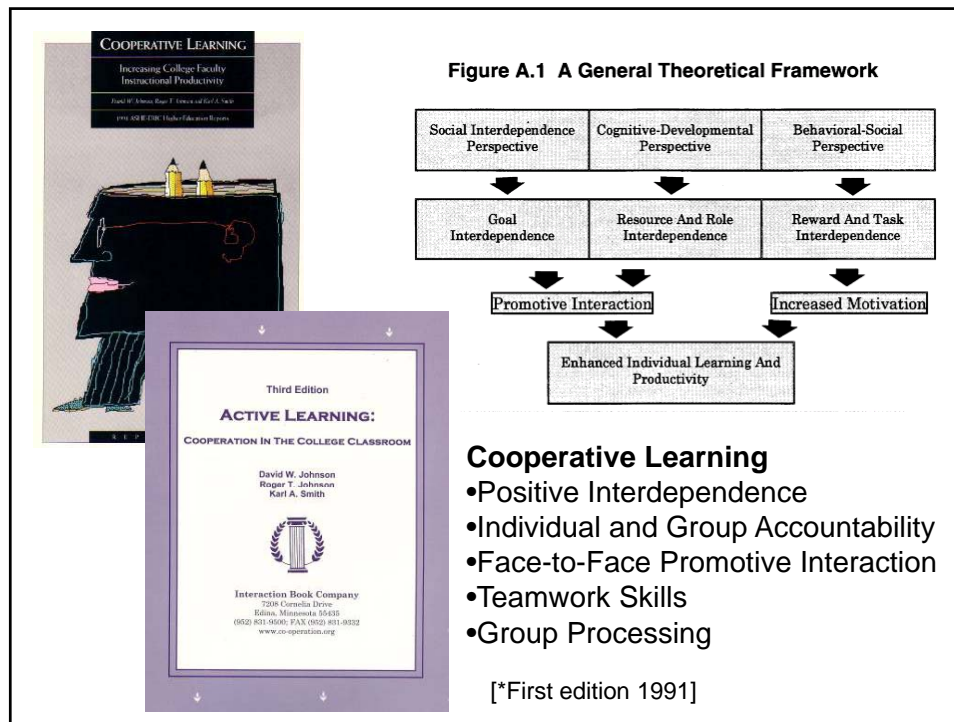
- Statistics, Measurement, Research Methodology
- Assessment and Evaluation
- Learning and Cognitive Psychology
- Knowledge Acquisition, Artificial Intelligence, Expert Systems
- Development Theories
- Motivation Theories
- Social psychology of learning – student – student interaction



Cooperative Learning

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





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

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

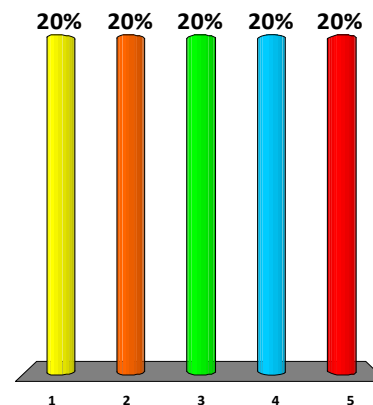
- Positive Interdependence
- Individual and Group Accountability
- Face-to-Face Promotive Interaction
- Teamwork Skills
- Group Processing

Cooperative Learning	
Positive Interdependence	Individual Accountability
<ul style="list-style-type: none"> • Goal interdependence (essential) 1. All members contribute 2. All group members agree to get an overall group score 3. All group members must be successful for the group to be successful 	<ul style="list-style-type: none"> • Each student is responsible for the group's success • Each student is responsible for the group's success • Each student is responsible for the group's success • Each student is responsible for the group's success
Face-to-Face Promotive Interaction	Teamwork Skills
<ul style="list-style-type: none"> • Face-to-face interaction • Face-to-face interaction • Face-to-face interaction • Face-to-face interaction 	<ul style="list-style-type: none"> • Face-to-face interaction • Face-to-face interaction • Face-to-face interaction • Face-to-face interaction

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

What is your experience with cooperative learning?

1. Little 1
2. Between 1&3
3. Moderate 3
4. Between 3&5
5. Extensive 5



Seven Principles for Good Practice in Undergraduate Education

- Good practice in undergraduate education:
 - Encourages student-faculty contact
 - Encourages cooperation among students
 - Encourages active learning
 - Gives prompt feedback
 - Emphasizes time on task
 - Communicates high expectations
 - Respects diverse talents and ways of learning

Chickering & Gamson, June, 1987¹⁹

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

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.

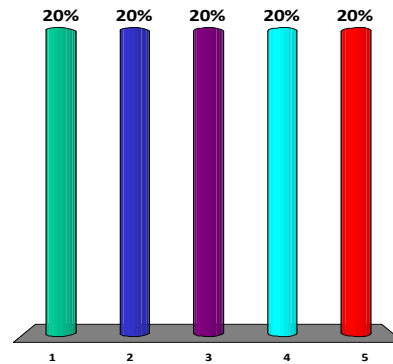
*“It could well be that faculty members of the twenty-first century college or university will find it necessary to set aside their roles as teachers and instead become **designers** of learning experiences, processes, and environments.”*

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



What is your experience with course (re)design?

1. Little 1
2. Between 1&3
3. Moderate 3
4. Between 3&5
5. Extensive 5



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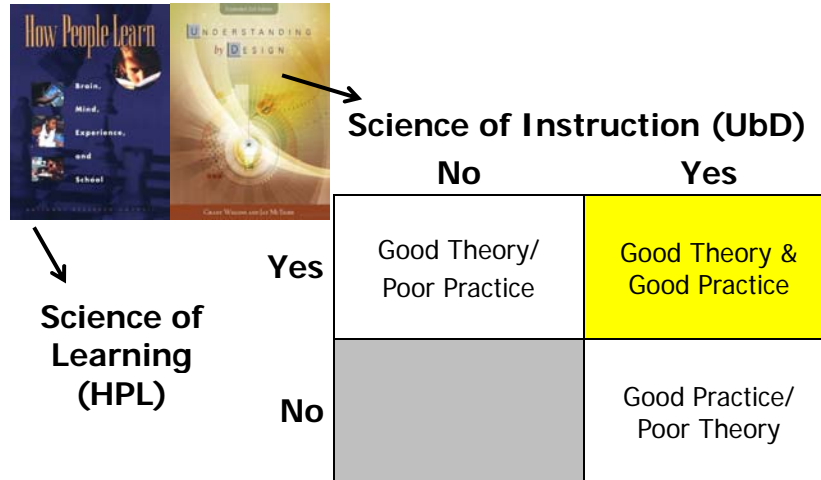
What do you already know about course design?

[Background Knowledge Survey]

Short Answer Questions

- What do you feel are important considerations about course (re) design?
- What are challenges you have faced with course (re) design?

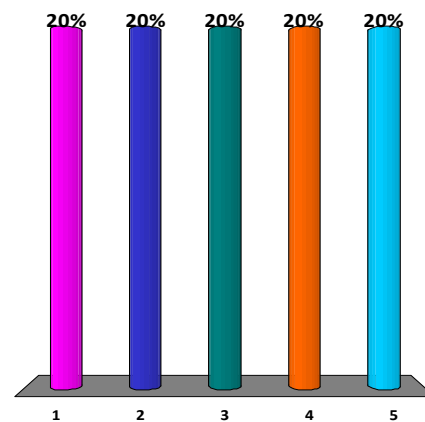
Design Foundations

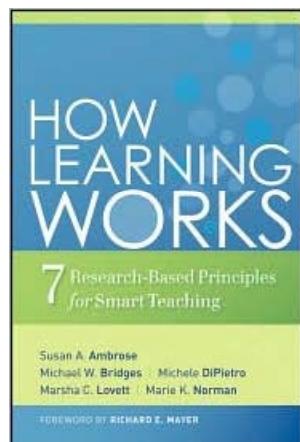
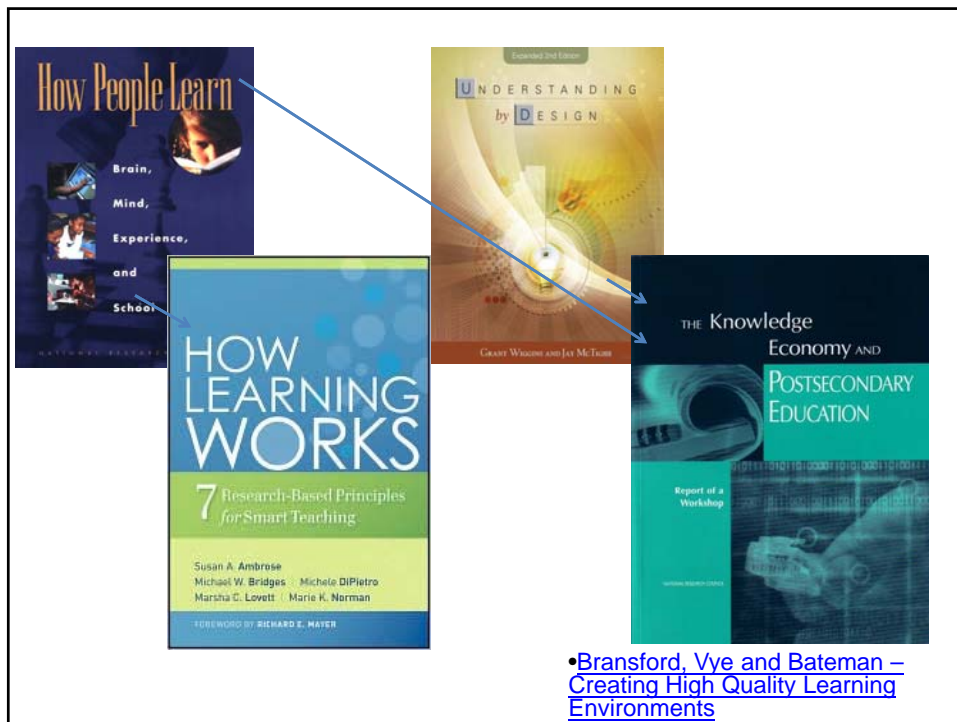


Sources: Bransford, Brown & Cocking. 1999. *How people learn*. National Academy Press.
Wiggins, G. & McTighe, J. 2005. *Understanding by design*, 2ed. ASCD.

What is your level familiarity with learning theories (e.g., HPL) & instruction theories (e.g., UbD)?

1. Low 1
2. Between 1&3
3. Moderate 3
4. Between 3&5
5. High 5





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

Understanding by Design

Wiggins & McTighe (1997, 2005)

Stage 1. Identify Desired Results

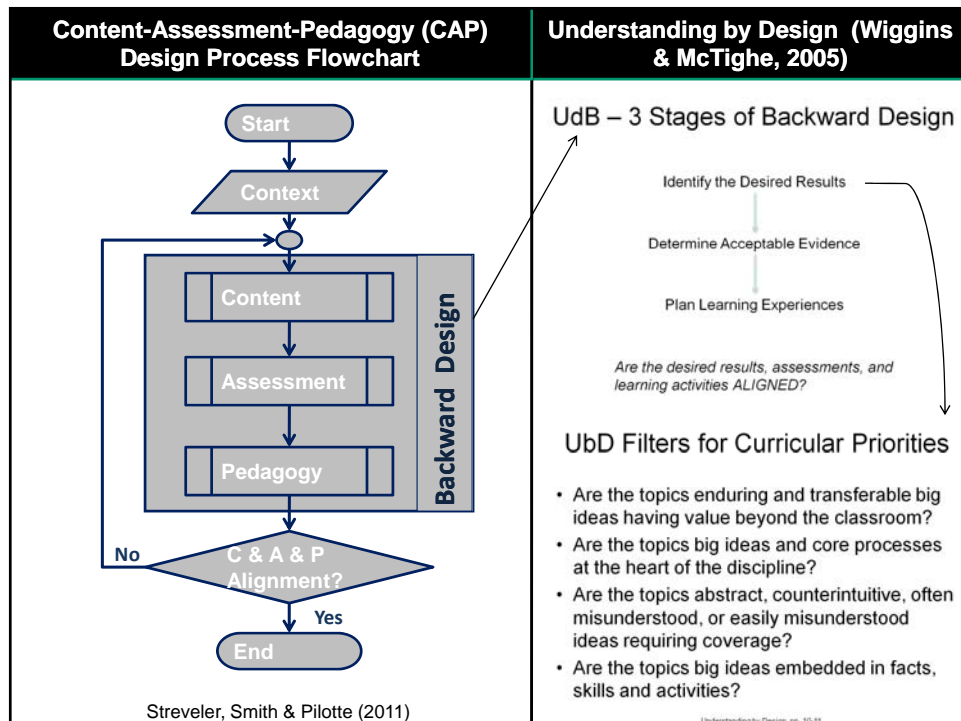
- Enduring understanding
- Important to know and do
- Worth being familiar with

Stage 2. Determine Acceptable Evidence

Stage 3. Plan Learning Experiences and Instruction

Overall: *Are the desired results, assessments, and learning activities ALIGNED?*

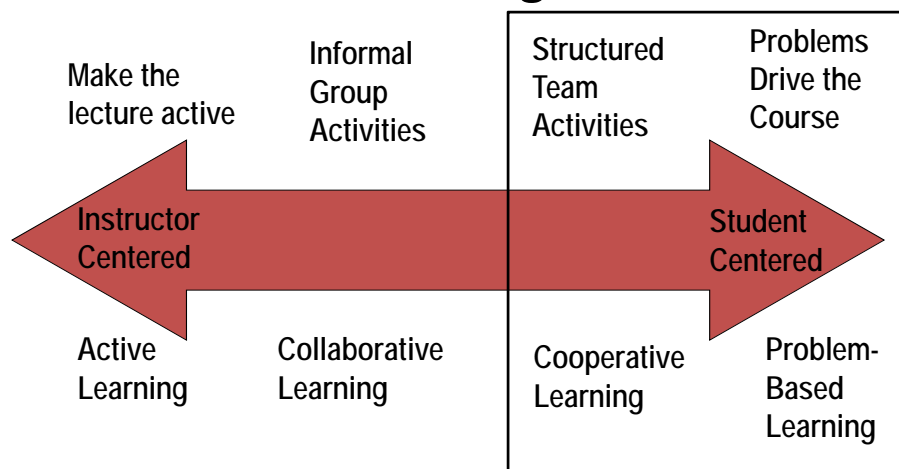
From: Wiggins, Grant and McTighe, Jay. 1997. *Understanding by Design*. Alexandria, VA: ASCD



Pedagogies of Engagement



The Active Learning Continuum

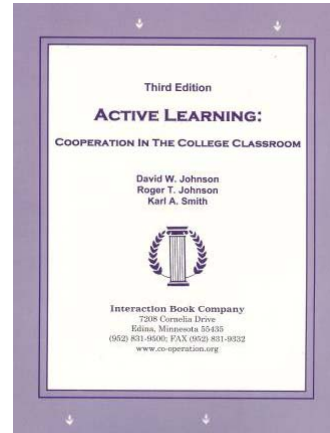


Prince, M. (2010). NAE FOEE

My work is situated here – Cooperative Learning & Challenge-Based Learning

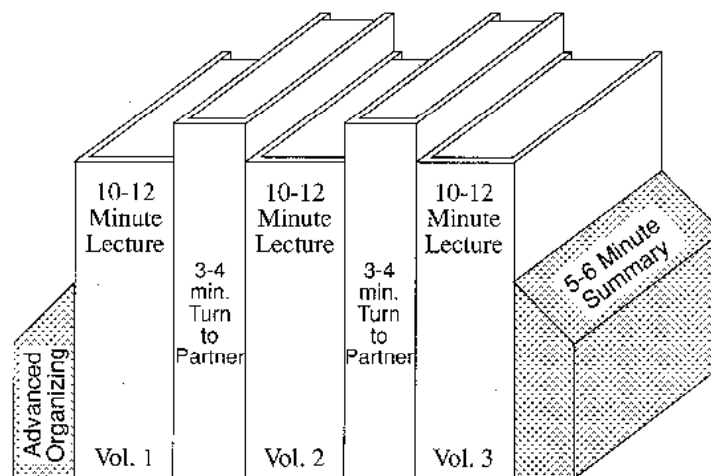
Active Learning: Cooperation in the College Classroom

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



See Cooperative Learning Handout (CL College-804.doc) 33

Book Ends on a Class Session



Smith, K.A. 2000. Going deeper: Formal small-group learning in large classes: From small groups to learning communities. *New Directions for Teaching and Learning*, 2000, 81, 25-46. [[NDTL81Ch3GoingDeeper.pdf](#)] 34

Cooperative Learning Adopted

The American College Teacher:

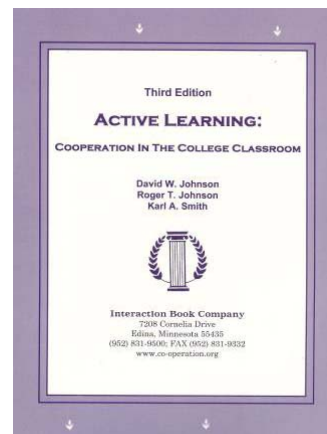
National Norms for 2007-2008

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.ucla⁸⁵.edu/index.php](http://www.heri.ucla.edu/index.php)

Active Learning: Cooperation in the College Classroom

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



See Cooperative Learning
Handout (CL College-804.doc) 36

Professor's Role in Formal Cooperative Learning

1. Specifying Objectives
2. Making Decisions
3. Explaining Task, Positive Interdependence, and Individual Accountability
4. Monitoring and Intervening to Teach Skills
5. Evaluating Students' Achievement and Group Effectiveness

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Formal Cooperative Learning – Types of Tasks

- 1. Jigsaw – Learning new conceptual/procedural material**
2. Peer Composition or Editing
- 3. Reading Comprehension/Interpretation**
- 4. Problem Solving, Project, or Presentation**
5. Review/Correct Homework
6. Constructive Academic Controversy
- 7. Group Tests**

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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 Parson 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 tasks and be deeply involved with the material they are studying. We promote active learning in a redesigned classroom 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 drives the approach's success. 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.

Class time is spent primarily on "tutorials" and "condensables". Essentially these are hands-on activities, resolutions, or interesting questions and problems. There are also some hypothesis-driven labs where students have to write detailed reports. (The [examples](#) is more sophisticated than most, but shows what the best students are capable of doing.) Students sit in three groups of three students at a 6 or 7 foot diameter round table. Instructors circulate and work with teams and individuals engaging them in Socratic-like dialogues. Each table has at least three networked laptops. The setting is very much like a banquet hall, with lively interactions nearly all the time. Many other [colleges and universities](#) are adopting/adopting the SCALE-UP room design and pedagogy. Engineering schools are especially pleased with the [SCALE-UP design](#), which fits 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 1/3 of all science, math, and engineering students in the country.

Impact

Rigorous evaluations of learning have been conducted in parallel with the curriculum development effort. Inside 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/post/professor 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 follows:

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

Details

A [document](#) describing the approach and its underpinnings is available. A shorter [document](#) is posted on the PER website, or you can view an [audio](#) describing the project from the proceedings of the Sigma Xi Forum on Reforming Undergraduate Education. The Raleigh News & Observer newspaper also has a [document](#) of the project. The very successful pilot project was [documented](#) in the first issue of the Physics Education Research supplement to Am. J. of Physics. See our publication [page](#) for more information.

More than 50 colleges and universities across the US have adapted the SCALE-UP approach to their own institutions. In all cases, the basic idea remains the same: get the students working together to learn something interesting. That free the instructor to roam about the room, asking questions and stirring up debates. 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

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 come as new hub for student life, including technology with "classrooms of the future" and One Stop Student Services

CONTACT: David Winter, University News Service, dwinter@umn.edu, (612) 625-2000

MINNEAPOLIS (ST. PAUL, MN 55455)—University of Minnesota leadership and students 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 110,000-square-foot STSS, which replaces the demolished Science Classroom Building, will be home not only to new, state-of-the-art "active learning" classrooms but also to numerous student services offices, including One Stop Student Services, retention services and career services.

"This really is the future of education at our Twin Cities campus," said university President Robert Berenson. "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 five stories 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 instruction among students and faculty. There are also five multipurpose classrooms and two larger lecture halls.

"Active learning classrooms are the classrooms of the future and have proven results in improving educational achievement for students," said university President Thomas Sultzer. "There is a critical need for more progress 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 difference of tomorrow."

In addition, the STSS is designed to meet or exceed the requirements of Minnesota's stringent B3 sustainable design code and seeks LEED Gold certification. Sustainable

UMNews

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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

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UNIVERSITY OF DELAWARE

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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](#)

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

PBL@UD • info@pbl.udel.edu


Afternoon Session Preview

- Design and Implementation of Active and Cooperative Learning
 - Pedagogies of Engagement – Cooperative Learning and Challenge Based Learning
 - Formal Cooperative Learning
 - Instructor's Role
- Preparation for Afternoon Session
 - Reflect on your use of student teams
 - List things that are working well
 - List problems you've encountered

Session Summary (Minute Paper)

Reflect on the session:

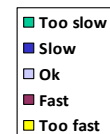
1. Most interesting, valuable, useful thing you learned.
2. Things that helped you learn.
3. Question, comments, suggestions.
4. Pace: Too slow 1 5 Too fast
5. Relevance: Little 1 . . . 5 Lots
6. Instructional Format: Ugh 1 . . . 5 Ah

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Pace

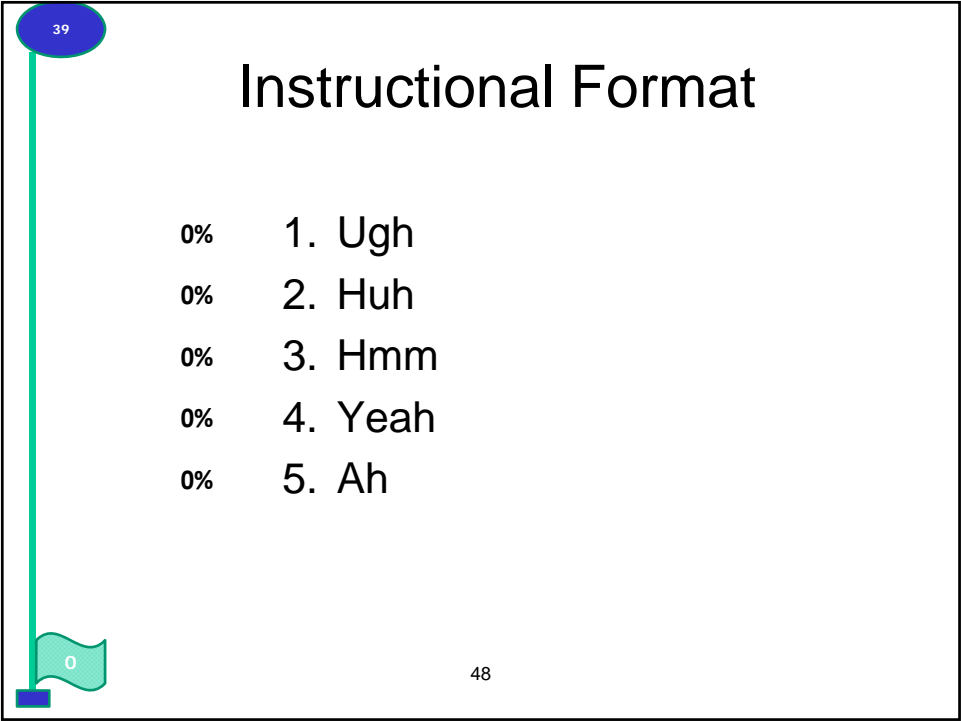
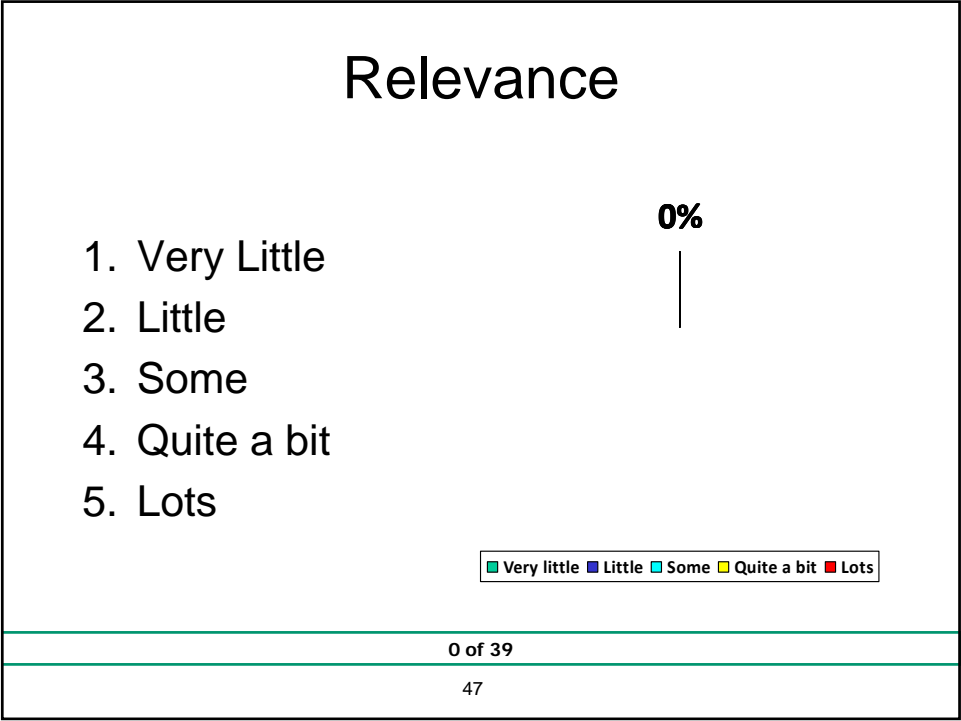
1. Too slow
2. Slow
3. Ok
4. Fast
5. Too fast

0%

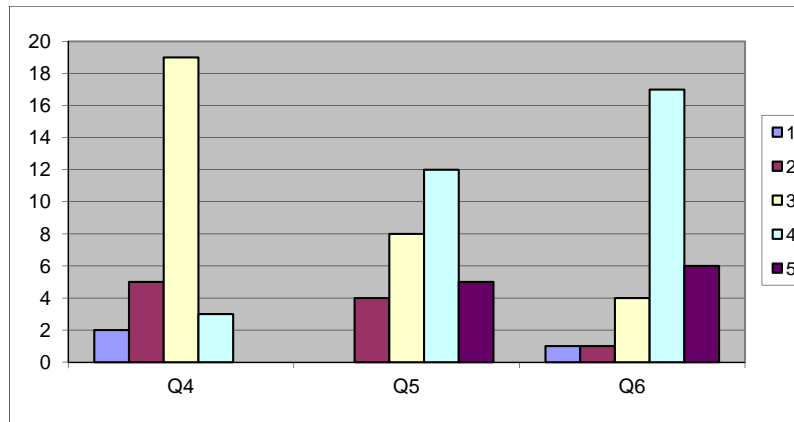


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BSC – Session 1 (7/15/12)



Q4 – Pace: Too slow 1 5 Too fast (2.8)

Q5 – Relevance: Little 1 . . . 5 Lots (3.6)

Q6 – Format: Ugh 1 . . . 5 Ah (3.9)

College Teaching: What do we know about it?

- Five assertions about what we know about college teaching
 - Good teaching makes a difference
 - Teachers vary markedly
 - Some characteristics/methods are present in all good teaching
 - Teaching can be evaluated and rewarded
 - There is ample room for improvement.
- K. Patricia Cross, 1991 ASEE ERM Distinguished Lecture

- Four factors in good teaching, based on student ratings*:
 - Skill. Communicates in an exciting way.
 - Rapport. Understands and emphasizes with students.
 - Structure. Provides guidance to course and material.
 - Load. Requires moderate work load.
- *Student ratings of teaching are consistent (with other measures), unbiased, and useful. Students agree on good teaching and their views are consistent with faculty.

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Resources

- Design Framework – How People Learn (HPL) & Understanding by Design (UdB) Process
 - Bransford, John, Vye, Nancy, and Bateman, Helen. 2002. Creating High-Quality Learning Environments: Guidelines from Research on How People Learn. *The Knowledge Economy and Postsecondary Education: Report of a Workshop*. National Research Council. Committee on the Impact of the Changing Economy of the Education System. P.A. Graham and N.G. Stacey (Eds.). Center for Education. Washington, DC: National Academy Press. <http://www.nap.edu/openbook/0309082927/html/>
 - Mayer, R. E. 2010. *Applying the science of learning*. Upper Saddle River, NJ: Pearson.
 - Pellegrino – Rethinking and redesigning curriculum, instruction and assessment: What contemporary research and theory suggests. <http://www.skillscommission.org/commissioned.htm>
 - Smith, K. A., Douglas, T. C., & Cox, M. 2009. Supportive teaching and learning strategies in STEM education. In R. Baldwin, (Ed.). Improving the climate for undergraduate teaching in STEM fields. [New Directions for Teaching and Learning, 117](#), 19-32. San Francisco: Jossey-Bass.
 - Wiggins, G. & McTighe, J. 2005. *Understanding by Design: Expanded Second Edition*. Prentice Hall.
- Content Resources
 - Donald, Janet. 2002. Learning to think: Disciplinary perspectives. San Francisco: Jossey-Bass.
 - Middendorf, Joan and Pace, David. 2004. Decoding the Disciplines: A Model for Helping Students Learn Disciplinary Ways of Thinking. *New Directions for Teaching and Learning*, 98.
- Cooperative Learning
 - Cooperative Learning (Johnson, Johnson & Smith) - Smith web site – www.ce.umn.edu/~smith
 - Smith (2010) Social nature of learning: From small groups to learning communities. *New Directions for Teaching and Learning*, 2010, 123, 11-22 [[NDTL-123-2-Smith-Social Basis of Learning-.pdf](#)]
 - Smith, Sheppard, Johnson & Johnson (2005) Pedagogies of Engagement [[Smith-Pedagogies of Engagement.pdf](#)]
 - Johnson, Johnson & Smith. 1998. Cooperative learning returns to college: What evidence is there that it works? *Change*, 1998, 30 (4), 26-35. [[CLReturnstoCollege.pdf](#)]
- Other Resources
 - University of Delaware PBL web site – www.udel.edu/pbl
 - PKAL – Pedagogies of Engagement – <http://www.pkal.org/activities/PedagogiesOfEngagementSummit.cfm>
 - Fairweather (2008) Linking Evidence and Promising Practices in Science, Technology, Engineering, and Mathematics (STEM) Undergraduate Education :http://www7.nationalacademies.org/bose/Fairweather_CommissionedPaper.pdf

Thank you!

An e-copy of this presentation is posted to:
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